Database Platform Development for Regulating Transmission and Distribution (T&D) Pricing in China

Proposed improvements to T&D database platform from an international review

Final Report

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Riverswan

Strategy I Regulation I Investment I Change I Communications

Contents

1. Executive Summary

1.1 Introduction

The aim of the preliminary Chinese T&D database design is to improve the routine regulatory supervision system for T&D companies. The design seeks to improve the separation of T&D data from other business activity, and to provide a common platform for data comparison and analysis.

Continued improvements to the proposed Chinese T&D performance database design are being sought. An international review has been commissioned into comparable T&D performance databases and systems.

This is the final report in a series of three international review reports to analyse the proposals for a Chinese T&D performance database. Prior reports have explained the monitoring systems in the UK and other countries and compared them with the proposed Chinese T&D database platform. This report builds on this analysis and suggests improvements to the Chinese T&D database platform.

As part of the analysis, some of the practical problems with collecting and using performance information have been identified and addressed. The report focuses on the following issues:

1. the design for the performance indicator system (**what performance should be measured?**)
2. the functional frameworks for supervision (**how should data be collected?**)
3. the design for the data platform (**what data should be collected?)**

The content of this report firstly covers the key findings from the international comparison, and then moves on to recommend improvements to address the above issues.

1.2 Key findings from the international comparison

What performance should be measured?

The Chinese T&D monitoring system targets the key areas of financial and technical performance. It includes revenues, investment in assets, operational costs and quality of service indicators. But there are some important differences with international performance indicator systems, namely:

- The Chinese data is collected for T&D businesses combined, whereas most international T&D performance indicators are separately measured for transmission and distribution.
- The Chinese performance data includes sales of electricity whereas most international T&D performance indicators do not include electricity sales data. This is because their energy sales are the responsibility of separate energy supply businesses and not of T&D businesses.

It is recommended that data requirements are defined in comprehensive detail for each of transmission and distribution, clearly excluding all data not related to T&D.

The performance indicators used in the international examples provide additional detail to those identified in the Chinese database. These include:

- **Financial performance** – a more detailed breakdown of financial performance allowing returns on regulated assets to be calculated together with earnings (or losses) from incentives. Financial models are used to update all aspects of each licenced business performance
- **Asset Investment** – a more detailed breakdown of assets and capital investments is used. Also, information on asset health, seeking to predict if or when assets will need to be replaced.
- **Network load and reinforcement needs** – a more detailed breakdown of the loading on individual lines, cables and transformers highlighting the need for future reinforcement. New connections – more data including the number of new connections, and time to connect.

- **Costs and volumes** – a more detailed breakdown of unit costs and volumes to assist benchmarking between businesses.
- **Revenues** – a more detailed breakdown of the component parts of allowed revenue and the assumptions made in calculating allowed revenue.
- **Quality of service** – more detailed reliability and availability measures e.g. customer minutes off supply, and repeated interruptions.
- **Customer service** – may include numbers of complaints or customer satisfaction surveys.
- **Other performance indicators** – these may include environmental indicators, safety, network losses, and spend on innovation projects.
- **Historical and forecast performance** – for each of the above indicators, historic and forecast information is generally provided to allow trends to be analysed, and a comparison made against prior forecasts or targets.

It is recommended that the Chinese T&D performance indicators and data collection are enhanced along the lines of international best practice, as explained further in this report.

How should data be collected?

Regulated businesses will always have more access to performance information than their regulators. International experience has shown that regulated businesses are likely to seek to minimise the amount of reporting they must do. This may be to ensure that they do not incur additional costs, or they may wish to reduce transparency about operational, maintenance or other information, particularly if they are subject to performance incentive or penalty arrangements.

Without clear reporting obligations and systems, the quality of the reporting information may be sub-standard and cause a significant amount of effort by regulators to understand the information provided. It may make performance deficiencies more difficult to evidence and compliance more difficult to enforce. Disputes over information may become common. It may be necessary to penalise businesses that do not provide accurate or timely data.

The international comparisons show the detailed approach that is deployed to collect information, including detailed data definitions, spreadsheets where entries can be checked and reconciled, and the inclusion of data checking and audit processes to assure the robustness of the data.

The Chinese spreadsheet tables require each business to provide information for monitoring of the electricity system and in relation to specific cost and performance targets. They require technical and financial information to be provided. But there is very little detail on the definition of what should be provided, and how consistency may be assured throughout.

It is recommended that:

- ***Detailed guidance for reporting should be produced, including data definitions, and how changes to reporting requirements may be made, or how disputes/errors will be resolved.***
- ***Assurance should be provided by each enterprise's that their data systems are robust, consistent and accurate.***
- ***Assurance should be provided by each enterprise that their individual performance and monitoring reports are accurate and consistent, especially with historic and forecast data.***
- ***Data accuracy should be incentivised by applying penalties for the submission of incomplete or misleading data.***

What data should be collected?

The current data collection proposed for the Chinese enterprises covers many the parameters necessary for the calculation of the defined performance indicators. However, the international examples require significantly more information to be provided, and recommendations for additional data collection requirements have been proposed in this report.

It will be important that the performance indicators each have a clear purpose, ensuring that they provide information that contribute to the current price control, or to inform the next one.

It is recommended that the following additional data requirements be specified:

- ***'Raw' data should be provided alongside performance indicators****. This will provide greater flexibility for future development of regulatory supervision systems.*
- ***An annual report which provides all the key data and associated calculations in a series of spreadsheets provided by the regulatory body (NDRC).*** *This should reduce errors or disputes.*
- ***An annual commentary which explains the data provided, and the overall performance of the enterprise.*** *This should address a prescribed content list and should be approved at a senior level in the business submitting the information. It allows the enterprises to explain their overall challenges and successes, and to set out what they have done to manage these.*
- ***An updated calculation of the prescribed business model which allows changes to revenues and changes to the asset base to be calculated.*** *It should also calculate revised revenue allowances due to agreed cost or output changes, or the application of penalties and incentives.*
- ***Senior management assurance from the regulated enterprise that the data provided is accurate and has been thoroughly checked and the results explained.*** *If possible, independent audit or assurance should also be provided.*

1.3 Next steps - recommended improvements to the T&D database platform

This report has suggested how the current proposals for a performance database might be improved. Several additional performance measures and data requirements have been identified. However, it will take time to develop and implement an improved design, especially as much of the information will take time to gain the required degree of accuracy and understanding.

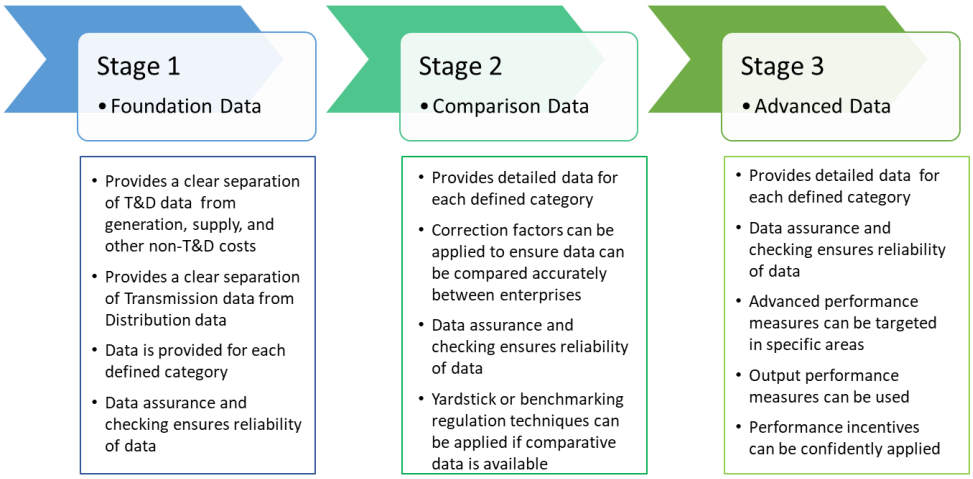
There are two key implementation issues that should be addressed at an early stage, namely:

1. **Obtaining accurate data** - The need for accurate and consistent data to be obtained only for T&D networks. The difference between transmission and distribution will need to be clearly specified (it is suggested that, in accordance with international norms, transmission is classified as voltages above 132kV, and distribution as 132kV and below).
2. **Prioritise performance measures** - The need to prioritise the key performance measures needed for regulation to be implemented effectively, and to allow further development to more advanced regulatory regimes in the future.

Obtaining accurate data

International experience of regulatory supervision is that it will be a significant challenge to obtain accurate, comparative data. It is likely to take several years of experience and refinement to fully achieve this goal.

It is suggested that an evolutionary approach be applied to the development of the T&D performance database. This is illustrated in the three stages of the diagram below.



Prioritising performance measures

The data collected for the T&D monitoring database will play a key role in approving the income, returns, asset value and depreciation to ensure the T&D networks are efficient. The key variables in the price control formula over each regulatory period will be the operation and maintenance cost (opex) and capital expenditure (capex) values, which are under the control of each enterprise**.** Furthermore, the performance of T&D networks is judged on the reliability and availability of the systems as experienced by end consumers, but also the new generation and demand.

Opex and capex performance monitoring, together with key output measures should be prioritised. It is proposed that a smaller number of key primary measures are identified for high level monitoring and comparison, supported by a range of secondary indicators that can each provide further detail. It is proposed that the following list of primary indicators for each enterprise be considered for further definition and development.

Recommended priorities for T&D enterprise performance measures

Financial measures

- *Capex under/over performance*
- *Opex under/over performance*
- *Revenue under/over performance*
- *Rate of return under/over performance*
- *Regulated asset value increase/decrease*

Output measures

- *Reliability*
  - *Transmission - Energy not supplied (MWh)*
  - *Distribution – average mins not supplied/customer*
- *New generation connections, including increased import (MW)*
- *New demand connections, including increased export (MW)*
- *Customer service performance*
- *Safety violations*

2. Introduction

2.1 Background

China's electricity sector is undergoing a major transition from a state managed pricing system to one that is market price based. Reforms have taken place to separate the monopoly T&D power networks from the generation of electricity.

China is seeking to establish an appropriate T&D regulatory regime for these monopoly networks. This regulatory regime includes a) the setting of network prices and b) a performance management system. This regime should incentivise grid enterprises to:

- promote the orderly and coordinated development of both generation and power grids,
- optimise the development of electricity resources, and
- safeguard the healthy and orderly development of overall power market.

It has already been recognised that China needs to strengthen the following three aspects regarding the regulation of T&D pricing and performance:

1. **Improvement of data collection processes** - First, China needs to improve the routine supervision system for T&D prices. Although the responsibility to supervise T&D prices has been assigned clearly to NDRC Price Department, the supervisory system still needs to be improved to meet the requirement of routine supervision, and the data reports that shall be submitted by the grid enterprises are specified clearly.
2. **Improvement of data definitions and parameters** - Second, the accounting system applied to the power grid companies cannot meet the supervisory requirements. Now, Chinese grid enterprises adopt the full cost accounting method, which doesn't distinguish between power distribution & transmission business and other business. The cost auditing processes varies in different regions and thus it's hard to report data as per the supervisory requirements.
3. **Improvement of data supervision processes** - Third, the supervision of T&D prices is short of supporting platform for data analysis. Now, as the supervisory scope has been increasingly expanded and deepened, a series of problems have occurred, such as the supervisory departments lack human resources and other resources, lacking data on verification and enforcement of T&D prices. The supervisory indicators, assessment tools and information supervisory measures need to be improved.

2.2 Development of a T&D database platform

To improve the supervisory capacity for power transmission and distribution pricing, the NDRC Price Department plans to establish a database platform to supervise T&D prices, as an important tool for auditing T&D costs in future.

It is intended that the database platform will be an authoritative and professional data application platform, developed for advancing the supervision of T&D prices in all provinces, enabling effective data access, smart analysis, accurate calculation and suitable information sharing.

The purposes and significances of developing such a platform are summarized as follows:

1. To unify data standards and lay a common basis of supervision. To establish consistent data standards, eliminate misunderstanding among various organizations, regularly collect related data in the process of verifying and enforcing T&D prices, and provide solid data bases for the supervisory departments.

2. To undertake multidimensional dynamic analysis and assist scientific supervision. To deeply explore data values through integrated analysis of data resources, gradually establish the supervisory indicator system for T&D prices, strengthen scientific supervisory measures and improve the capacity of dynamic supervision.
3. To enable the mechanism to be operated normally and supervision to be scientific, regulated, transparent and systematic. To establish the powerfully supervised and scientifically reasonable T&D pricing system through normalized database operations to supervise T&D prices. To realize scientific, regulative and systematic supervision on T&D prices, and effectively support the supervision of power T&D prices in a scientific, regulated, transparent and systematic manner.

The NDRC Price Department has entrusted China Electricity Council (CEC) to undertake a preliminary design study on the database platform. For this study, the performance indicators system and functional framework related to supervising T&D costs and prices have been proposed for review by an international expert.

This report has been prepared for CEC by Robert Hull, formerly a Managing Director at Ofgem, the UK energy regulator. He has over 25 years of senior leadership experience in UK and international utility sectors, holding senior roles with energy regulator Ofgem, utility National Grid, the UK Government, and professional services firms KPMG and Dentons. He has worked on energy regulation and investments in over 40 countries, across 6 continents.

2.3 Structure of report

This report is the final of three reports to be produced as part of this analysis. The reports are:

1. **Report 1** – Overview of UK T&D pricing and performance regulatory regime (an initial report was provided in early July and is being updated to address further questions)
2. **Report 2** – Comparison of Chinese T&D database platform with international examples (incorporating analysis from report 1)
3. **Report 3** – Suggestions to improve the China T&D database platform (incorporating analysis from reports 1 and 2)

This report (Report 3) is organised in the following way:

- **Chapter 1 – Executive Summary,** providing an overview of the report.
- **Chapter 2 - Introduction**, recaps the current position in China and the project requirements.
- **Chapter 3 – Scope**, sets out the scope of the study and this report.
- **Chapter 4 – Analysis of the Chinese T&D database proposal** for data collection, data requirements and performance indicators.
- **Chapter 5 – UK T&D** examples for performance indicators, and data collection systems.
- **Chapter 6 – Summary of key differences** between the Chinese T&D database proposal and international examples
- **Chapter 7 – Proposed improvements** to the China T&D database proposal

3. Scope of work

3.1 Objectives

The objectives of the study are to

a) improve the preliminary design of the Chinese database platform for supervising T&D prices, through review of the database indicators system to incorporate international practices and domestic experience of supervising T&D costs, and

b) analyse the gap between current data reports submitted by the Chinese grid companies and data requirements for the database platform. Propose recommendations for improvement.

3.2 Key tasks

This study consists of the following two tasks:

Task 1: Review the proposed indicator system for the database platform

A. Provide a brief introduction to the regulatory system in UK, describing how it has developed, including the regulators, regulatory process, relevant laws and regulations etc. This overview will provide an overall understanding of how the UK performance indicator system works.

B. Collect publicly available T&D cost and performance indicator information primarily from the UK which has an advanced performance indicator system, and from other countries where equivalent data and indicators are readily available e.g. Australia.

C. Provide a summary of the performance indicator system used in the UK (and Australia), providing an explanation, or an example calculation for each indicator. Compare this with the indicators system that has been proposed in the preliminary design of the China data base platform and identify the differences between them.

Task 2: Suggestions to improve the data collection mechanism (covered by this report)

A. Provide an overview of data and performance information disclosed by the grid companies in the UK. Provide as many indicators and their functions as possible, including original data and sources as appropriate.

B. Describe the data collection processes in the UK, including:

- Responsibilities for data submission and compliance
- The frequency and scope of data submissions
- Supporting evidence to ensure accuracy e.g. financial statements
- Data assurance protocols

C. Review the public information disclosed by the China grid companies and data reports submitted from the China grid companies to the supervisory authorities to set T&D prices.

D. Provide suggestions to improve the China data collection and database system. We will also identify some of the practical problems with using a database system.

E. Provide suggestions to improve the indicator and regulatory system, identifying the key indicators that should be measured, and identify the purpose for their use. As part of this analysis, we will also identify some of the practical problems with using some of the indicators.

4. Review of Chinese T&D Performance Database

4.1 Introduction

China's power sector is being reformed from a state managed system to a market price based one. The introduction of competition and market prices is expected to reduce costs to power consumers. Generation of power is being separated from the transmission and distribution grids. But network companies will remain as natural monopolies and an appropriate T&D pricing system is required.

This T&D pricing mechanism is intended to provide the necessary revenues for the T&D businesses together with incentives and penalties, incentivising them to operate efficiently, and to:

- Promote the orderly development of both generation and power grids
- Optimise the development of electricity resources
- Safeguard the healthy and orderly development of the overall power market.

Following a pilot T&D pricing exercise in the Shenzhen and Inner Mongolia grids, the National Development and Reform Commission (NDRC) issued a notice in December 2016: '*Measures for Regulating Transmission and Distribution Costs and Pricing Measures for Provincial T&D Networks*'. The principle aim is to strengthen the supervision and regulation of power transmission and distribution costs. Since 2017, the T&D prices in all provincial power grid enterprises have been set on this basis.

However, a review of the implementation of T&D pricing reform has identified variations between different provinces. It has been identified that the supervision of T&D pricing needs to be strengthened in the following three areas:

- To improve the routine supervisory system to specify the data reports to be submitted by the grid enterprises
- To ensure that the accounting systems used by the grid enterprises meets the supervisory requirements, including the separation of T&D accounts, and the consistent reporting of costs
- To develop a supporting platform for data analysis so that data can be verified and accurately assessed so that it may be used for incentives of enforcement action

The remainder of this section reviews the performance indicators that are currently being collected from Chinese T&D enterprises.

4.2 Performance indicators

The sixty-three Chinese performance indicators are listed below, categorised by the parameter being measured. Appendix 1 sets out the full definition for each of these indicators. A brief commentary is provided below on each group of indicators.

In assessing performance indicators, it's important to consider the difference between what **data** should be collected and what **performance indicators** are useful. For performance indicators, it is important that they serve clear purposes, such as:

a) monitoring performance: the indicators must measure something meaningful and of value;

b) deriving required input to determine the allowed revenue, e.g. capex underspend which will result in clawback, opex/capex ratios subject to maximum caps;

c) Informing the next price control e.g. in terms of unit costs.

Asset investments

The asset performance indicators (numbers 1 to 18) are listed below. They are each to be reported annually, except for indicators 13 and 16 which are to be reported every 3 years.

Parameter	Serial no.	Parameter name
Assets	1	Planned Investment Completion Rate
	2	Actual rate of planned investment being converted to asset value
	3	Fixed assets investment amount per unit power transformer capacity - 500KV and above
	4	Fixed assets investment amount per unit power transformer capacity - 220 kV
	5	Fixed assets investment amount per unit power transformer capacity - 110 (66) KV
	6	Fixed assets investment amount per unit power transformer capacity - 35KV
	7	Fixed assets investment amount per unit power transformer capacity - 10KV (20KV)
	8	Fixed assets investment amount per unit line length - 500KV and above
	9	Fixed assets investment amount per unit line length - 220KV
	10	Fixed assets investment amount per unit line length - 110 (66) KV
	11	Fixed assets investment amount per unit line length - 35KV
	12	Fixed assets investment amount per unit line length - 10KV (20KV)
	13	Deviation rate between approved value and reported value of fixed assets original value
	14	Deviation rate between actual value and approved value of fixed assets original value
	15	Deviation rate between actual value and reported value of fixed assets original value
	16	Deviation rate between approved value and the reported value of fixed assets net value
	17	Deviation rate between actual value and approved value of fixed assets net value
	18	Deviation rate between actual value and reported value of fixed assets net value

Comments

These asset performance indicators provide information on the asset investment that is taking place against a plan or target. The objectives appear to be to:

- identify the costs of additional actual asset investment and measure how these are performing against the predicted overall and unit costs for additional asset investment
- identify how the actual asset value has changed compared to the original asset values and predicted/target change in asset values.

In this schedule, parameters 1 and 2 allow under or overinvestment to be identified in the prior year. It is understood that a maximum of 75% for parameter 2 is set out in NDRC's December 2016 document.

The subsequent parameters 3-12 break down the investment into unit costs for categories of transformer capacity and overhead line length. This will allow a comparison of investment costs to be performed per unit of transformer or line volume.

Finally, parameters 13 to 15, and 16 to 18, appear to focus on identifying the differences between a) the reported values, b) the approved values, and c) the actual values for both the original and net asset values. By way of explanation, it is understood that:

- Original value is the original value of the asset (this may or may not be net of depreciation)
- Reported asset value is the forecast asset value that reported by the company before any regulatory adjustment

- Approved value is the forecast asset value after regulatory adjustment and approved by the Government.
- Actual asset value represents the actual value of assets

These indicators will identify differences in asset values due to changing forecasts, regulatory change, and actual expenditure.

Costs

The cost performance indicators (numbers 19 to 41) are listed below. They are each to be reported annually, except for indicators 19 to 24 which are to be reported every 3 years.

Parameter	Serial no.	Parameter name
Cost	19	Deviation rate between approved value and the reported value of allowed expenditure
	20	Deviation rate between approved value and the reported value of operation & maintenance expenditure
	21	Deviation rate between approved value and the reported value of material cost
	22	Deviation rate between approved value and the reported value of repairing cost
	23	Deviation rate between approved value and the reported value of other cost
	24	Deviation rate between approved value and the reported value of depreciation
	25	Deviation rate between the actual value and the approved value of allowed expenditure
	26	Deviation rate between actual value and approved value of operation maintenance expenditure
	27	Deviation rate between actual value and approved value of material cost
	28	Deviation rate between actual value and approved value of repairing cost
	29	Deviation rate between actual value and approved value of other cost
	30	Deviation rate between actual value and approved value of depreciation
	31	Deviation rate between actual value and reported value of allowed expenditure
	32	Deviation rate between actual value and reported value of operation and maintenance expenditure
	33	Deviation rate between actual value and reported value of material cost
	34	Deviation rate between actual value and reported value of repairing cost
	35	Deviation rate between actual value and reported value of other cost
	36	Deviation rate between actual value and reported value of depreciation
	37	Annual composite depreciation rate of fixed assets
	38	Rate of newly increased material fees in regulatory period
	39	Rate of newly increased repairing fees in regulatory period
	40	Rate of newly increased other fees in regulatory period
	41	Operation & maintenance cost per 10,000 Yuan value of fixed assets

Comments

These cost performance indicators provide information on a range of different cost and depreciation parameters. The objective appears to be to measure deviations between actual and approved values for several cost categories. These parameters allow comparisons across T&D enterprises.

The costs (parameters 19 to 37) are broken down into operational maintenance, material costs, repair costs, other costs, and depreciation rates.

Parameters 38 to 40 represent some additional measures to assess the rate of cost increases for materials, repairs and other costs during the regulatory period. It is noted that NDRC's December 2016 document sets maximum values for these three parameters (at 1.0%, 1.5% and 2.5% respectively) in the current regulatory period.

Parameter 41 assesses operation & maintenance cost as a proportion of fixed assets.

Income

The income performance indicators (numbers 42 to 43) are listed below. They are each to be reported annually.

Parameter	Serial no.	Parameter name
Income	42	Rate of Return on Common Stockholders' Equity (ROE)
	43	Income ratio from users applied to network charges

Comments

Income parameter 42 sets out the rate of return on stockholders' equity and allows the overall profitability of the enterprise to be assessed and compared.

Income parameter 43 is understood to set out the ratio of income from user T&D network charges against the total income of the grid company from transmission, distribution and retail. It indicates the degree to which grid charges account for overall income, and hence the degree to which grid charges have been separated from other charges. It is stated that this is a measure of marketisation.

Electricity sales

The electricity sales performance indicators (numbers 44 to 55) are listed below. They are each to be reported annually.

Parameter	Serial no.	Parameter name
Electricity	44	Ratio of actual sales and forecast sales of electricity
	45	Regional line loss Rate
	46	Electricity sales per unit transformer capacity – 500(330) KV and above
	47	Electricity sales per unit transformer capacity – 220KV
	48	Electricity sales per unit transformer capacity – 110(66) KV
	49	Electricity sales per unit transformer capacity – 35KV
	50	Electricity sales per unit transformer capacity – 10KV (20KV)
	51	Electricity sales per unit line length - 500(330) KV and above
	52	Electricity sales per unit line -220KV
	53	Electricity sales per unit line -110(66) KV
	54	Electricity sales per unit line -35KV
	55	Electricity sales per unit line - 10KV (20KV)

Comments

Parameter 44 reports the difference between actual and forecast sales. It highlights the difference between the two figures and it is understood that this may signal a need to adjust electricity prices.

Parameter 45 reports on the energy loss in the transmission and distribution network. This a composite loss rat*e which* refers to technical losses and non-technical losses such as metering errors and theft.

Parameters 46 to 55 report sales per unit of transformer capacity or line length. Unit sales will allow comparisons between assets and enterprises. This indicator will identify the revenue (and profitability at each voltage. It will also allow the extent of cross-subsidisation to be identified e.g. the electricity price for domestic consumers is much lower than that for industry.

Service

The service performance indicators (numbers 56 to 61) are listed below. They are each to be reported annually.

Parameter	Serial no.	Parameter name
Service	56	Ratio of guaranteed users
	57	Ratio of guaranteed users' power consumption
	58	Customer Satisfaction Degree
	59	Average user interruption time
	60	Labour productivity
	61	Ratio of voltage compliance rate to operation & maintenance cost per unit assets

Comments

Parameters 56 and 57 measure the proportions of guaranteed users and their energy consumption.

Parameter 58 measures an independently derived customer satisfaction index, and parameter 59 measures the average user interruption time. Parameter 60 measures gross labour output per employee.

Finally, parameter 61 measures the 'voltage compliance rate' to operation & maintenance cost per unit of assets. This derives an operation and maintenance cost in relation to voltage quality. This indicator is designed to evaluate whether the operation and maintenance cost is within a reasonable range for the quality of voltage performance e.g. a high operation cost should not be expected for a poor voltage quality.

Special

The special performance indicators (numbers 62 to 63) are listed below. They are each to be reported annually.

Parameter	Serial no.	Parameter name
Special	62	Ratio of grid-connected distributed energy
	63	Distributed power supply access Cost

Comments

Parameter 62 refers to the proportion of grid connected distributed power, and parameter 63 refers to the unit cost of connecting this distributed power.

4.3 T&D Data collection

The data collection regime for Chinese T&D enterprises is based on the following key principles:

- The approach to cost supervision will be underpinned by principles of legality, relevance and reasonableness. It shall be underpinned by the relevant Chinese accounting law and regulations, shall apply only to T&D, and shall be reasonably applied in accordance with industry standards.
- The power grid enterprises shall establish the cost accounting systems and shall report data as required, including independently audited annual financial reports for the last 3 years.

The supervisory regime also defines what T&D costs are to be reported. T&D costs shall include asset depreciation and operational maintenance costs as described below:

Assets and Depreciation cost definitions

- Assets are defined as those related to transmission and distribution only. These assets include the overhead lines and cables and substation equipment, together with the costs associated with construction development. They do not include assets associated with other business activities
- Depreciation refers to the original asset value and a depreciation rate linked to the lifetime of the T&D assets
- Asset lifetimes and depreciation rates vary for different types of assets. Centrally provided assumptions are to be used for asset lives. These range from 30-35 years for 500KV equipment, and 6-9 years for communications and metering equipment.

Operational maintenance cost definitions

- Operating maintenance costs comprise the costs for normal power system operation, including material costs, repair costs, staff remuneration and other costs.
- Material costs are those required to provide T&D services and include expendable materials, spare parts for repairs and low value consumables.
- Repair costs are defined as the costs to maintain the normal working condition of the T&D system.
- Staff remuneration refers to the remuneration to various types of workers who provide T&D services. These include wages, bonuses, benefits e.g. insurance, pensions, accommodation allowances.
- Other costs include overheads (or indirect costs) for the provision of T&D services, including office costs, utilities, R&D costs, general insurances, etc.
- The costs unrelated to T&D that should not be included cover government subsidies, donations, liquidated damages, fines, advertising, loss and damage, and non-T&D related administrative expenses.
- T&D costs may also include an appropriate proportion of shared or special T&D services where this applies. Shared service costs apply where T&D enterprises operate a shared network, and special service costs apply where the T&D enterprises provide a service for specific grid customers.

4.4 Data requirements

The following tables show the key titles of the Excel data sheets that are currently provided for reporting by T&D enterprises. They show the type of information that is provided, the frequency of submission, and the scope of reporting. The relevant NDRC notice is also referenced.

Each of these data sheets has been reviewed in turn, highlighting some of the key features, and then a summary of general observations from this review is provided.

Sheet 1

Report classification	Number	Report Name	Frequency	Business unit
Cost Supervision and	Sheet 1-1	Report on the basic status of power transmission and distribution company	3years	T&D
	Sheet 1-2	Report on T&D cost survey		
	Sheet 1-3	Xxxx Annual cost of electricity purchase report		

Report classification	Number	Report Name	Frequency	Business unit
examination report[1]	Sheet 1-4	Xxxx Detailed statement of annual fixed assets and depreciation of power transmission and distribution companies		
	Sheet 1-5	Xxxx Annual report on Electricity Sales Survey		
	Sheet 1-6	Summary of transmitted power against voltage levels		
	Sheet 1-7	Report on labor cost Survey		
	Sheet 1-8	Report on total and unit cost of transmission and distribution		
	Sheet 1-9	Calculation table for transmission and distribution unit cost regarding voltage level in Xxxx year		
	Sheet 1-10	Report on xx provincial grid company loan structure and interest rate		
	Sheet 1-11	Report on basic status of Xx Provincial power grid subsidiary company in Xxxx year		
	Sheet 1-12	Report on transmission and distribution assets and related status of xx provincial grid		
	Report 1-1	Report on supervision and examination of transmission and distribution costs		
Calculation table of transmission and distribution charges[2]	Sheet 1-13	Calculation table of Xx Provincial (district, city) power grid allowed revenue and transmission and distribution charges	3years	T&D

Comments

This report includes all the key reporting items needed for the performance indicators. It includes financial reporting (balance sheet, loans and P&L statement), together with detailed breakdowns of T&D costs, assets, labour costs, electricity transmitted as well as sales and purchases of electricity. It includes calculations of unit costs of T&D.

The sheet concludes with a trial calculation where values of T&D charges are based on several parameters that are derived from the submission and analysis or are set as centrally approved allowances e.g. permitted rates of return.

Sheet 2

Report classification	Number	Report Name	Frequency	Business unit
Monthly report by	Sheet 2-1	Monthly report on transmission and distribution charges and state of operation of power grid companies-01	Monthly	Full scope

[1] Regulatory Reference - Notice of The General Office of the NDRC on the implementation of cost regulatory of transmission and distribution pricing in 14 provincial grid companies (NDRC Office Pricing [2016] No.1953)

[2] Regulatory reference - Pricing method of T&D price in provincial power grid (trial) NDRC (2016) No.2711

Report classification	Number	Report Name	Frequency	Business unit
grid Company	Sheet 2-2	Monthly report on transmission and distribution charges and state of operation of power grid enterprises-02		
Annual report by grid Company[3]	Sheet 2-3	Balance sheet	Annual	Full scope
	Sheet 2-4	Income statement		Full scope
	Sheet 2-5	Assets and profit Statement		T&D
	Sheet 2-6	Electricity Sales breakdown		Full scope
	Sheet 2-7	Cost and expense breakdown		Full scope T&D
	Sheet 2-8	Table on Cost of electricity purchase		Full scope
	Sheet 2-9	Fixed assets and depreciation breakdown		Full scope T&D
	Sheet 2-10	Annual Investment statement		T&D
	Sheet 2-11	Statement of assets from political source and depreciation		T&D
	Sheet 2-12	Table of network Structure statistics		T&D
	Sheet 2-13	Table of electricity Load status		T&D
	Sheet 2-14	Status of new energy power plant connection		T&D
	Sheet 2-15	Table of Dynamic Analysis Parameter		T&D
	Sheet 2-16	Benchmark Prices for electricity purchase		
	Sheet 2-17	Transmission and distribution charges		
	Sheet 2-18	Electricity Sales price		
Annual Analysis Report[4]	Report 2-1	Annual report on the implementation of transmission and distribution charges reform		

Comments

This report content is generally similar to sheet 1 but data is reported on a monthly or annual basis.

Sheet 3

Report classification	Number	Report Name	Frequency	Business unit
Energy supply and demand	Sheet 3-7	Production of major energy products	Annual	
	Sheet 3-8	Consumption of major energy products		
	Sheet 3-9	Energy consumption indicators		
	Sheet 3-10	Total electricity consumption in the whole society		
Power supply Reliability	Sheet 3-11	Seven indicators including Power supply reliability, average blackout time, etc.		

[3] Regulatory reference - notice of the NDRC office on requiring grid companies to cooperate with the implementation of transmission and distribution pricing reform (NDRC Office pricing No. 1849)

[4] Regulatory reference - notice of the NDRC office on requiring grid companies to cooperate with the implementation of transmission and distribution pricing reform (NDRC Office pricing No. 1849)

Comments

This sheet lists requirements for general data on energy consumption, including other fuel types. It also includes data on the different types of energy production. It specifically requests information on T&D reliability measures.

Overall observations

The forms seek a comprehensive amount of information and are well targeted in relation to the performance indicators discussed earlier. However, there are several areas where further information or development of the spreadsheets could be helpful, including:

- A built-in checking mechanism to ensure that disaggregated numbers reconcile to totals
- A clear map to link the data and calculations to the performance indicators
- A reconciliation of monthly figures to annual to 3-yearly, ensuring consistency possible
- Detailed guidance to assist submissions, including detailed definitions for each data item
- Separation of T&D performance reporting from wider industry data collection requirements

5. Review of UK T&D Performance Database

5.1 Introduction

The UK power sector was reformed over 25 years ago to separate electricity generation and supply from transmission and distribution networks. These networks were privatised but maintained as regulated monopolies, while competition was introduced into generation and supply.

In Great Britain, electricity distribution network voltages are generally 132 kV and below, and electricity transmission network voltages are 132KV to 400kV. The investor owned companies that own the 3 transmission and 14 distribution networks are shown below. Each of these companies is licensed and the prices they can charge, and their performance, are regulated by Ofgem. They are each required to report on investment and operational performance each year.

Diagram 1: UK electricity transmission networks

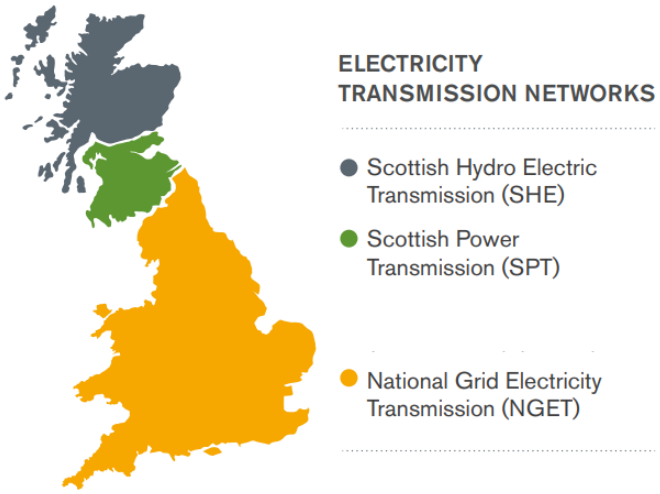
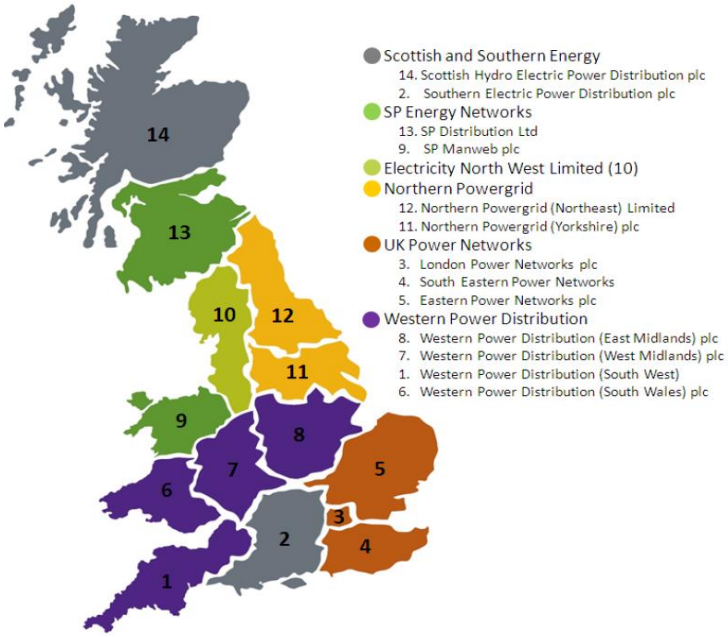


Diagram 2: UK electricity distribution networks



Revenue and performance regulation by Ofgem

Ofgem is the Office of Gas and Electricity Markets. They are a National Regulatory Authority as set out in legislation and are independent of Government. Ofgem's principal objective in carrying out its functions is to protect the interests of existing and future electricity and gas consumers.

Ofgem regulates each licensee through a price control. Price controls are a method of setting the amount of money (allowed revenue) that can be earned by the network companies over the length of a price control, and the relevant outputs that they are required to deliver. These companies recover their allowed revenues from their charges to electricity suppliers who in turn pass these costs through to customers. The revenues must be set at a level which covers the companies' costs and allows them to earn a reasonable return subject to them delivering value for consumers, behaving efficiently and achieving their targets as set by Ofgem.

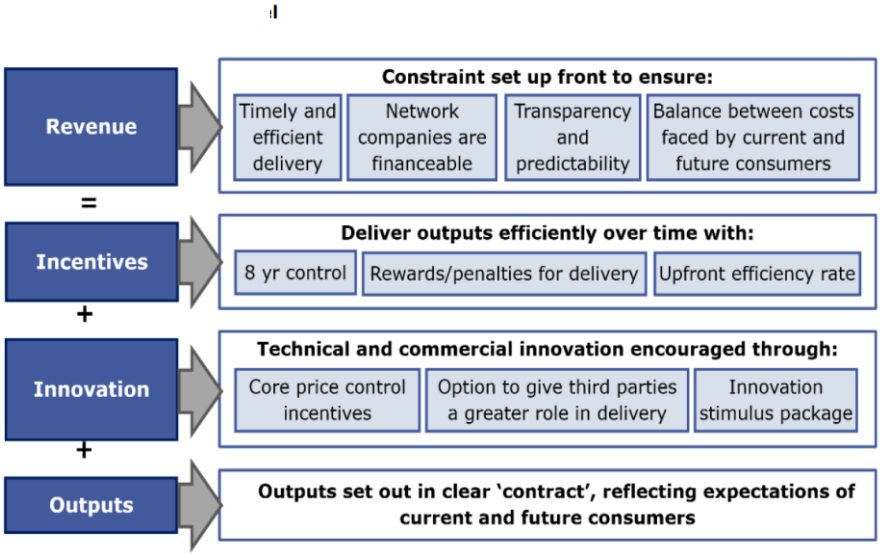
The current RIIO model for transmission and distribution companies sets **R**evenue to deliver strong **I**ncentives, **I**nnovation and **O**utputs (RIIO). The framework encourages these companies to:

- Better understand the changing needs of existing and new consumers
- Invest in new capital assets and new operating solutions
- Look for ways of delivering efficient and economic services at long term value for money
- Look for alternative delivery options
- Develop new commercial relationships with users of the network and end consumers,

The model was designed to be more transparent, more accessible and more proportionate than the previous RPI-X regime, which focused on setting efficiency targets for regulated companies. (These companies were previously given a target revenue over a five-year period that could increase by the Retail Price Index (RPI) less 'X' which was an efficiency factor set by Ofgem – so the companies could keep any additional profits achieved by increasing their efficiency savings).

The RIIO model is illustrated below and focuses on outputs rather than inputs, and greater engagement with consumers and less with regulators. The first RIIO price controls (called RIIO-1) are due to end in 2021 and work is underway to understand past performance and improve the regime for the future.

Diagram 3: RIIO regulatory model



This section goes on to explain the key performance indicators that are assessed for the T&D companies, the processes for collecting data and a description of the data that is collected.

5.2 RIIO-1 Monitoring and performance indicators

To monitor and assess the companies' performance against regulatory requirements, Ofgem requires companies to provide annual reports and data submissions. After analysing the companies' reports, Ofgem publishes reports of their own findings to inform wider stakeholders. The purpose of these reports is:

1. **To implement the ongoing price control**. For example, the actual performance level against targets will result in rewards or penalties; the difference between actual expenditure and allowed levels will be shared between company and consumers.
2. **To collect relevant data and to understand network businesses to inform the next price control**. For example, unit costs to be used in benchmarking; companies' behaviour may result in different mechanisms in the next price control.

The key performance indicators being monitored by Ofgem for distribution and transmission companies are set out in published annual reports by Ofgem. The performance indicators essentially focus upon the following:

a) **Operational performance** and delivery of specified outputs against target, and

b) **Financial performance** and delivery against targets. The financial performance is also impacted by incentives for delivery of outputs.

The following diagrams are reproduced from annual performance reports published by Ofgem. They provide actual performance data for 2015/16 and illustrate:

Electricity transmission[5]

- **Electricity transmission output performance** for safety, reliability, generation & demand, availability, customer service, environmental and new connections (overall and by company)
- **Electricity transmission financial performance** showing revenues, asset value, returns, innovation and incentives (overall and by company)

Electricity distribution[6]

- **Electricity distribution output performance** for safety, reliability, environmental, social obligations, connections and customer service (overall and by company)
- **Electricity distribution financial performance** showing revenues, asset values, returns, innovation and incentives (overall and by company). The adjacent table shows the abbreviations used for each electricity distribution company (DNO)

DNO Group		DNO
ENWL	Electricity North West Ltd	ENWL
NPg	Northern Powergrid	NPgN
		NPgY
WPD	Western Power Distribution	WMID
		EMID
		SWALES
		SWEST
UKPN	UK Power Networks	LPN
		SPN
		EPN
SPEN	SPEN Energy Networks	SPD
		SPMW
SSEPD	Scottish and Southern Energy Power Distribution	SSEH
		SSES

[5] https://www.ofgem.gov.uk/system/files/docs/2017/12/riio_transmission_annual_report_2017_final_1.pdf

[6] https://www.ofgem.gov.uk/publications-and-updates/riio-electricity-distribution-annual-report-2015-16

Diagram 4: Overall TO output performance 2015-16

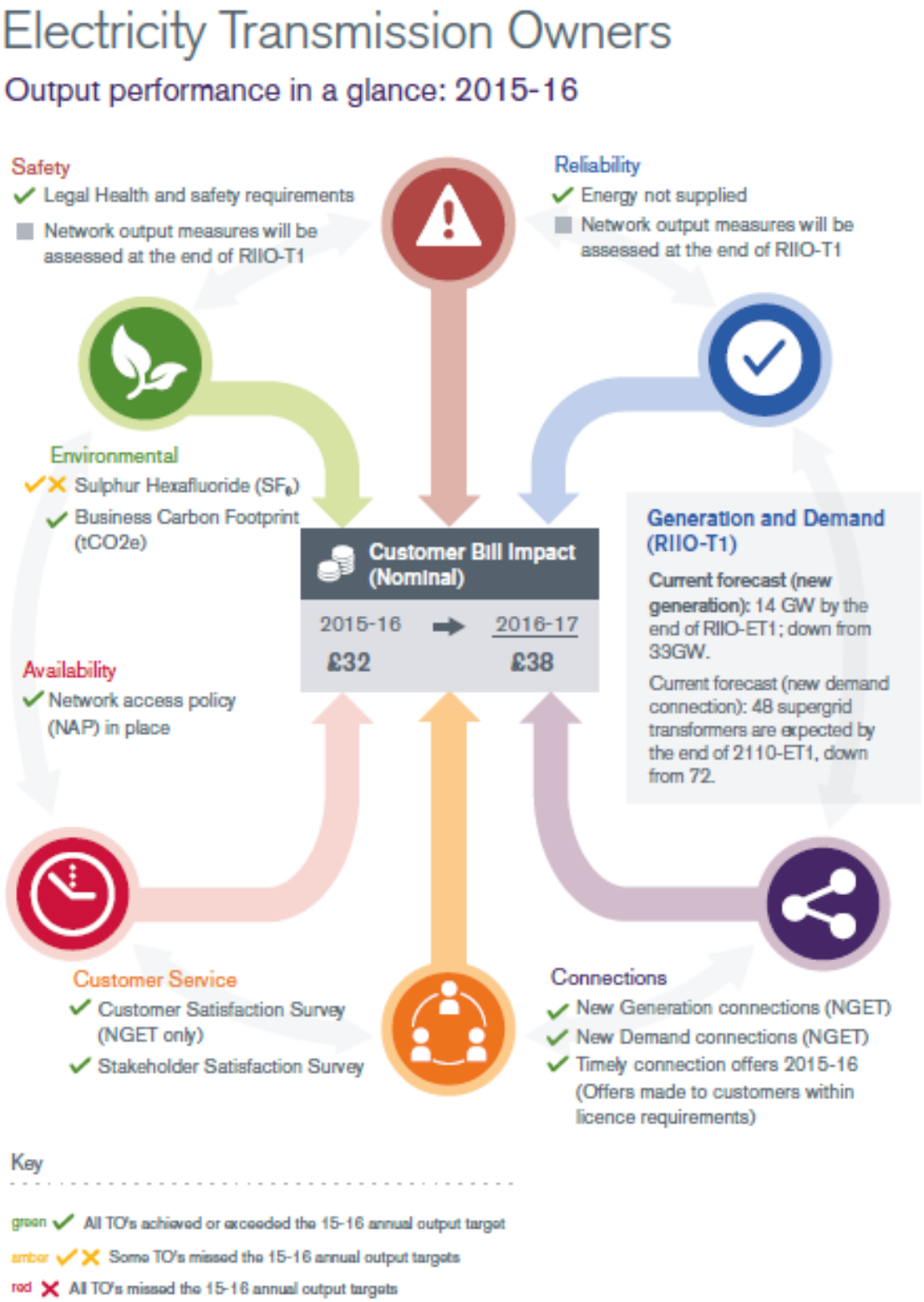


Diagram 5: TO output performance 2015-16 by Company

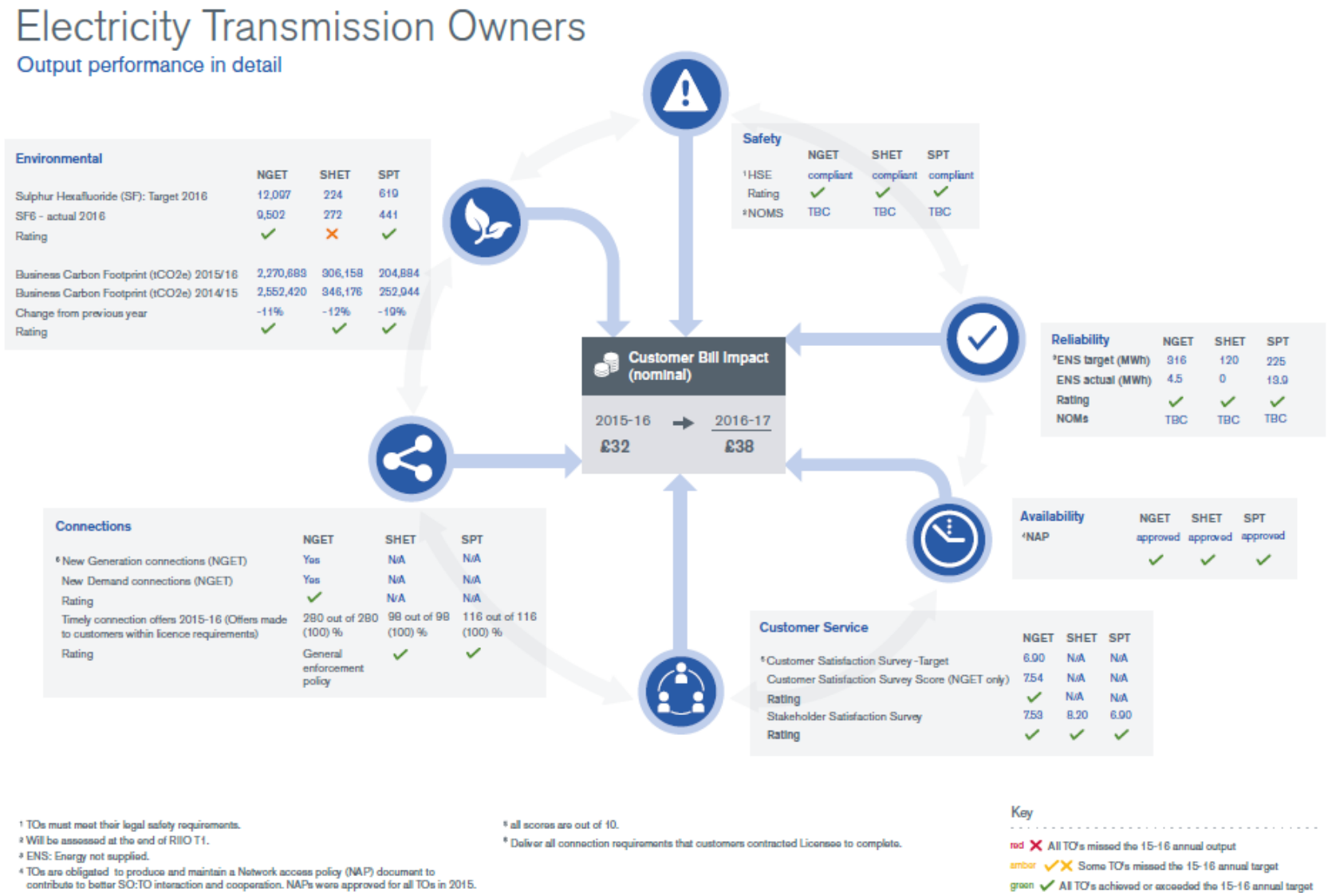
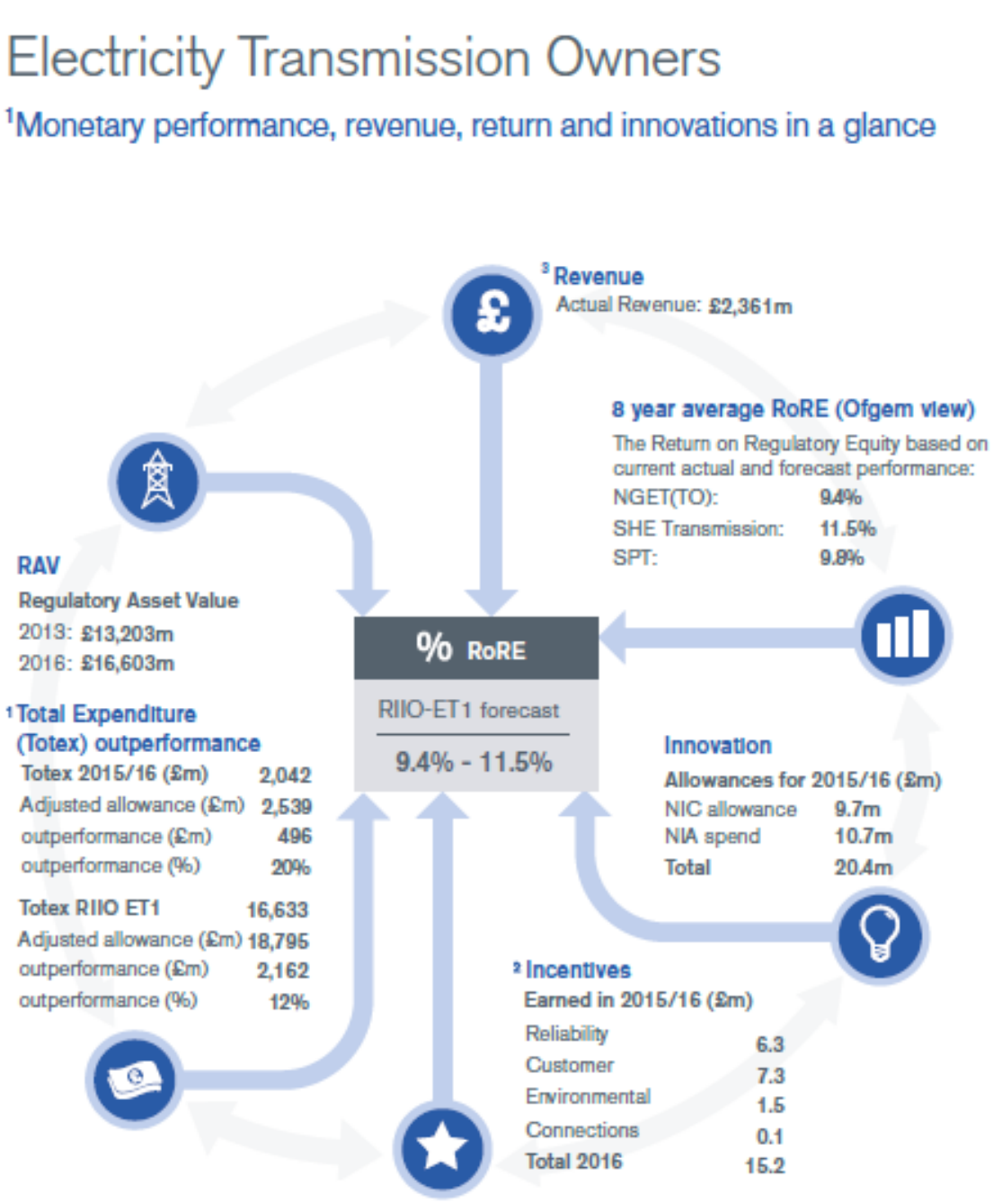
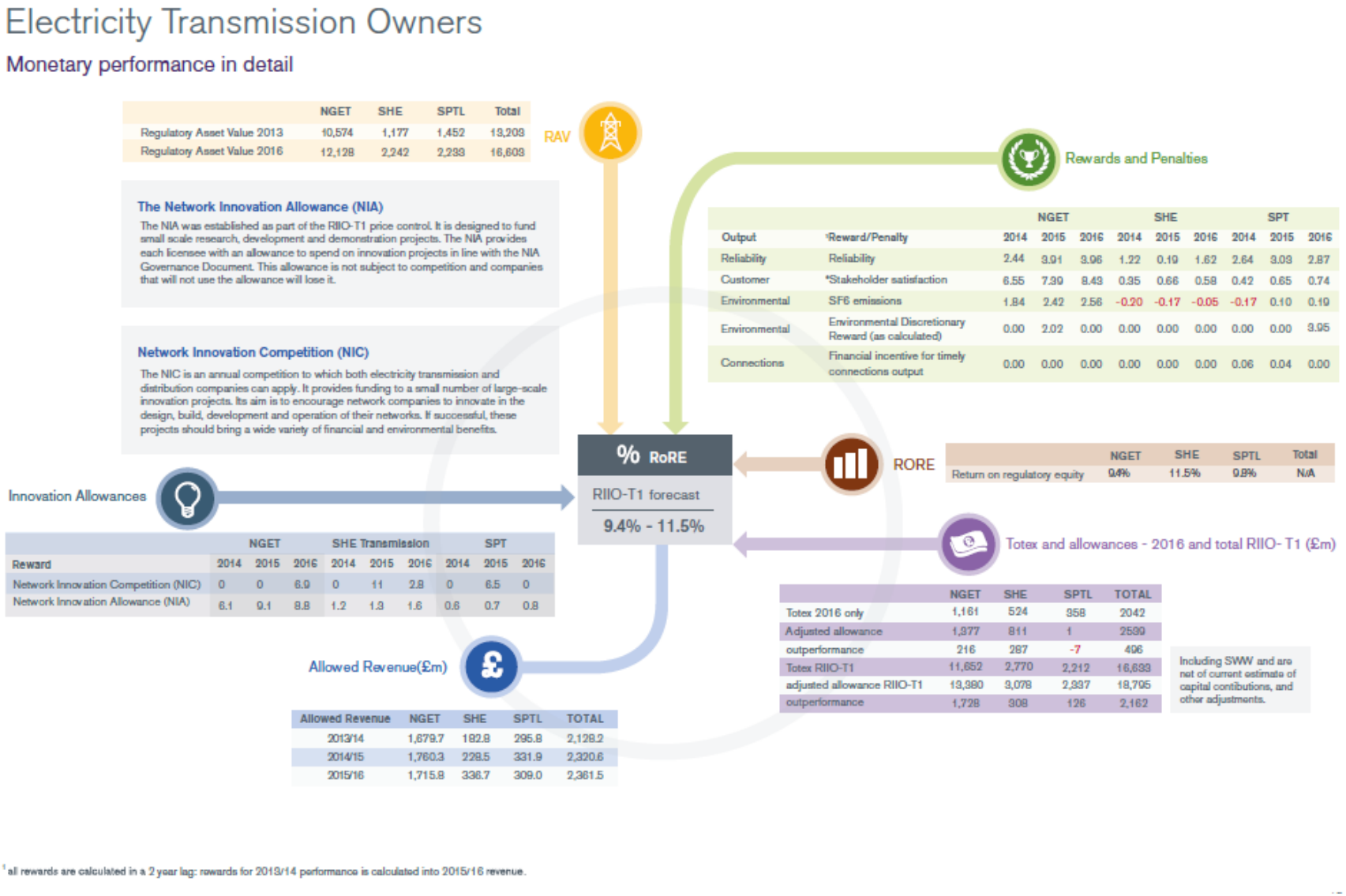


Diagram 6: Overall TO financial performance 2015-16



[1] all the data relates to the cumulative performance position of all TOs reported in 2015/16, unless stated otherwise. Allowances and expenditure are in 2015/16 price base.
[2] all rewards are calculated in a 2 year lag:
[3] 2015-16 amounts will feed into Maximum Allowed Revenue in 2017/18, and are not final. Nominal pricebase.

Diagram 7: TO financial performance 2015-16 by Company



	NGET	SHE	SPTL	Total
Regulatory Asset Value 2013	10,574	1,177	1,452	13,203
Regulatory Asset Value 2016	12,128	2,242	2,233	16,603

		NGET			SHE			SPT		
Output	[1]Reward/Penalty	2014	2015	2016	2014	2015	2016	2014	2015	2016
Reliability	Reliability	2.44	3.91	3.96	1.22	0.19	1.62	2.64	3.03	2.87
Customer	*Stakeholder satisfaction	6.55	7.39	8.43	0.35	0.66	0.58	0.42	0.65	0.74
Environmental	SF6 emissions	1.84	2.42	2.56	-0.20	-0.17	-0.05	-0.17	0.10	0.19
Environmental	Environmental Discretionary Reward (as calculated)	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	3.95
Connections	Financial incentive for timely connections output	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.04	0.00

	NGET	SHE	SPTL	Total
Return on regulatory equity	9.4%	11.5%	9.8%	N/A

	NGET			SHE Transmission			SPT		
Reward	2014	2015	2016	2014	2015	2016	2014	2015	2016
Network Innovation Competition (NIC)	0	0	6.9	0	11	2.8	0	6.5	0
Network Innovation Allowance (NIA)	6.1	9.1	8.8	1.2	1.3	1.6	0.6	0.7	0.8

Allowed Revenue	NGET	SHE	SPTL	TOTAL
2013/14	1,679.7	182.8	295.8	2,128.2
2014/15	1,760.3	228.5	331.9	2,320.6
2015/16	1,715.8	336.7	309.0	2,361.5

	NGET	SHE	SPTL	TOTAL
Totex 2016 only	1,161	524	358	2042
Adjusted allowance	1,377	811	1	2590
outperformance	216	287	-7	496
Totex RIIO-T1	11,652	2,770	2,212	16,633
adjusted allowance RIIO-T1	13,380	3,078	2,337	18,795
outperformance	1,728	308	126	2,162

Diagram 8: Overall DNO output performance 2015-16

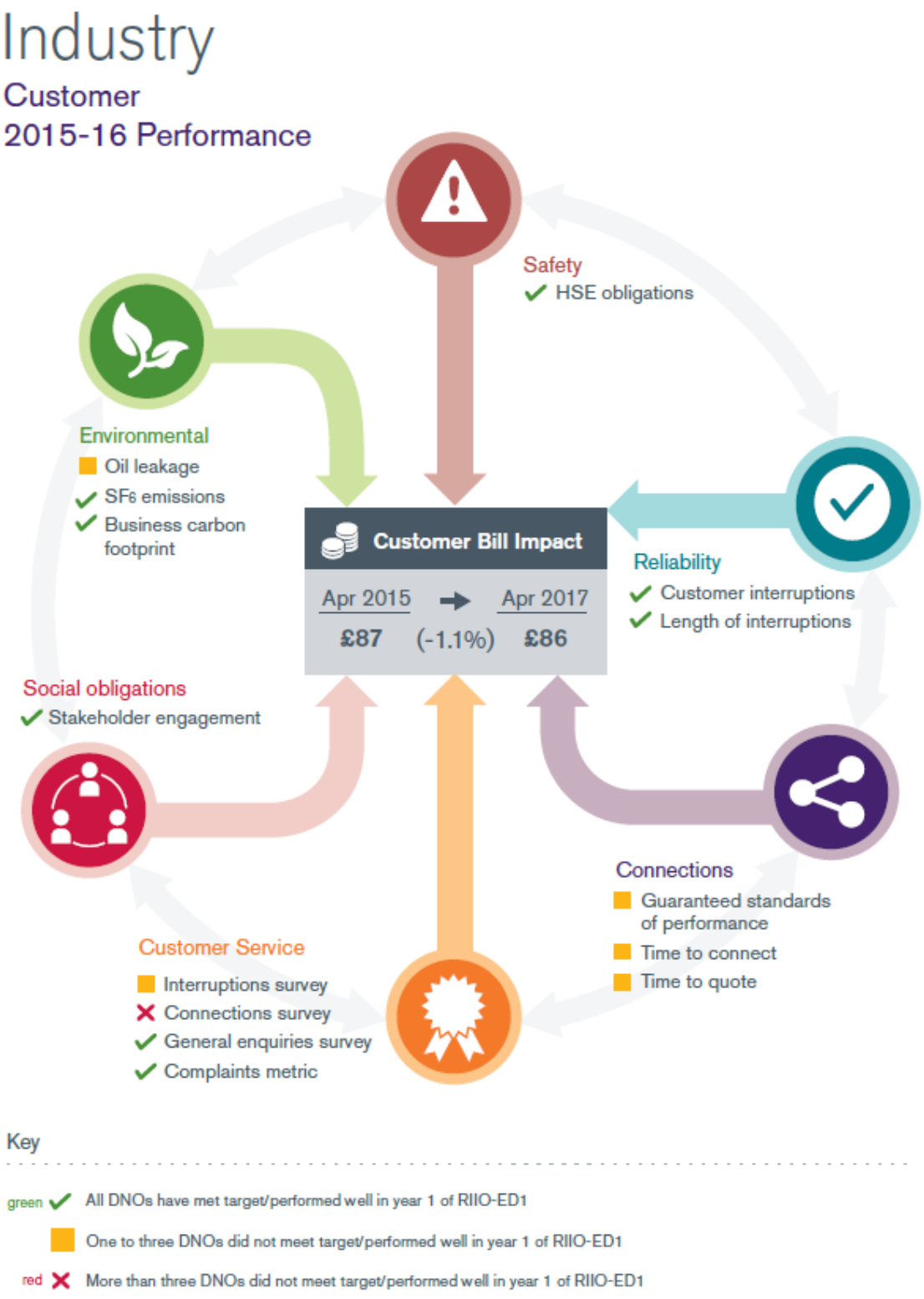


Diagram 9: DNO output performance 2015-16 by Company

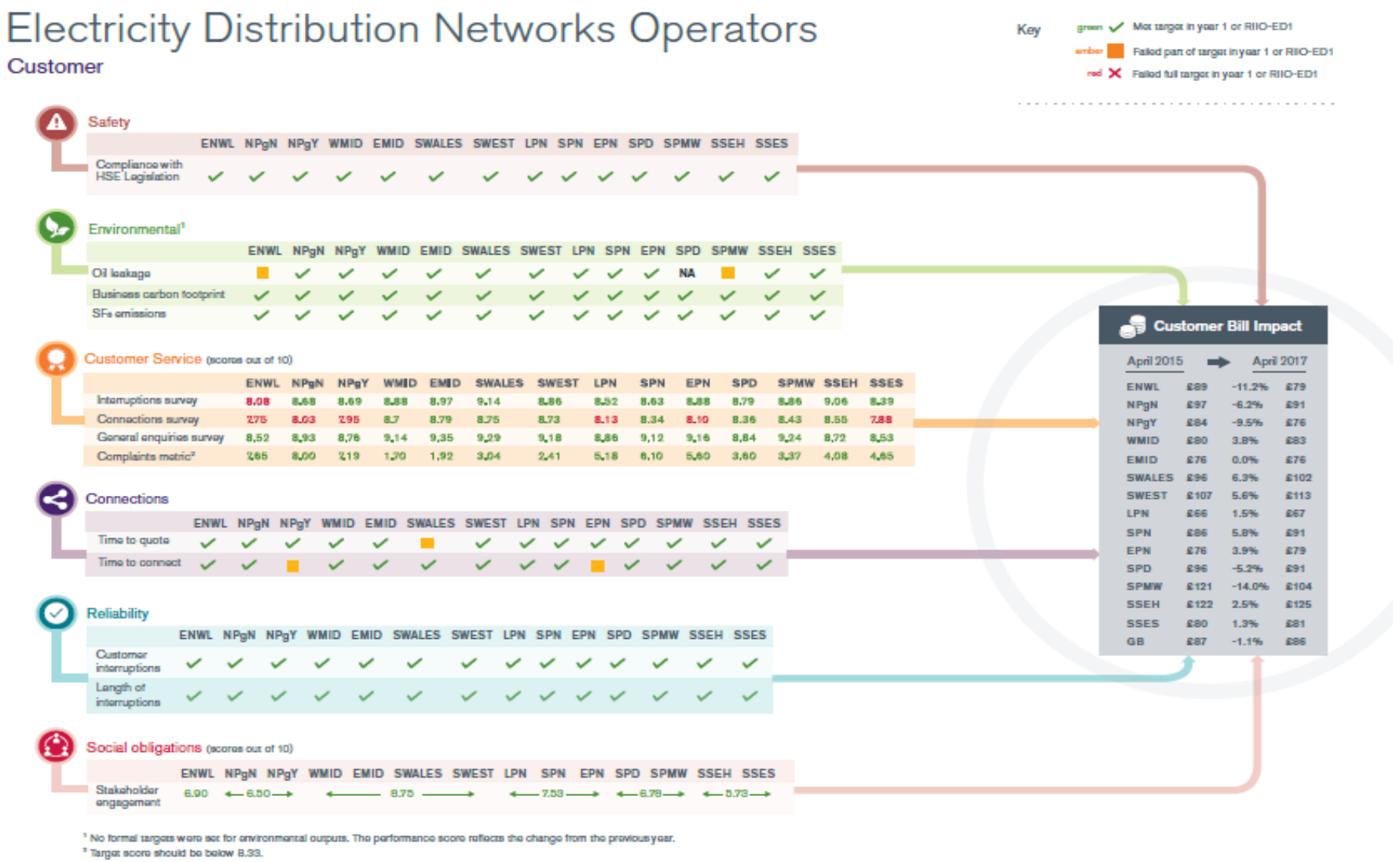
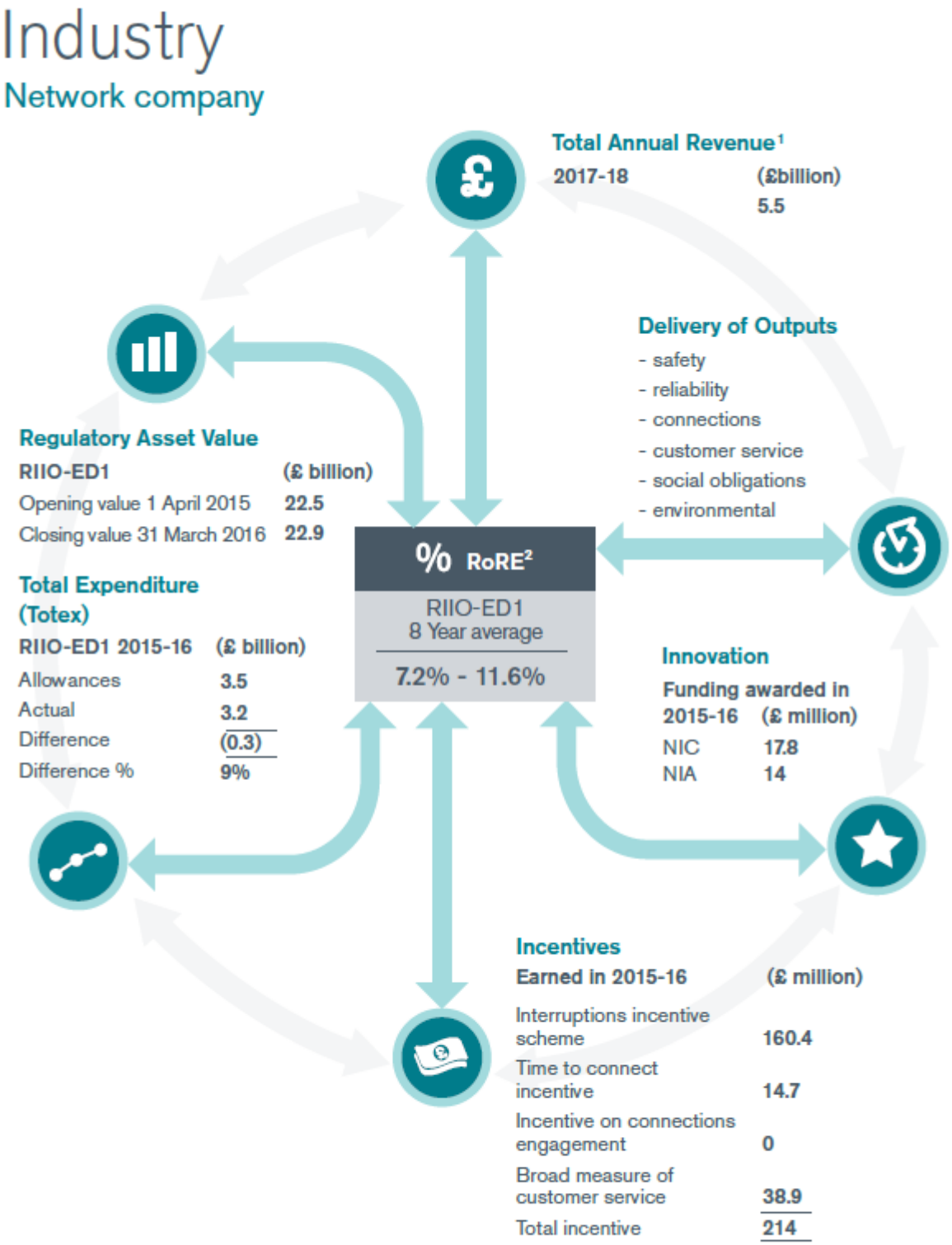
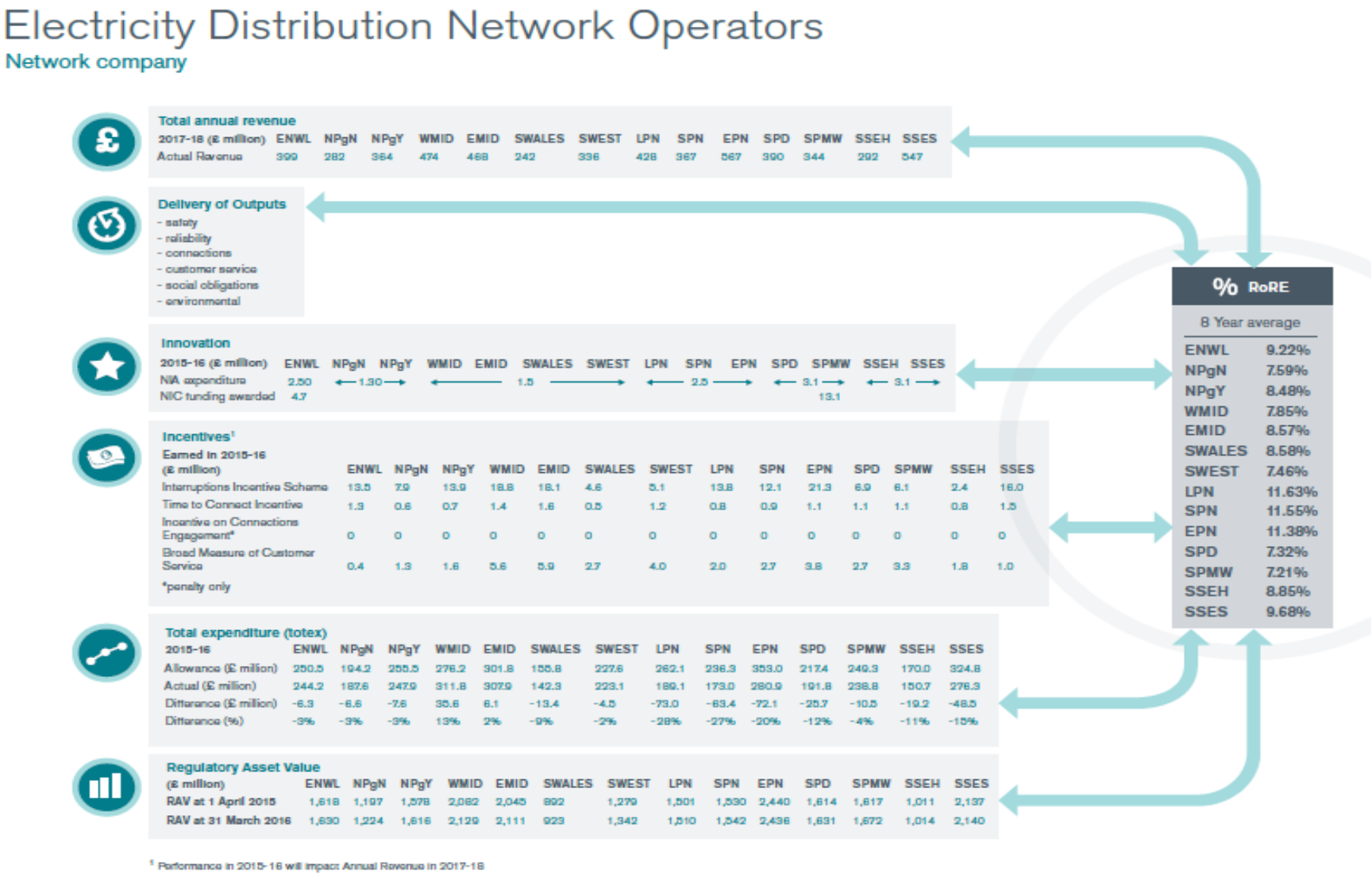


Diagram 10: Overall DNO financial performance 2015-16



[1] Performance in 2015-16 will impact Annual Revenue in 2017-18.
[2] Return on Regulatory Equity.

Diagram 11: DNO financial performance 2015-16 by Company



5.3 Data collection

Performance reporting is critical to effective regulation

The UK regulatory regime is based on a balance of incentives to encourage companies to improve their performance, while at the same time maintaining compliance measures to ensure that underperformance is addressed. Accurate performance information is critical for the regulator.

However, a key challenge for all regulators is the 'information asymmetry' between themselves and the companies being regulated. As such, it is important to ensure:

- Accuracy of data – ensuring that the quality of the data is maintained, and appropriate assurance is provided
- Timeliness – delivering data when required, but not so late that it is not useful.
- Transparency – ensuring that data is available (and provided publicly wherever possible), identifying all relevant data items
- Consistency – ensuring there is a clear and consistent history to data and changes
- Flexibility - ensuring that data requirements can adapt to meet changing requirements
- Incentives for accurate, timely data to be provided, or penalties for inaccurate/late data

This has required clear protocols to be established for regulatory reporting, enforced by licences.

Ensuring effective monitoring and performance reporting

To ensure that robust monitoring and performance information is provided to Ofgem, specific requirements are set out the Network Company Licences. The key terms for a Distribution Company licence are summarised below and set out in more detail in Appendix 3. Data requirements for transmission companies are very similar for financial matters but technical and performance criteria are different. Key licence requirements are:

Condition 44. Regulatory Accounts - This clause provides the detailed requirements for the publication of regulatory accounts, the accounting and corporate reporting standards that should be applied, together with the key elements that should be included. The report should include:

- A profit and loss account,
- A statement of gains and losses,
- A balance sheet,
- A cash flow statement,
- A corporate governance statement,
- A strategic report, and
- A Director's report

The regulatory accounts must demonstrate consistency with the Statutory Accounts. The Licensee must undertake an audit of the Regulatory Accounts by an external auditor, who should provide assurance to Ofgem that the regulatory accounts fairly present the Licensee's financial position. An external auditor should also report on the Distribution licence condition that prohibits cross-subsidy and discrimination. Appendix 5 provides details of an example set of Regulatory Accounts together with links to the published document.

Condition 45. Data Assurance requirements - This clause requires the licensee to undertake and report to Ofgem on data assurance activities for the purpose of reducing the risk of any inaccurate and incomplete reporting. It requires the licensee to carry out a risk assessment and take steps to address such risks.

Ofgem may direct the licensee to undertake data assurance activities. Ofgem may also appoint an 'Examiner' (a representative of Ofgem) to undertake a review of submitted data or the systems and processes used to generate it.

Condition 46. Regulatory Instructions and Guidance - To ensure clarity of the requirements for regulatory reporting, Electricity Distribution Regulatory Instructions and Guidance (**RIGs**) are used. They clarify both the existing reporting requirements and introduce new requirements in a clear manner. The RIG's specify the information that the Licensee must measure and record and (where permitted), estimate, and when the information should be provided to Ofgem. Ofgem uses the RIGs to specify the information they collect to:

- monitor DNOs' delivery of their price control outputs and associated deliverables
- monitor the rewards and penalties the DNOs have received because of this performance
- monitor DNOs' delivery of wider price control commitments
- monitor compliance with licence requirements
- collect information for use in the annual revenue adjustment process
- have visibility of the DNOs' latest forecasts on key deliverables
- inform the assessment in the next price control review.

Condition 50: Business Plan Commitment Reporting - This condition requires each licensee to publish an annual report on how it has performed against commitments made in its RIIO Business Plan. Each licensee is required to publish the Report by each subsequent 31 October. The purpose of the reporting requirement is to oblige licensees to provide stakeholders with information on how they are performing against the commitments they made in their business plans.

Ofgem guidance for regulatory reporting packs

Ofgem provides blank reporting packs that the transmission and distribution companies must use when reporting specified numerical information. They ensure the licensees submit data in a consistent format by setting out requirements for:

- Navigation of content
- Worksheet restrictions to ensure submitted data is in specified worksheet cells
- Maintaining a change log
- Ensuring consistency with previously submitted and linked data
- Complying with definitions
- Accounting policies e.g. costs on a cash basis
- Provision of historic cost - real/nominal values
- Use of estimates, apportionments and allocations.
- Provision of forecast data
- Provision of commentaries

Accuracy of information – under licence condition 45 (Data Assurance requirements) licensees should perform a risk assessment and carry out data assurance activities on specified information submitted in the RIGs. The data assurance activities carried out should ensure the accuracy of the information submitted.

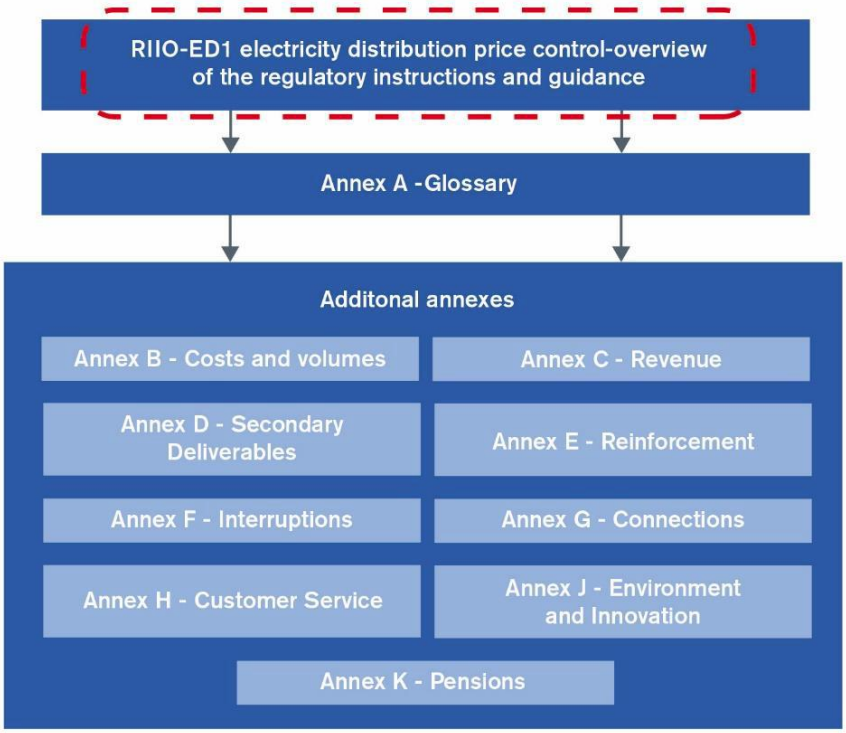
The packs specify how should errors be notified and dealt with, addressing factors such as materiality, timescales; actions to be taken in the event of discovery. Provision of misleading data could be considered a licence breach and subject to enforcement action.

The Ofgem RIGs packs for electricity distribution contain the sections set out in the following diagram. These cover a wide range of financial, technical, customer, environmental and efficiency factors. The guidance for completing the RIGs is described further in Appendix 4, and further detail is provided in the following section.

5.4 Data requirements

Ofgem's data requirements are described in detail in the RIGs guidance and spreadsheets for the transmission and distribution companies as shown in the following diagram.

Diagram 12: Distribution company Regulatory Reporting Pack Content



The above diagram shows the information that is to be provided by each distribution licensee. Transmission information requirements follow a similar pattern. All this information is published on Ofgem's website[7]. The Ofgem website provides access to detailed explanations of each reporting area together with the spreadsheets for completion. The elements are summarised below.

[7] https://www.ofgem.gov.uk/publications-and-updates/direction-make-modifications-regulatory-instructions-and-guidance-rigs-riio-ed1-version-30 (Appendix 2 includes the RIGS templates as well as guidance on completion of the RIGS)

Costs and volumes – network operators are required to provide a detailed breakdown of costs using a common template, so that Ofgem can use this data to benchmark network companies against each other and to validate that expenditure is efficiently incurred. This includes, for example, unit costs for network and substation components.

Revenues – revenue reporting requirements are intended to allow Ofgem to monitor compliance of network companies in their calculation of allowed revenues. Licence holders are required to report the various component parts of allowed revenues, and the assumptions made in calculating allowed revenue. This is mostly calculated as a function of other inputs provided by the network companies. Appendix 6 sets out an outline example of the formulas used to calculate revenues, together with links to the associated models and licence documents.

Secondary deliverables – Ofgem also monitors secondary deliverables; this is primarily focused on monitoring the health and criticality of network companies' assets. This is intended to inform Ofgem on the probability and consequence of asset failure respectively.

Reinforcement – network companies are required to report on the load at each substation, and the likely evolution of that load over the course of a regulatory reporting period. This reporting highlights where interventions, such as reinforcements, are required. Where such requirements are highlighted by the reporting the company must state what intervention is proposed for the network to remain compliant with security standards.

Interruptions – reporting requirements also cover Quality of Service. This includes reporting on metrics such as Customers Interrupted (CIs), Customer Minutes Lost (CMLs), Short Interruptions (SIs), Customers Re-interrupted (RIs), and Occurrences Not Incentivised (ONIs). As is suggested by the final metric, many of these metrics feed into incentive payments that are part of Allowed Revenue under Great Britain's regulatory framework.

Connections – connections data covers the numbers of new connections, the types of connection, quotations for new connections, and time to connect and time to quote. This allows Ofgem to monitor the timeliness of network companies in providing new connections.

Customer service – companies are required to report on customer satisfaction metrics including data on complaints, complaints handling, results from customer satisfaction surveys, and telephone response.

Environment and innovation – this reporting covers a wide range of metrics. Ofgem requires network companies to provide detailed cost and volume information on activities and investments that are required to comply with specific regulatory requirements (e.g. to meet visual amenity or environmental requirements). Companies are also required to report on losses and spend on innovation projects under this reporting heading.

The following tables (1 and 2) set out the overall reporting pack requirements for transmission and distribution, together with the frequency of submission and submission deadlines.

Table 1: Distribution Network Owner RIGs reporting packs, commentaries and timeframes

Instructions and guidance	Reporting pack	Period	Submission deadline
Costs and Volumes	Costs and Volumes	Regulatory year	31 July
Revenue	Revenue calculations	Regulatory year	31 July
Secondary Deliverables	Secondary Deliverables e.g. asset health, safety	Regulatory year	31 July
Reinforcement	Reinforcement Load Index (LI)	Regulatory year	30 September

Instructions and guidance	Reporting pack	Period	Submission deadline
Interruptions	Quality of Service - Interruptions	Regulatory year	30 April
	Guaranteed Standards of Performance	Regulatory year	31 July
	Occurrences Not Incentivised		
	Quality of Service - HV Disaggregation	Regulatory year	30 November
Connections	Connections	Regulatory year	31 July
	Connections – Guaranteed Standards	Quarterly	31 July
Customer Service	Customer service	Complaints and customer satisfaction – quarterly, Telephony – monthly	31 July
Environment and Innovation	Environment and Innovation	Regulatory year	31 July
Pensions	Pensions	-	2017, 2020, and 2023

Table 2: Transmission Owner RIGs reporting packs, commentaries and timeframes

Instructions and guidance	Reporting pack	Period	Submission deadline
Costs and Volumes	Costs and Volumes	Regulatory year	31 July
Revenue	Revenue	Regulatory year	31 July
Secondary Deliverables	Secondary Deliverables e.g. asset health, safety, flood mitigation, visual amenity	Regulatory year	31 July
Reinforcement	Planning; Pre-construction works; timely reinforcement	Regulatory year	31 July
Quality of Service	Reliability - Energy not supplied (ENS) - Network Asset Health	Regulatory year	31 July
	Availability		
Connections	Timely connections - generation Timely connections – demand	Regulatory year	31 July
Customer Service	Customer service - Customer satisfaction - Stakeholder satisfaction	Regulatory year	31 July
Environment	Environment - SF6 - Business Carbon Footprint	Regulatory year	31 July
Pensions	Pensions	-	2017, 2020, and 2023

5.5 Other international comparisons

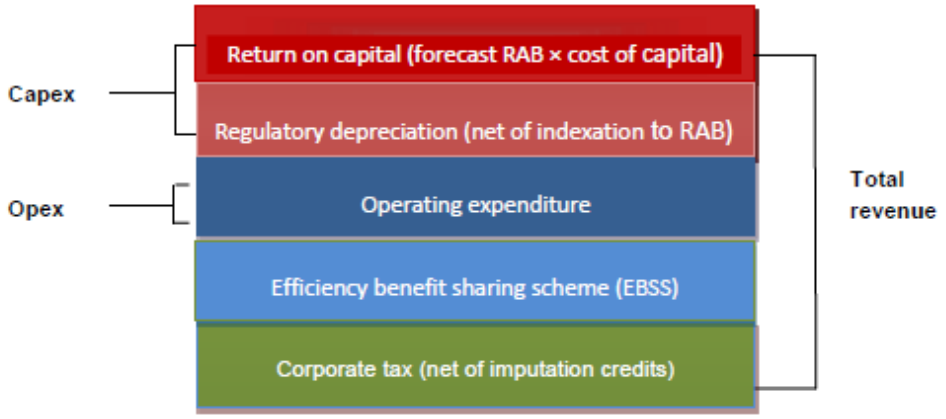
A review of alternative approaches to performance databases from Australia, Europe, North America, Asia and Africa was undertaken. Australia was selected for further examination and the regime is described in more detail in Appendix 7.

In Australia, the independent Australian Energy Regulator (AER) regulates electricity network revenues with the goal of ensuring that consumers pay no more than necessary for the safe and reliable delivery of electricity services. The AER applies incentive-based regulation across all the 7 transmission companies and 13 distribution companies they regulate.

The AER determines the revenues that an efficient business would require at the start of each five-year regulatory period. The business is then given financial rewards when it improves its efficiency and spends less than the forecast during the regulatory period—while maintaining or improving its service standards. If the business spends less than the forecast, it can keep the difference between the forecast and its actual expenditure until the end of the regulatory control period. Conversely, if its spending exceeds the forecast, it must carry the difference itself until the end of the period.

An AER determination does not set network expenditures or costs but establishes a cap on the maximum revenue that a network can recover from its customers during the regulatory control period. The key components of the Australian price control mechanisms are set out below. While the UK RIIO regime incentivises outputs, the Australian regime is a more traditional approach which focuses on efficiency benefits, although the efficiency benefit sharing scheme (EBSS) can include some service performance incentive elements.

Diagram 13: Australian T&D price control components



Performance indicators

The AER performance report uses several measures to produce useful analysis and bench-marking between organisations. Due to the diversity of population and geography, companies are difficult to compare. The approach AER has adopted is to define common inputs and outputs for each company, and then to derive 'partial performance indicators' for comparison.

- The **output measures** include factors such as customer numbers, circuit line length, maximum demand, circuit throughput, and reliability.
- The **input measures** include opex, Regulated Asset Base (RAB), depreciation and asset cost
- The **partial performance indicators** provide a comparison of input costs relative to an output.

In summary, the Australian performance monitoring regime has many similarities to the UK system in that it requires companies to report annually so that financial and output performance can be monitored. However, compared to the UK, the regime is less advanced in using output incentives and performance benchmarking.

6. Comparison of T&D Performance databases

6.1 Underlying differences need to be recognised

The previous chapters in this report have examined the key features of the proposed Chinese performance databases, and those considered to provide international best practice. While most countries use performance monitoring for T&D regulation, the UK is among the most advanced and has been used for comparison with the proposed T&D monitoring regime for China.

This report seeks to draw out the differences between the UK and China regimes, but in doing so it is important to recognise several fundamental underlying differences. These include:

- The UK T&D performance indicator system has developed over more than 20 years and is operating in an environment where both the regulated companies and the regulator are very experienced with the system. Decisions on data collection and performance indicators have been revised based on experience and analysis of prior information.
- The design of performance indicators will need to recognise the key factors affecting the respective businesses. For example: government policy, demand growth, growth in large/small renewable generation, changing customer requirements, cost and revenue targets, service performance standards and targets, and the technical characteristics of the T&D assets and systems.

The following section summarises the key findings from the international comparison, focusing on the following key elements:

- design of the performance indicator system (**what performance is measured?**)
- design of the functional frameworks for supervision (**how is data collected?**)
- design of the data platform (**what data is collected?)**

6.2 Key findings from the international comparison

What performance is measured?

The Chinese performance monitoring focuses on key areas of financial and technical performance. They include revenues, investment in assets, operational costs and quality of service indicators. But there are some important differences with the international performance indicator systems, namely:

- The Chinese data is collected for T&D businesses combined, whereas most international T&D performance indicators are separately measured for transmission and distribution.
- The Chinese performance data includes sales of electricity whereas most international T&D performance indicators do not include electricity sales data. This is because their energy sales are the responsibility of separate energy supply businesses and not of T&D businesses.

The performance indicators used in the international examples provide additional detail to those identified in the Chinese database. These include:

- **Financial performance** – a more detailed breakdown of financial performance allowing returns on regulated assets to be calculated together with earnings (or losses) from incentives. A financial model is used to provide an updated financial model of all aspects of each licenced business performance
- **Asset Investment** – a more detailed breakdown of asset capital investments that have been undertaken. Also, information on asset health, seeking to predict when assets will need to be replaced

- **Network load and reinforcement needs** – a detailed breakdown of the loading on individual transformers highlighting the need for future reinforcement.
- **New connections** – more data provided including the number of new connections, and time to connect.
- **Costs and volumes** – a more detailed breakdown of unit costs and volumes to assist benchmarking between businesses.
- **Revenues** – a more detailed breakdown of the component parts of allowed revenue and the assumptions made in calculating allowed revenue.
- **Quality of service** – these may include more detailed reliability and availability measures e.g. customer minutes off supply, and repeated interruptions.
- **Customer service** – these may include numbers of complaints and customer satisfaction surveys.
- **Other performance indicators** – these may include environmental indicators, safety, network losses, and spend on innovation projects.
- **Historical and forecast performance** – for each of the above indicators, historic and forecast information may be provided to allow trends to be analysed and a comparison made against prior forecasts or targets.

How is data collected?

The Chinese spreadsheet tables require each business to provide information for monitoring of the electricity system and in relation to specific cost and performance targets. They require technical and financial information to be provided. But there is very little detail on the definition of what should be provided, and how consistency may be assured throughout. For example:

- The detailed guidance for reporting is not fully defined, nor how changes to reporting requirements may be made, or how disputes/errors will be resolved.
- No evidence of assurance is provided that each business's data systems are robust, consistent and accurate
- No evidence of assurance is provided that the individual performance and monitoring reports are accurate and consistent, especially with historic and forecast data

Regulated businesses will always have more information than their regulator. It is likely that the businesses will seek to do the minimum amount of reporting required to ensure that they do not incur additional costs. They may also wish to reduce transparency about operational, maintenance or other information particularly if they are subject to penalty arrangements. It may also be necessary to penalise businesses that do not provide accurate or timely data.

Without clear reporting obligations and systems, the quality of the reporting information may be sub-standard and cause a significant amount of effort by regulators to understand the information provided. It may make performance deficiencies more difficult to evidence and compliance more difficult to enforce. Disputes over information may become common.

The international comparisons show the detailed approach that may be deployed to collect information, including detailed data definitions, spreadsheets where entries can be checked and reconciled, and the inclusion of data checking and audit processes to assure the robustness of the data.

What data is collected?

The data collected for the Chinese businesses covers the parameters necessary for the calculation of the defined performance indicators. As set out above in the section on performance indicators, the international examples require significantly more information to be provided. In addition to this, some further important data requirements include:

- An annual report which provides all the key data and associated calculations in a series of spreadsheets provided by the regulatory body. This means that errors or disputes are less likely.
- An annual commentary which explains the data provided, and the overall performance of the business. This is provided to address a prescribed content list and should be agreed at a senior level in the business submitting the information. It allows the businesses to explain their overall challenges and successes, and to set out what they have done to manage these.
- An updated calculation of the prescribed business model which allows changes to revenues and changes to the asset base to be calculated. It can also calculate revised revenue allowances due to agreed cost or output changes, or the application of penalties and incentives.
- Senior management and independent assurance from the regulated company that the data provided is accurate and has been thoroughly checked and the results explained.

7. Recommended performance measures and data

7.1 Introduction

The previous section drew on experience from the UK and other countries to suggest improvements to the Chinese T&D monitoring database. The key potential areas highlighted to realise improved data and performance information were:

- Financial performance, including revenues
- Asset investment
- Asset condition, including age and utilisation of assets
- Costs and volumes, including new connections
- Outputs, including quality of service, customer service and other performance indicators
- Historical and forecast information

This section considers each of these in detail and proposed how they may be applied in China. Specific recommendations are made for improvements to the Chinese T&D database, taking account of the circumstances applying to the T&D sector in China.

The improvements should enhance the regulation and supervision of the Chinese T&D sector and support the wider market reforms that are underway.

7.2 Regulation of T&D

The China T&D price control regime

The design of the proposed T&D price control regime consists of a revenue allowance that is approved by regulatory authorities (NDRC) for a 3-year regulatory cycle. The price control calculation is understood to comprise the following elements:

Approved Income = Approved Cost + Approved Returns + Tax
+/- Approved ex-post adjustments

(Approved cost = Depreciation + Operation & Maintenance cost)

(Approved returns = Asset value x Rate of return)

The approved income is derived from the building blocks of cost (capex, opex and depreciation), with an allowed rate of return. If efficient levels of approved income are set, this approach should achieve the policy goals of promoting efficiency in T&D while also allowing the healthy development of the T&D system to benefit consumers.

It is understood that the proposed design of the regulatory regime also includes a clawback mechanism for underspend of capital expenditure (capex) where 70% of the relevant depreciation and return for any capex underspend is removed from the approved income. At the same time, there are no similar arrangements applied to overspend of capex. For opex, they are kept at below certain proportions of the incremental capex. There are no targets for outputs, such as measures of reliability.

Common methodologies are used for setting rates of return and depreciation rates. The value of the approved revenue allowance is mostly dependent upon the regulatory authorities making the following judgements for each enterprise:

- **The asset base and the value of efficient capex costs**. These are used to calculate returns and depreciation costs.
- **The efficient operation and maintenance (opex) costs**, which form part of the Approved cost calculation.

Opex and capex - lessons from international experience

International regulatory experience has shown that it is difficult for regulatory authorities to accurately set targets for opex and capex. There are many differences between companies that make it difficult to set targets. For example, some T&D companies may have large geographical areas with sparse population and low demand, and others may have a high concentration of urban areas and high demand.

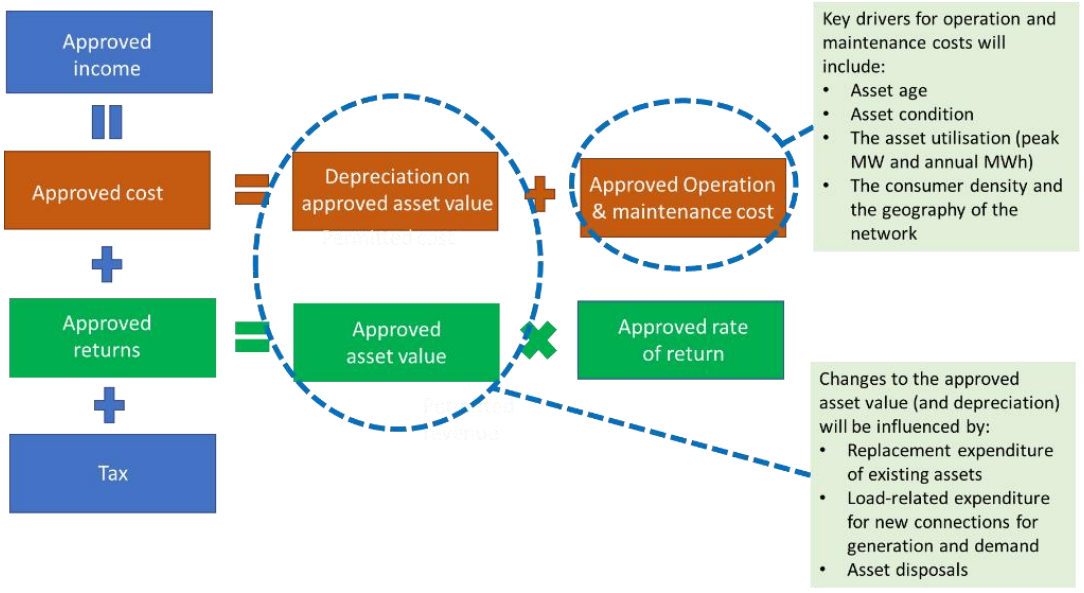
Furthermore, some T&D companies may have a variety of associated businesses e.g. generation, which make it difficult to accurately separate costs, and run the risk of cross-subsidies being reflected in the costs.

In addition to understanding justifiable cost differences, regulated companies always have more information than their regulators. They may commonly seek to protect their own commercial or management interests by over-forecasting costs or providing insufficient information for regulators to make decisions.

Key opex and capex cost drivers

The following diagram shows the basic components of the China T&D regulatory formula. The opex and capex costs will be driven by several underlying power system characteristics that will differ for each enterprise. These will each impact on the level of allowed efficient cost.

Diagram 14 – Key opex and capex cost drivers



The key cost drivers for network opex and capex are expected to include:

Energy requirements

- **Peak demand** – indicates the annual peak utilisation of each system or part of system. May indicate if additional capex investment is required for enough capacity to be available.
- **Energy delivered** – indicates system utilisation, particularly for distribution assets. Higher energy delivered may indicate a higher capex and opex cost for distribution assets.
- **Generation capacity** – indicates system utilisation and connection requirements, particularly for transmission assets. A higher generation capacity may indicate a higher capex and opex cost for transmission assets.
- **Number of customers** – indicates system utilisation and demand connections. An increased number of customers may indicate a higher capex and opex cost.

Network characteristics

- **Asset health** – generally, asset age is used as a proxy for asset health. Assets may be expected to have higher operating costs at the beginning and ends of their lifetimes, but this can be impacted by environmental conditions, modes of operation, and maintenance regimes. Older assets may have higher operating costs and may be less reliable.
- **Asset composition** – population of key components i.e. overhead lines, cables, switchgear, transformers, and other equipment. Opex may be higher if there is a greater proportion of substation equipment to overhead lines.
- **Network dimensions** (line length and transformer capacity) – line length or transformer capacity are often used for comparison purposes. They can be used to demonstrate comparative costs or reliability.
- **Customer density** (no of customers in each geographic area) – a higher operation and maintenance cost may be expected if the network is in non-urban (rural) areas

These cost drivers form an important part of the regulatory price setting process. To set the appropriate targets, it will be important to:

a) Collect data on these cost drivers to help understand the impact that they are having on the costs of each regulated organisation

b) To apply this information to improve the regulatory performance measures, and better understand the performance of each regulated organisation

T&D regulatory data – lessons from international experience

The proposed China T&D regulatory regime is at an early stage of development and will need to develop further in due course. It is expected that future price controls will include incentives for cost and output performance.

Similarly, international experience of T&D regulation has shown an evolution from simple revenue or rate of return controls, to ones that are more advanced such as the RIIO regime in the UK with a high degree of incentivisation.

The evolutionary stages of price control regulation generally mirror a sequence where data definition and data collection improvements lead to greater confidence in the data and allow a

greater sophistication in the design of the regulatory regime. The pathway to improved data definition and collection is likely to include the following steps:

1. **Stage 1 - Foundation** - Initially, it is critical to obtain accurate data for each regulated organisation; essentially obtaining 'clean' data for each organisation which removes distorting factors such as cross-subsidies, inaccurate definitions, and inaccurate reporting. This allows performance to be assessed against forecasts and targets.
2. **Stage 2 - Comparative** - Then, obtaining comparative data – obtaining cost and output data for each organisation which allow effective comparisons to take place and efficiency targets and output targets to be set based on benchmarking different companies. The data may need to be adjusted to achieve effective comparisons.
3. **Stage 3 - Advanced** - Next, deepening the performance data, where additional cost and output measures are obtained and incentivised, including factors such as asset health or customer satisfaction. Efficiency incentives may be more accurately targeted.

As set out above, the more comprehensive and accurate the dataset, the more advanced the regulatory regime can be. So, a plan to improve regulatory reporting will be critical to support the improvements in the China T&D regulatory regime that will be expected in the future. The T&D performance database will need to include more comprehensive datasets, that allow more detailed monitoring and analysis of performance over time. Accuracy and consistency of data and comparative datasets will be critical.

To illustrate the potential level this reporting regime will need to develop to, examples are set out in Appendix 4 for UK regulatory reporting and in Appendix 8 for Australian regulatory reporting. A key part of these is the provision of guidance, spreadsheets for data provision, clear definitions, together with incentives and independent assurance to ensure accurate data is provided.

It is recommended that the approach to improvement of the China T&D performance database be to firstly ensure that a sound foundation (Stage 1) is put in place, but with all the key elements in place so that the development can move to a comparative approach (Stage 2), and then to an advanced approach (Stage 3) which will provide greater regulatory supervision benefits.

With this approach in mind, the following section proposes the suggested improvements that should be made to the current proposals for performance measures, and the associated data requirements.

7.3 Proposed improvements to T&D performance monitoring

The current proposals for the China T&D performance monitoring regime consist of the following key categories:

A. **Asset investments**, including capex investment for different voltages, and against allowances
B. **Costs**, including variations of opex elements against allowances
C. **Income**, including rates of return, and potential cross-subsidisation
D. **Electricity sales**, including sales against T&D dimensions, and losses
E. **Service**, including loss of supply and reliability of supply
F. **Special**, including distributed energy ratios and costs

As these categories already align with many of the important regulatory areas, it is proposed to retain most of these categories but to add the suggested areas for improvement highlighted in the previous section. As such, it is suggested that the categories be redefined as follows:

A. **Assets** – including regulated asset value, capex, depreciation, and asset condition

B. **Costs** – opex, broken down by various categories

C. **Network revenue** – including revenue calculation and overall financial model

D. **Electricity revenue** – electricity sales and technical/non-technical losses

E. **Service and outputs** – including quality of service, customer service and other performance indicators

F. **System parameters** – generation/demand energy requirements and T&D system parameters

In addition to improved performance measures, the associated 'raw' data categories, together with historical and forecast information, will be required to support this more detailed analysis. This is detailed further in Appendix 8.

It is important that regulatory authorities collect both the raw data and the associated performance indicators to undertake regulatory supervision. Having verifiable raw data will enable performance indicators to be calculated and analysed, and for performance indicators to be adjusted if necessary.

Also, understanding the purpose of each performance indicators is important. It is expected that that each performance indicator or raw data submission should fulfil one or more of the following:

- An input to revenue calculation for this price control,
- Measures of good/bad or efficient/inefficient performance, and
- Data / indicators to inform future price controls.

A. Assets

Current proposals

The current proposals for asset reporting focus on the investment completion rate, the unit investment amount at different voltage levels rate, and variances between reported (forecast), approved and actual fixed asset values at different voltages.

It is proposed to retain these measures but to enhance this reporting area as described below.

Parameter	Serial no.	Parameter name
Assets	1	Planned Investment Completion Rate
	2	Actual funding transfer rate
	3	Fixed assets investment amount per unit power transformer capacity - 500KV and above
	4	Fixed assets investment amount per unit power transformer capacity - 220 kV
	5	Fixed assets investment amount per unit power transformer capacity - 110 (66) KV
	6	Fixed assets investment amount per unit power transformer capacity - 35KV
	7	Fixed assets investment amount per unit power transformer capacity - 10KV (20KV)
	8	Fixed assets investment amount per unit line length - 500KV and above
	9	Fixed assets investment amount per unit line length - 220KV
	10	Fixed assets investment amount per unit line length - 110 (66) KV
	11	Fixed assets investment amount per unit line length - 35KV
	12	Fixed assets investment amount per unit line length - 10KV (20KV)
	13	Deviation rate between approved value and reported value of fixed assets original value

Parameter	Serial no.	Parameter name
	14	Deviation rate between actual value and approved value of fixed assets original value
	15	Deviation rate between actual value and reported value of fixed assets original value
	16	Deviation rate between approved value and the reported value of fixed assets net value
	17	Deviation rate between actual value and approved value of fixed assets net value
	18	Deviation rate between actual value and reported value of fixed assets net value

Recommended measures

This section will be expanded significantly to also include the regulated asset value, calculation of depreciation, asset condition, and capex. Capex will be categorised into load related and non-load (asset replacement) related capex. This will allow the key drivers of capex to be identified.

Performance measure	Description
Regulated asset value (T&D)	
1. Initial asset value	Value of asset population at start of year
2. Plus, additional capex (actual)	
(a) Load related capex	Capex related to new generator and demand connections
(b) Non-load related capex (asset replacement, refurbishment)	New capex related to refurbishment, asset replacement
(c) Other non-load related	Other new capex not related to network assets e.g. IT systems, offices
3. Less disposals/write downs (actual)	Assets removed from asset valuation over the year
4. Less depreciation (actual)	Depreciation calculated in line with pre-set lifetimes for each category of asset
5. Final asset value	Value of asset population at end of year
Asset condition	
Average age of overhead lines (by voltage level)	Indicates expected level of opex and reliability
Average age of cables (by voltage level)	Indicates expected level of opex and reliability
Average age of transformers (by voltage level)	Indicates expected level of opex and reliability
Average age of switchgear (by voltage level)	Indicates expected level of opex and reliability
Performance measures	
Actual total capex versus approved capex (by voltage)	Shows the variation in total actual capex compared with the approved level
Actual load related capex versus forecast load related capex	Shows the variation in load related capex compared with the approved level
Actual non-load related capex versus non-load related capex	Shows the variation in non-load related capex compared with the approved level
Total new capex as percentage of regulated asset value	Shows the rate of increase in regulated asset value
Regulated asset value per line length of each voltage level	Shows the change over time of asset cost per line length
Regulated asset value per transformer capacity of each voltage level	Shows the change over time of asset cost per transformer capacity
Regulated asset value per MWh of energy	Shows the change over time of asset cost per energy delivered

B. Costs

Current proposals

The current proposals set out measures to track the variations between reported, approved and actual values of overall Operation & Maintenance or opex costs. They also track similar variations

for sub-elements of operating costs, namely material costs, repair costs, other costs, and depreciation. A ratio of O&M cost per 10,000 Yuan of fixed assets is also calculated. It is proposed to retain most of these measures, together with some additions as described below.

Parameter	Serial no.	Parameter name
Cost	19	Deviation rate between approved value and the reported value of allowed expenditure
	20	Deviation rate between approved value and the reported value of operation & maintenance expenditure
	21	Deviation rate between approved value and the reported value of material cost
	22	Deviation rate between approved value and the reported value of repairing cost
	23	Deviation rate between approved value and the reported value of other cost
	24	Deviation rate between approved value and the reported value of depreciation
	25	Deviation rate between the actual value and the approved value of allowed expenditure
	26	Deviation rate between actual value and approved value of operation maintenance expenditure
	27	Deviation rate between actual value and approved value of material cost
	28	Deviation rate between actual value and approved value of repairing cost
	29	Deviation rate between actual value and approved value of other cost
	30	Deviation rate between actual value and approved value of depreciation
	31	Deviation rate between actual value and reported value of allowed expenditure
	32	Deviation rate between actual value and reported value of operation and maintenance expenditure
	33	Deviation rate between actual value and reported value of material cost
	34	Deviation rate between actual value and reported value of repairing cost
	35	Deviation rate between actual value and reported value of other cost
	36	Deviation rate between actual value and reported value of depreciation
	37	Annual composite depreciation rate of fixed assets
	38	Rate of newly increased material fees in regulatory period
	39	Rate of newly increased repairing fees in regulatory period
	40	Rate of newly increased other fees in regulatory period
	41	Operation & maintenance cost per 10,000 Yuan value of fixed assets

Recommended measures

It is proposed that additional categories of cost assessment are introduced to provide further detail for analysis and identification of future efficiencies. It is proposed to introduce additional cost categories for non-controllable costs and to separate overhead or support costs from direct costs associated with operation, maintenance and repairs. Furthermore, R&D costs are included as a separate item. Depreciation is calculated in Section A (Assets) above.

Several performance measures are then proposed to highlight the proportion of costs in relation to a number of system parameters and cost drivers. Increases or decreases in these parameters should impact the opex costs accordingly.

Performance measure	Description
Cost breakdown (T&D)	
1. Total direct costs (forecast and actual)	Increase/decrease in costs directly associated with network operation and maintenance, and deviation from forecast value
(a) Direct costs – Fault repairs (forecast and actual)	Increase/decrease in costs incurred in unplanned fault repairs, and deviation from forecast value

Performance measure	Description
(b) Direct costs - operation & maintenance (forecast and actual)	Increase/decrease in costs for routine operation and maintenance, and deviation from forecast value. This is assumed to include labour and material costs associated with operation & maintenance
(c) Other direct costs (forecast and actual)	Increase/decrease in other direct costs associated with operation & maintenance activities, and deviation from forecast value
2. Total support costs (forecast and actual)	Increase/decrease in support costs indirectly associated with network operation & maintenance, and deviation from forecast value
(a) Support & overhead costs (forecast and actual)	Increase/decrease in support and overhead costs indirectly associated with network operation & maintenance, and deviation from forecast value
(b) R&D support costs (forecast and actual)	Increase/decrease in T&D costs indirectly associated with network operation and maintenance, and deviation from forecast value
3. Non-controllable costs (forecast and actual)	Increase/decrease in non-controllable costs associated with network operation and maintenance, and deviation from forecast value
Total operation & maintenance cost (approved and actual)	Increase/decrease in total cost of network operation and maintenance, and deviation with approved value (it is assumed that only the total O&M allowance is approved).
Cost ratios	
Total O&M cost as percentage of asset value	Shows the amount of opex in relation to the regulated asset value
O&M cost per unit of line length	Shows the amount of opex per unit of line length
O&M cost per customer	Shows the amount of opex per customer
O&M cost per MW of max demand	Shows the amount of opex per unit of maximum demand
O&M cost per MWh of energy delivered	Shows the amount of opex cost per unit of energy throughput
O&M cost as percentage of capex	Shows the amount of opex spend in proportion to capex spend; can be used to assess the capitalisation ratio that has been applied
Labour productivity	Increase/decrease in labour productivity

C. Network revenue

Current proposals

The current proposals set out the following parameters for the measurement of rate of return and how income is charged to users of the network. The second factor seeks to assess cross subsidisation but would need a common definition to be compared between companies. It is recommended that both these measures be retained with some additions as below.

Parameter	Serial no.	Parameter name
Income	42	Rate of Return on Common Stockholders' Equity (ROE)
	43	Income ratio from users applied to network charges

Recommended measures

The calculation of income (or revenue) for each organisation is a critical figure, combining all the cost (opex and capex) and asset data. The following measures show all the key movements in the factors affecting the revenue calculation, allowing each area to be interrogated further.

It is also recommended that a common price control financial model is used to provide assurance that each element reconciles to the total revenue figure, and various maximum adjustments (such as

capex underspend clawback) and limits (such as maximum ratios for opex elements) are applied correctly. This becomes particularly important when some adjustments need to be reconciled some years after they are first initiated.

Performance measure	Description
Revenue calculation (T&D)	
Actual revenue	Shows under/over-recovery of revenue versus allowed revenue
Actual rate of return	Shows higher or lower rate of return versus approved rate of return
Capex under/over performance	Shows capex under/over performance versus allowance
Opex under/over performance	Shows opex under/over performance versus allowance
Depreciation actual v forecast	Shows depreciation increase/decrease versus allowance
Actual tax	Shows tax increase/decrease versus allowance
Actual regulated asset value	Shows regulated asset value versus allowance
Actual revenue adjustment	Shows revenue adjustment versus forecast
Network charges (T&D)	
Actual network charges	Shows the total actual network charges
Ratio of actual revenue recovered from network charges	Shows the amount of revenue that is recovered from network charges
Network charges for generation	Shows the network charges per MW of distributed or transmission generation
Network charges for demand	Shows the network charges per MW of distributed or transmission demand

D. Electricity Revenue

Current proposals

The following table sets out the measures that are currently proposed. A key objective of this area is to identify where cross subsidisation between electricity supply revenues and network revenues may be taking place. It is suggested that all of these are retained with some amendments and additions.

Parameter	Serial no.	Parameter name
Electricity	44	Ratio of actual sales and forecast sales of electricity
	45	Regional line loss Rate
	46	Electricity sales per unit transformer capacity – 500(330) KV and above
	47	Electricity sales per unit transformer capacity – 220KV
	48	Electricity sales per unit transformer capacity – 110(66) KV
	49	Electricity sales per unit transformer capacity – 35KV
	50	Electricity sales per unit transformer capacity – 10KV (20KV)
	51	Electricity sales per unit line length - 500(330) KV and above
	52	Electricity sales per unit line -220KV
	53	Electricity sales per unit line -110(66) KV
	54	Electricity sales per unit line -35KV
	55	Electricity sales per unit line - 10KV (20KV)

Recommended measures

The following measures are recommended. However, it is unclear whether the split of sales by voltage and unit cost will be sufficiently accurate in showing the cross subsidy between a) electricity sales and T&D, and b) between T and D. A more effective approach could be to move to benchmarking between similar enterprises once data is available to do this.

Performance measure	Description
Electricity sales (T&D)	
Total forecast electricity sales	Shows increase/decrease
Total actual electricity sales	Shows increase/decrease
Ratio of actual to forecast sales	Shows accuracy of forecast
Electricity sales per unit of transformer capacity, by voltage	Shows split of sales by transformer capacity
Electricity sales per unit of overhead lines, by voltage	Shows split of sales by overhead lines
Electricity losses (T&D)	
Ratio of technical losses	Measurement of losses attributed to each of transmission and distribution
Ratio of non-technical losses	Measurement of losses attributed to metering errors, theft, etc.

E. Service and outputs

Current proposals

The current proposals for service indicators are set out below. Numbers 56 to 59 are included in the recommended proposals. Items 60 and 61 are included in section B (Costs) above.

Parameter	Serial no.	Parameter name
Service	56	Ratio of guaranteed users
	57	Ratio of guaranteed users' power consumption
	58	Customer Satisfaction Degree
	59	Average user blackout time
	60	Labor productivity
	61	Ratio of voltage quality to operation & maintenance cost per unit assets

Recommended measures

The following measures should identify the key output performance of the T&D networks as experienced by its customers. Performance measures as appropriate for T or D companies are highlighted. They are all annual measures.

Performance measure	Description
1. Reliability	
Number of customer interruptions (T&D)	The number of times an average customer will experience unplanned interruptions to supply
Length of interruptions (T&D)	The time an average customer will experience unplanned interruptions to supply
Energy not supplied (T)	The MWh of unsupplied energy to consumers
Number of unplanned outages (T)	Average number of outages, indicating reliability problems
Duration of unplanned outages (T)	Average time of outage duration, indicating time that reliability is reduced
2. Availability	
Guaranteed users (T&D)	The number and capacity of customers where supply is guaranteed
Guaranteed users' power consumption (T&D) [8]	Energy supplied to guaranteed users

[8] Adapted from existing proposal for performance measures – definition to be confirmed

Performance measure	Description
Energy not supplied to guaranteed users (T&D)	The MWh of unsupplied energy to guaranteed users
3. Customer service	
Number of complaints (D)	The number of complaints together with an overview of actions taken to remedy complaints
Customer surveys (T&D)	The overall response received from customer surveys in response to specific issues affecting them e.g. new connections, interruptions
4. Connections	
Time to connect new demand customer (T&D)	The average time it takes to a) make offers, and b) connect new customers
Time to connect new generator customer (T&D)	The average time it takes to a) make offers, and b) connect new customers
5. Safety	
Compliance with safety legislation	No of violations of safety legislation
6. Environmental	
Compliance with environmental legislation	No of violations of environmental legislation

F. System parameters

Current proposals

The following table sets out the indicators termed as 'Special'. It is proposed that No. 62 is included in this section for system parameters, and that No. 63 is included in section C (Revenues).

Parameter	Serial no.	Parameter name
Special	62	Ratio of grid-connected distributed energy
	63	Distributed power supply access Cost

Recommended parameters

The following table sets out data and performance measures to allow the key characteristics of the T&D networks and their utilisation to be captured. Knowledge of the key cost drivers and physical characteristics allow comparisons of costs and performance to be made more effectively.

Parameter/Performance measure	Description
Energy requirements (T&D)	
Peak demand (MW)	Total and increase/decrease in peak demand, indicates capex requirements
Energy delivered (MWh)	Total and increase/decrease in energy delivered indicating network utilisation
Distribution network loading	Average duration of network feeders operating at higher than planned utilisation factors
Transmission network loading	Average duration of transmission network operating at higher than planned utilisation factors
Distribution connected generation (MW)	Total and increase/decrease in distribution connected generation; split by renewables, and other fuel sources
Transmission connected generation (MW)	Total and increase/decrease in transmission connected generation; split by renewables, and other fuel sources
Capacity of non-grid connected distributed energy	Total and increase/decrease in non-grid connected distributed energy
Ratio of grid connected distributed energy	Increase/decrease in non-grid energy
Network characteristics (T&D)	

Parameter/Performance measure	Description
Overhead line length	Total and increase/decrease in length of overhead line; split by voltage level
Cable length	Total and increase/decrease in length of cables; split by voltage level
Transformer capacity	Total and increase/decrease in numbers and capacity of transformers; split by voltage level
Switchgear	Total and increase/decrease in numbers of switchgear; split by voltage level
General information	
Geographic area	Area served by enterprise
Total population	Allows population density to be calculated
Number of customers	Allows customer density to be calculated

7.4 Implementation issues

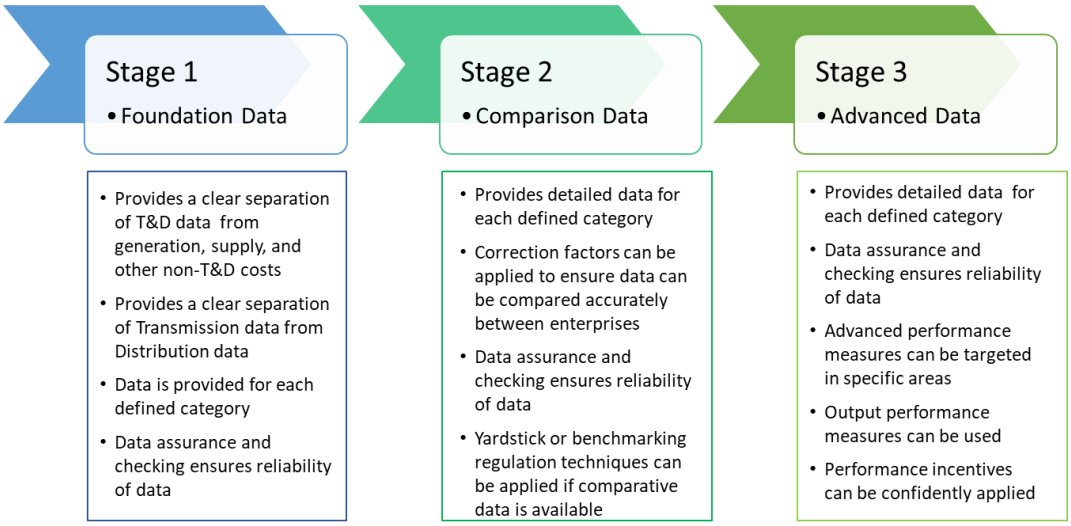
The above sections have suggested how the current proposals for a performance database might be improved. Several additional performance measures and data requirements have been identified. However, a clear plan will be required to implement these suggestions and establish a robust T&D database and monitoring system. There are two key implementation issues to be addressed, namely:

1. **Obtaining accurate data** - The need for accurate and consistent data to be obtained only for T&D networks. The difference between transmission and distribution will need to be clearly specified (it is suggested that, in accordance with international norms, transmission is classified as voltages above 132kV, and distribution as 132kV and below).
2. **Prioritise performance measures** - The need to prioritise the key performance measures needed for regulation to be implemented effectively, and to allow further development to more advanced regulatory regimes in the future.

Obtaining accurate data

It is suggested that an evolutionary approach be applied to the development of the T&D performance database. This is illustrated in the three stages of the diagram below. It will be a significant challenge to obtain accurate, comparative data. **It may be necessary to incentivise data accuracy by applying penalties for the submission of incomplete or misleading data.**

Diagram 15: Evolution of data quality

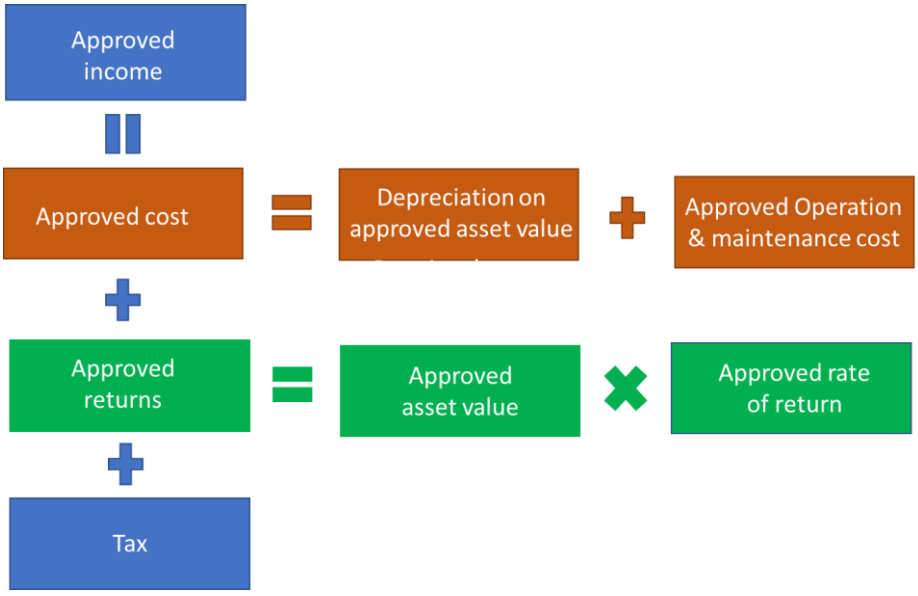


Prioritising performance measures

The following diagram sets out the key components of the price control formula. The data collected for the T&D monitoring database will play a key role in approving the income, returns, asset value and depreciation to ensure the T&D networks are efficient.

The key variables in the formula over each regulatory period will be the opex and capex values, which are under the control of each enterprise**. Opex and capex performance monitoring should be prioritised.**

Diagram 16: Price control calculation



Furthermore, the performance of T&D networks is judged on the reliability and availability of the systems as experienced by end consumers, but also the new generation and demand that relies on the system for export/import of power. **Network output performance monitoring should be prioritised.**

In conclusion, whereas there are a wide range of performance measures identified in this study, it is proposed that a small number of key primary measures are identified for high level monitoring and comparison, supported by a range of secondary indicators that can each provide further detail. It is proposed that the following list of primary indicators for each enterprise be considered for further definition and development.

T&D enterprise performance measures

- **Financial measures**
    - Capex under/over performance
    - Opex under/over performance
    - Revenue under/over performance
    - Rate of return under/over performance
    - Regulated asset value increase/decrease
- **Output measures**
    - Reliability
        - Transmission - Energy not supplied (MWh)
        - Distribution – average mins not supplied/customer
    - New generation connections, including increased import (MW)
    - New demand connections, including increased export (MW)
    - Customer service
    - Safety violations

Appendix 1 - Chinese performance indicators for transmission and distribution

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
Assets	1	Planned Investment Completion Rate	The completion rate of planned investment refers to the degree of matching between scheduled investment and planned investments, reflecting the implementation of the investment and identifying the occurrence of overinvestment and major planning changes。	Scheduled investment/Planned investment*100%		Annual
	2	Actual funding transfer rate	The actual funding transfer rate refers to the matching degree between the monetary value of fixed assets due to investment and the amount of planned investment, which reflects the extend that the investment increases and transfers into the value of fixed assets。	Increased fixed asset Monetary value /Planned investment*100%	75%	Annual
	3	Fixed assets investment amount per unit power transformer capacity - 500KV and above in	Fixed assets investment amount per unit power transformer capacity - 500KV and above in refers to the monetary value of invested fixed assets on transformer capacity over the voltage level of 500 (330) KV and above, reflecting the investment management level of transformer capacity over the voltage level of 500 (330) KV and above.	The original value of the fixed assets of transformer (500KV and above)/Transformer Capacity (500KV and above)		Annual
	4	Fixed assets investment amount per unit power transformer capacity - 220 kV	Fixed assets investment amount per unit power transformer capacity - 220 kV refers to the monetary value of invested fixed assets on transformer capacity over the voltage level of 220KV, reflecting the investment management level of transformer capacity over the voltage level of 220KV.	The original value of the fixed assets of transformer (220KV)/ Transformer Capacity (220KV)		Annual
	5	Fixed assets investment amount per unit power transformer capacity - 110 (66) KV	Fixed assets investment amount per unit power transformer capacity - 110 (66) KV refers to the monetary value of invested fixed assets on transformer capacity over the voltage level of 110 (66) KV, reflecting the investment management level of transformer capacity over the voltage level of 110 (66) KV.	The original value of the fixed assets of transformer (110（66）KV)/Power Transformer Capacity (110（66）KV)		Annual
	6	Fixed assets investment amount per unit power transformer capacity - 35KV	Fixed assets investment amount per unit power transformer capacity - 35KV refers to the monetary value of invested fixed assets on transformer capacity over the voltage level of 35KV, reflecting the investment management level of transformer capacity over the voltage level of 35KV.	The original value of the fixed assets of transformer (35KV)/ Transformer Capacity (35KV)		Annual
	7	Fixed assets investment amount per unit power transformer capacity - 10KV (20KV)	Fixed assets investment amount per unit power transformer capacity - 10KV (20KV) refers to the monetary value of invested fixed assets on transformer capacity over the voltage level of 10KV (20KV), reflecting the investment management level of transformer capacity over the voltage level of 10KV (20 KV).	The original value of the fixed assets of transformer (10KV (20KV)) / Transformer Capacity (10KV (20KV))		Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	8	Fixed assets investment amount per unit line length - 500KV and above	Fixed assets investment amount per unit line length - 500KV and above refers to the amount of fixed assets investment on the length of lines at the voltage level of 500 (330) KV and above, reflecting the investment management level of the length of lines over the voltage level of 550 (330) KV.	The original value of the fixed assets of lines (500(330) KV and above) / Line Length (500(330) KV and above)		Annual
	9	Fixed assets investment amount per unit line length - 220KV	Fixed assets investment amount per unit line length - 220KV refers to the amount of fixed assets investment on the length of lines at the voltage level of 220 KV, reflecting the investment management level of the length of lines over the voltage level of 220KV.	The original value of the fixed assets of lines (220KV) / Line Length (220KV)		Annual
	10	Fixed assets investment amount per unit line length - 110 (66) KV	Fixed assets investment amount per unit line length – 110 (66) KV refers to the amount of fixed assets investment on the length of lines at the voltage level of 110 (66) KV, reflecting the investment management level of the length of lines over the voltage level of 110 (66) KV.	The original value of the fixed assets of lines (110(66) KV) / Line Length (110(66) KV)		Annual
	11	Fixed assets investment amount per unit line length - 35KV	Fixed assets investment amount per unit line length - 35KV refers to the amount of fixed assets investment on the length of lines at the voltage level of 35 KV, reflecting the investment management level of the length of lines over the voltage level of 35KV.	The original value of the fixed assets of lines (35KV) / Line Length (35KV)		Annual
	12	Fixed assets investment amount per unit line length - 10KV (20KV)	Fixed assets investment amount per unit line length - 10KV (20KV) refers to the amount of fixed assets investment on the length of lines at the voltage level of 10KV (20KV), reflecting the investment management level of the length of lines over the voltage level of 10KV (20KV).	The original value of the fixed assets of lines (10KV (20KV)) / Line Length (10KV (20KV))		Annual
	13	The deviation rate between approved value and reported value of fixed assets original value	The deviation rate between the approved value and the reported value of fixed assets original value refers to the ratio deviation between the approved value and the reported value of the fixed assets original value, which reflects the verification of the original value of the fixed assets and cost supervision and examination.	Approved value of fixed assets original value /Reported value	1	3 年
	14	Deviation rate between actual value and approved value of fixed assets original value	Deviation rate between actual value and approved value of fixed assets original value refers to the ratio deviation between the actual value and the approved value of the fixed assets original value, which reflects the changing of the original value of fixed assets during the regulatory period and provides supervision basis for next period according to the comparison with initial approved value.	Actual value of fixed assets original value /Approved value	1	Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	15	Deviation rate between actual value and reported value of fixed assets original value	Deviation rate between actual value and reported value of fixed assets original value refers to the ratio deviation between the actual value assets and the reported value of the fixed assets original value, which reflects the change of the original value of the fixed assets and provides the basis for regulatory by analyzing the deviation from the reporting value of the base period.	Actual value of the fixed assets original value /Reported value	1	Annual
	16	Deviation rate between approved value and the reported value of fixed assets net value	The deviation rate between the approved value and the reported value of fixed assets net value refers to the ratio deviation between the approved value and the reported value of the fixed assets net value, which reflects the verification of the net value of the fixed assets and cost supervision and examination.	Approved value of fixed assets net value/Reported value	1	3 Yrs.
	17	Deviation rate between actual value and approved value of fixed assets net value	Deviation rate between actual value and approved value of fixed assets net value refers to the ratio deviation between the actual value and the approved value of the of the fixed assets net value, which reflects the changing of the net value of fixed assets during the regulatory period and provides supervision basis for next period according to the comparison with initial approved value.	Actual value of fixed assets net value/Approved value	1	Annual
	18	Deviation rate between actual value and reported value of fixed assets net value	Deviation rate between actual value and reported value of fixed assets net value refers to the ratio deviation between the actual value assets and the reported value of the fixed assets net value, which reflects the change of the net value of the fixed assets and provides the basis for regulatory by analyzing the deviation of the reported value from base period.	Actual value of fixed assets net value/Reported value	1	Annual
Cost	19	Deviation rate between approved value and the reported value of allowed expenditure	Deviation rate between approved value and the reported value of allowed expenditure refers to the ratio deviation between the approved data and the reported data of allowed expenditure, which reflects the cost supervision and verification of allowed expenditure.	Approved value of allowed expenditure cost/ Report value	1	3 Yrs.
	20	Deviation rate between approved value and the reported value of operation & maintenance expenditure	Deviation rate between approved value and the reported value of operation & maintenance expenditure refers to the ratio deviation between the approved data and the reported data of operation maintenance cost, which reflects the cost supervision and verification of operation & maintenance expenditure.	Approved value of operating maintenance cost/ Report value	1	3 Yrs.
	21	Deviation rate between approved value and the reported value of material cost	Deviation rate between approved value and the reported value of material cost refers to the ratio deviation between the approved data and the reported data of material cost, which reflects the cost supervision and verification of material cost.	Approved value of material cost/ Report value	1	3 Yrs.

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	22	Deviation rate between approved value and the reported value of repairing cost	Deviation rate between approved value and the reported value of repairing cost refers to the ratio deviation between the approved data and the reported data of repairing cost, which reflects the cost supervision and verification of repairing cost.	Approved value of repair cost/ Report value	1	3 Yrs.
	23	Deviation rate between approved value and the reported value of other cost	Deviation rate between approved value and the reported value of other cost refers to the ratio deviation between the approved data and the reported data of other cost, which reflects the cost supervision and verification of other cost.	Approved value of other cost /Report value	1	3Yrs
	24	Deviation rate between approved value and the reported value of depreciation	Deviation rate between approved value and the reported value of depreciation refers to the ratio deviation between the approved data and the reported data of depreciation, which reflects the cost supervision and verification of depreciation.	Approved value of depreciation expense /Report value	1	3Yrs
	25	Deviation rate between the actual value and the approved value of allowed expenditure	Deviation rate between actual value and approved value of allowed expenditure refers to the ratio deviation between the actual value and the approved value of allowed expenditure, which reflects the change of the allowed expenditure during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Allowable cost actual value/Approved value	1	Annual
	26	Deviation rate between actual value and approved value of operation maintenance expenditure	Deviation rate between actual value and approved value of operation maintenance expenditure refers to the ratio deviation between the actual value and the approved value of operation maintenance expenditure, which reflects the change of the operation maintenance expenditure during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Actual value of Operation maintenance fee/Approved value	1	Annual
	27	Deviation rate between actual value and approved value of material cost	Deviation rate between actual value and approved value of material cost refers to the ratio deviation between the actual value and the approved value of material cost, which reflects the change of the material cost during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Material cost actual value/Approved value	1	Annual
	28	Deviation rate between actual value and approved value of repairing cost	Deviation rate between actual value and approved value of repairing cost refers to the ratio deviation between the actual value and the approved value of repairing cost, which reflects the change of the repairing cost during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Actual value of repair cost/Approved value	1	Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	29	Deviation rate between actual value and approved value of other cost	Deviation rate between actual value and approved value of other cost refers to the ratio deviation between the actual value and the approved value of other cost, which reflects the change of the other cost during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Other cost actual value/Approved value	1	Annual
	30	Deviation rate between actual value and approved value of depreciation	Deviation rate between actual value and approved value of depreciation refers to the ratio deviation between the actual value and the approved value of depreciation, which reflects the change of the depreciation during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the approved value from base period.	Depreciation cost Actual value/Approved value	1	Annual
	31	Deviation rate between actual value and reported value of allowed expenditure	Deviation rate between actual value and reported value of allowed expenditure refers to the ratio deviation between the actual value and the reported value of allowed expenditure, which reflects the change of the allowed expenditure during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.	Actual value of allowed expenditure /Reported value	1	Annual
	32	Deviation rate between actual value and reported value of operation and maintenance expenditure	Deviation rate between actual value and reported value of operation and maintenance expenditure refers to the ratio deviation between the actual value and the reported value of operation and maintenance expenditure, which reflects the change of an operation and maintenance expenditure during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.	Actual value of operation maintenance expenditure/Reported value	1	Annual
	33	Deviation rate between actual value and reported value of material cost	Deviation rate between actual value and reported value of material cost refers to the ratio deviation between the actual value and the reported value of material cost, which reflects the change of the material cost during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.	Actual value of material cost /Reported value	1	Annual
	34	Deviation rate between actual value and reported value of repairing cost	Deviation rate between actual value and reported value of repairing cost refers to the ratio deviation between the actual value and the reported value of repairing cost, which reflects the change of a repairing cost during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.	Actual value of repair cost/Reported value	1	Annual
	35	Deviation rate between actual value and reported value of other cost	Deviation rate between actual value and reported value of other cost refers to the ratio deviation between the actual value and the reported value of other cost, which reflects the change of the other cost during the regulatory period	Actual value of other cost /Reported value	1	Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
			and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.			
	36	Deviation rate between actual value and reported value of depreciation	Deviation rate between actual value and reported value of depreciation refers to the ratio deviation between the actual value and the reported value of depreciation, which reflects the change of the depreciation during the regulatory period and provides the basis for next regulatory window by analyzing the deviation of the reported value from base period.	Actual value of depreciation /Reported value	1	Annual
	37	Annual composite depreciation rate of fixed assets	Composite depreciation rate of fixed assets refers to the ratio of total fixed assets depreciation over a period to the of all fixed assets original value, reflecting the depreciation level of fixed assets.	Depreciation on current year/ Fixed assets original value*100%		Annual
	38	Rate of newly increased material fees in regulatory period	Rate of newly increased material fees in regulatory period refers to the proportion of new added material fees to the new added fixed assets original value during the regulatory period, reflecting whether the new increased material fee exceeds the approved ratio during the regulatory period.	(Material fees for the current year-Material fee for last year)/New fixed asset original value*100%	1.00%	Annual
	39	Rate of newly increased repairing fees in regulatory period	Rate of newly increased repairing fees in regulatory period refers to the proportion of new added repairing fees to the new added fixed assets original value during the regulatory period, reflecting whether the new increased repairing fee exceeds the approved ratio during the regulatory period.	(Repairing fees for the year- Repairing fees for last year) / New fixed asset original value*100%	1.50%	Annual
	40	Rate of newly increased other fees in regulatory period	Rate of newly increased other fees in regulatory period refers to the proportion of new added other fees to the new added fixed assets original value during the regulatory period, reflecting whether the new increased other fee exceeds the approved ratio during the regulatory period.	(Other expenses for current year- Other expenses for last year) / New fixed asset original value*100%	2.50%	Annual
	41	Operation & maintenance cost per 10,000 Yuan value of fixed assets	Operation & maintenance cost per 10,000 Yuan value of fixed assets refers to the cost required by operating and maintaining the fixed assets with 10,000-yuan value, reflecting the level of operation maintenance rate of fixed assets.	Operation maintenance fee/ Fixed assets original value		Annual
Income	42	Rate of Return on Common Stockholders' Equity (ROE)	ROE is the percentage of net profit over average shareholder equity and represents the ratio of the company's after-tax profit divided by net assets, which reflects the income level of the owner's equity, and can be used to measure the efficiency of the company's use of capital.	Net profit/Net assets*100%		Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	43	Income ratio from users applied to network charges	Income ratio from users applied to network charges refers to the proportion of the total income of the grid company from implementing network charges to end used, which reflects the degree of electricity marketization.	Revenue from implementing network charges on users / Total revenue of power grid company from transmission, distribution and retail activities*100%		Annual
Electricity	44	Ratio of actual sales and forecast sales of electricity	Ratio of actual sales and forecast sales of electricity refers to the compared result between actual and forecast electricity sales data, reflecting the actual sales and forecast sales difference. When the difference is significant, the ratio provides a reference in adjusting electricity prices.	Actual electricity sales/Forecast electricity sale*100%		Annual
	45	Regional line loss Rate	The Regional line loss rate refers to the total line loss in a region, where the line loss is the energy loss during transmission and distribution processes. The index reflects the technology and management level of power supply.	（Electricity purchase - Electricity Sales） /Electricity purchase*100%		Annual
	46	Electricity sales per unit transformer capacity – 500(330) KV and above	Electricity sales per unit transformer capacity – 500(330) KV and above means the matching degree of electricity sales and transformer capacity at voltage level of 500(330) KV and above, reflecting the profitability of transformer capacity at voltage level of 500(330) KV and above.	Electricity sales (500KV and above)/Transformer capacity (500KV and above)		Annual
	47	Electricity sales per unit transformer capacity – 220KV	Electricity sales per unit transformer capacity – 220 KV means the matching degree of electricity sales and transformer capacity at voltage level of 220KV, reflecting the profitability of transformer capacity at voltage level of 220KV.	Electricity sales (220KV) / Transformer capacity (220KV)		Annual
	48	Electricity sales per unit transformer capacity – 110(66) KV	Electricity sales per unit transformer capacity – 110(66) KV means the matching degree of electricity sales and transformer capacity at voltage level of 110(66) KV, reflecting the profitability of transformer capacity at voltage level of 110(66) KV.	Electricity sales (110(66) KV) / Transformer capacity (110(66KV))		Annual
	49	Electricity sales per unit transformer capacity – 35KV	Electricity sales per unit transformer capacity – 35KV means the matching degree of electricity sales and transformer capacity at voltage level of 35KV, reflecting the profitability of transformer capacity at voltage level of 35KV.	Electricity sales (35KV)/ Transformer capacity (35KV)		Annual
	50	Electricity sales per unit transformer capacity – 10KV (20KV)	Electricity sales per unit transformer capacity – 10KV (20KV) means the matching degree of electricity sales and transformer capacity at voltage level of 10KV (20KV), reflecting the profitability of transformer capacity at voltage level of 10KV (20KV).	Electricity sales (10KV (20KV)) / Transformer capacity (10KV (20KV))		Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	51	Electricity sales per unit line length - 500(330) KV and above	Electricity sales per unit line length – 500(330) KV and above means the matching degree of electricity sales and line length at voltage level of 500(330) KV and above, reflecting the profitability of line length at voltage level of 500(330) KV and above.	Electricity sales (500(330) KV and above)/Line length (500(330) KV and above)		Annual
	52	Electricity sales per unit line -220KV	Electricity sales per unit line length – 220KV and above means the matching degree of electricity sales and line length at voltage level of 220KV and above, reflecting the profitability of line length at voltage level of 220KV and above.	Electricity sales (220KV)/Line length (220KV)		Annual
	53	Electricity sales per unit line -110(66) KV	Electricity sales per unit line length – 110(66) KV and above means the matching degree of electricity sales and line length at voltage level of 110(66) KV and above, reflecting the profitability of line length at voltage level of 110(66) KV and above.	Electricity sales (110(66) KV)/Line length (110(66) KV)		Annual
	54	Electricity sales per unit line -35KV	Electricity sales per unit line length – 35KV and above means the matching degree of electricity sales and line length at voltage level of 35KV and above, reflecting the profitability of line length at voltage level of 35KV and above.	Electricity sales (35KV)/Line length (35KV)		Annual
	55	Electricity sales per unit line - 10KV (20KV)	Electricity sales per unit line length – 10KV (20KV) and above means the matching degree of electricity sales and line length at voltage level of 10KV (20KV) and above, reflecting the profitability of line length at voltage level of 10KV (20KV) and above.	Electricity sales (10KV (20KV))/Line length (10KV (20KV))		Annual
Service	56	Ratio of guaranteed users	Ratio of guaranteed users is the ratio of users belong to domestic agricultural, vital public utilities and commonweal services over the total number of users. The proportion of the total number of users who are the most important and commonweal services, reflecting the basic social responsibility of grid companies.	Number of guaranteed users/Total number of users*100%		Annual
	57	Ratio of guaranteed users' power consumption	Ratio of guaranteed users' power consumption refers to the proportion of the electricity consumption from guaranteed users over the total electricity sales to entire society, reflecting the basic social responsibility of grid	Selling electricity to a guaranteed user/Total User Sales*100%		Annual
	58	Customer Satisfaction Degree	User satisfaction refers to the degree of match between user expectation and user experience, which is the index that the grid customer can get by comparing the perceived effect of power grid service with its expectation. The user satisfaction survey data of the third-party evaluation organization reflects the quality of customer service of the grid company.	Use of data from third party evaluation agencies		Annual

Parameter	Serial no.	Parameter name	Definition and use	Parameter Calculation formula	Contrast standard	Freq.
	59	Average user blackout time	The average user blackout time is the average number of hours of power outage during the statistical period. reflect the loss of user due to blackout	∑（Every blackout time × Number of users per outage)/ Total power supply User number		Annual
	60	Labor productivity	Labor productivity refers to the ratio of labor consumption that workers create in a certain period. reflect the enterprise production technology level, management level, technical proficiency of workers and the comprehensive performance of labor enthusiasm.	Gross labor output/ Average number of employees in current year		Annual
	61	Ratio of voltage passing rate to operation & maintenance cost per unit assets	The rate of voltage passing rate to operation & maintenance cost per unit assets is the degree of matching between the voltage qualification rate and the asset operation maintenance fee, which reflects the level of the assets operation and maintenance cost to ensure a certain voltage passing rate.	Voltage Pass Rate/Unit assets Operation Maintenance Fee		Annual
Special	62	Ratio of grid-connected distributed energy	Distributed energy refers to the integrated energy utilization system distributed on the user side. The ratio of grid-connected distributed energy is the proportion of connected distributed energy over the connected electricity in the whole region, reflecting the capability of the grid company to access distributed energy.	Grid-connected distributed electricity /Regional total connected electricity*100%		Annual
	63	Distributed power supply access Cost	Distributed power supply access Cost refers to the capital, operation and maintenance cost to connect distributed energy into the grid, reflecting the cost level of accessing the distributed power supply	Distributed power supply access capacity/Unit assets operation maintenance Fee		Annual

Appendix 2 - The UK RIIO regulatory regime and performance indicators

Ofgem's approach to regulation

In the UK, the energy regulator, Ofgem, is responsible for licencing and subsequent oversight of the performance of 3 regulated transmission companies and 14 regulated electricity distribution companies. It has evolved a regulatory regime over more than 25 years – one which has delivered reliable electricity supplies for customers, while at the same time delivering better customer service and lower costs.

Previous approach – Opex and Capex

Under the RPI-X approach, network companies would forecast their required capital (Capex) and operational expenditure (Opex). Ofgem would assess these forecasts and would usually apply a percentage cut to the Capex and the Opex of each company, separately.

Capex would increase a network's 'Regulatory Asset Value' (RAV), thereby increasing the value of a network, whereas Opex is upfront revenue that would provide a more immediate return (if efficiently spent). The perception in Ofgem (and other regulators) is that network companies always favour Capex because of the long term returns they can receive and that the RAV can make up a major part of a company's market value. A network company would therefore tend to favour capex solutions, even if they are not necessarily the most efficient solution – this is known as 'Capex bias'.

Totex approach

A significant innovation under the RIIO model is the total expenditure (Totex) approach to cost assessment. Under this approach Ofgem does not assess Opex or Capex separately, but instead sets an overall 'allowed revenue' within which a network must deliver all its outputs over the price control period. It is down to the company to decide how it balances Capex and Opex to deliver against these outputs.

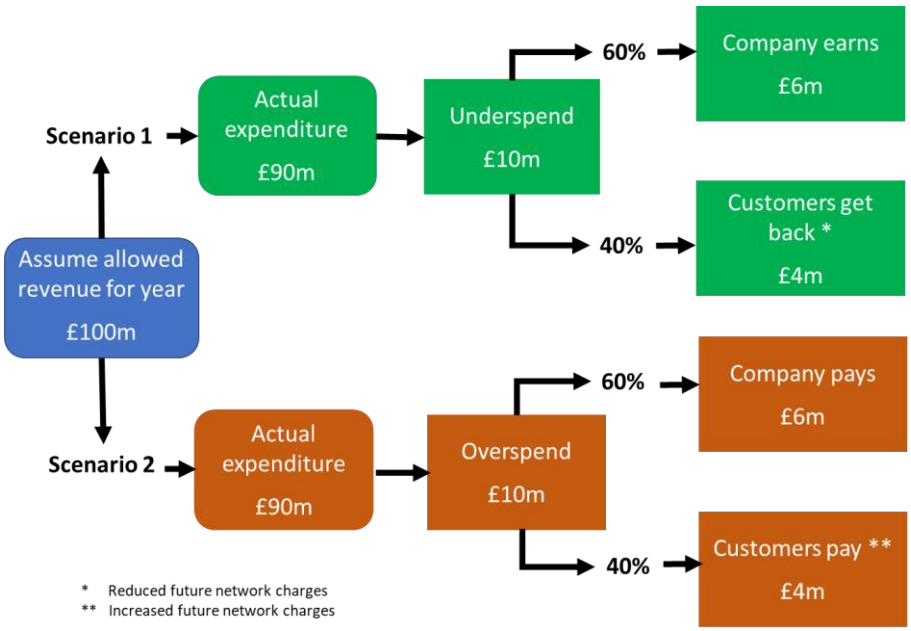
Rather than be determined by the level of Capex, the addition to RAV is a pre-set percentage, known as the Totex Capitalisation rate. The Totex capitalisation rate is pre-set. It does not change according to the percentage of their overall expenditure that comprises of Capex, meaning there is no advantage to be gained from capital investment over operational investment – thus removing any Capex bias.

Totex efficiency incentive

The RIIO model encourages network companies to manage their costs effectively by allowing them to keep a percentage of their under-spend on their base revenue, or be liable to cover the same percentage of any overspend. This percentage is called the Totex efficiency incentive rate, it is set at the beginning of each price control and can vary by Network Company. The rate is set symmetrically for the entire price control period, regardless of how much a network may have over or under spent.

As an example, if the efficiency incentive rate is set at 60 per cent, the companies will earn £60 profit (before tax) for each £100 that the company saves during the year and bear £60 of each additional £100 the company spends. The remainder will be passed on to consumers through lower or higher network charges. Diagram 1 illustrates how this may look overall.

Diagram 1: Example of how Totex efficiency incentive works (for a nominal 60% efficiency rate)



The efficiency incentives are about risk-sharing. Investors and consumers will share the benefits when the company delivers outputs for less money than Ofgem envisaged when setting the price control. Similarly, investors and consumers will share the additional costs if the company spends more money than envisaged.

Why a Totex approach?

The intention behind the Totex approach is to remove the bias towards capital solutions, encouraging companies to manage their expenditure in the most efficient and innovative way. For a company to manage and maximise benefit under the Totex incentive it needs to have an accurate understanding of both current and future capital and operational costs. It also needs a detailed knowledge of whole life cost and value of assets at all stages of planning, delivery, operation and maintenance. If it can manage these costs well, a network company can expect good returns from the Totex incentive. Conversely a network company can expect to earn lower returns if it does not manage its costs well.

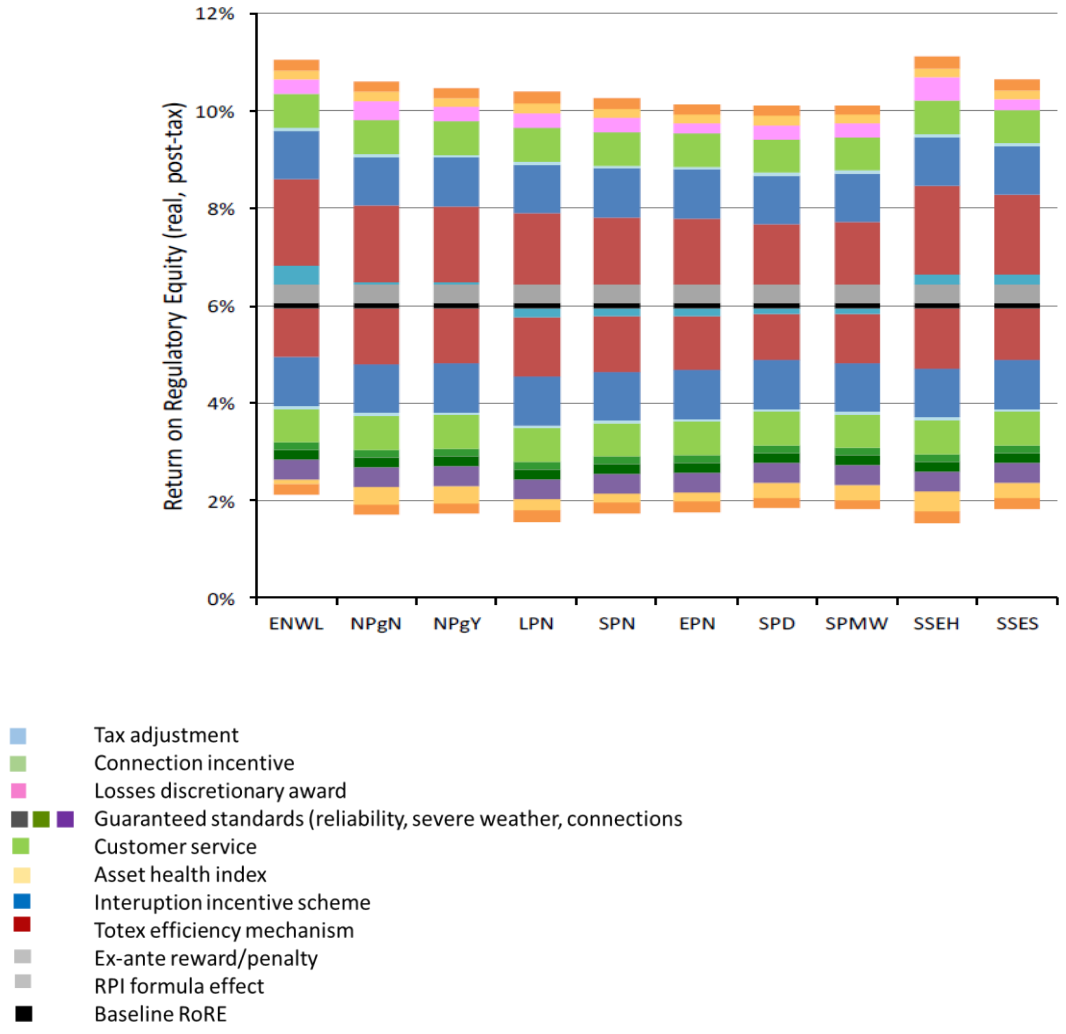
The Totex efficiency incentive is the overarching incentive for network companies to deliver the outputs that they set out in the price control in the most cost-effective manner. It encourages regulated companies to have effective management systems in place for Opex and capex forecasting, as well as operational budgeting, expenditure and financial control systems. Management and individual objectives will be aligned with these key incentives, which is a key motivational factor.

It is important to note, however, that management retains discretion on where and when, and how much Totex expenditure takes place over the price control period, so that investment of maintenance spend may be prioritised to a significant degree across the asset base, thereby allowing smoothing of expenditure, and outperformance against regulatory targets. Efficiencies may be sought from a variety of management initiatives e.g. more effective field staff management, multiskilling of staff, IT support systems, more effective procurement, including passing this incentive to the Totex supply chain.

Return on Regulatory Equity (RoRE)

Diagram 2 below shows the potential returns for each of the slow-tracked[9] electricity distribution companies over the course of the eight-year price control which commenced on 1st April 2015. This diagram for the network companies in other sectors would look broadly similar. As demonstrated in the diagram Ofgem generally expect that a good performing network company should be able to earn returns of 10% and a poor performing network 2% or even less.

Diagram 2 - Ofgem ranges for RoRE for electricity distribution companies price control



The diagram shows the range of other specific incentives that can also impact on a network company's revenue. These incentives can be symmetrical (reward or penalty depending on performance) or asymmetrical (either a reward or a penalty).

Timing of incentives

Ofgem applies any adjustments arising from performance against incentives through annual revenue adjustments during the price control period. Any revenue adjustment arising from most incentives (including the Totex efficiency incentive) will be made two years after the year that the incentive

[9] Five of the six distribution networks, WPD was fast-tracked so their settlement had already been made.

applied. The time delay allows the networks to report their actual expenditure data and enables revenue adjustments to be calculated in good time.

Reputational incentives

Financial rewards and/or penalties provide a strong direct incentive for companies to manage their costs and deliver more/improved outputs. Although a reputational-only 'incentive' is not as strong as a financial one, it can still have an effect. The desire to be viewed as the leading network (or to avoid the embarrassment of being the worst) does act as a performance driver particularly in distribution where there are six networks that are compared against each other.

Ofgem's assessment considers historic performance, meaning that building up a good reputation for efficient delivery with Ofgem (and wider stakeholders) over time can help when it comes to the price control.

RIIO output performance measures

Distribution network incentives

This section describes the key incentives that applies to distribution companies.

Information Quality Incentive (IQI)

Summary - An incentive on networks to present accurate information in business plans.

Financial value - Upfront additional revenue of 2.5% of Totex.

The Information Quality Incentive (IQI) was introduced as a regulatory tool to try to help solve the regulatory issue of asymmetric information. Prior to the IQI Ofgem was concerned that network companies had an incentive to inflate their forecasts to maximise their scope for outperformance. The IQI is designed to incentivise the network companies to provide accurate cost forecasts in their business plans and drive efficient expenditure. The main elements of the IQI are:

- Network companies receive an up-front financial reward or penalty depending on their forecast relative to Ofgem's assessment of efficient expenditure.
- Network companies that submit better forecasts (i.e. closer to Ofgem's view of efficient cost) receive a higher efficiency incentive rate.
- Allowed expenditure is based 75% on Ofgem's benchmark view and 25% on the Network Companies' forecasts.

The IQI takes Ofgem's baseline assumption of the cost elements included in the IQI and compares these to the forecasts provided by the Network company. Ofgem's assessed costs are weighted together with the Network companies' own submitted costs to define allowances, with a greater 75% weight on Ofgem's assessment. The final step is an adjustment for real price effects (RPEs) and (in some of the price controls) expected smart grid savings, which systematically disallow some expenditure from all slow track DNOs' business plan submissions.

Interruptions Incentive Scheme (IIS)

Summary

An incentive on the number and duration of network supply interruptions versus a target from benchmark industry performance.

Financial value -

Symmetrical incentive of +/- 2.5% of base revenue

The IIS is the main incentive for reliability. It provides rewards for outperformance and applies penalties for underperformance against set targets for two key metrics:

- The number of customer interruptions per 100 customers (CI- Customer interruptions); and
- The duration of these interruptions to supply per customer (CML- Customer minutes lost).

Ofgem sets annual targets for these two performance metrics for each of the networks. The IIS applies to two different categories, planned and unplanned interruptions, as outlined below:

Unplanned interruptions are ones where customers have been given little or no notice of an interruption. Ofgem set a baseline target for unplanned interruptions. Targets for unplanned interruptions are set up front and derived from industry benchmarks and have improvement factors applied so that they get tougher over time.

Planned interruptions - for any maintenance or improvement work where a network can let customers know in advance the expected time and duration of the outage. Targets for planned interruptions are based on the annual average level of planned interruptions and minutes lost over the previous three-year period.

There is a two-year lag on the years utilised in setting the targets, i.e. for the recent RIIO-ED1 price control the starting 2015-16 target is the average annual performance over the 2011-12 to 2013-14 period. The three-year average performance rolling target is updated on an annual basis. Networks are rewarded or penalised based on the difference between their actual performance and the target. The incentive rate for planned interruptions is half that of unplanned interruptions as the inconvenience to customers is perceived to be less.

Performance is measured through well-defined guidelines that have been refined since the introduction of IIS in 2002-3. Reporting is externally audited annually to ensure that the details of interruptions are being accurately recorded and reported. Network Companies can claim an adjustment for a one-off 'exceptional' event: this claim must also be externally audited[10]. The price control will set out a threshold for what is considered a severe weather event, i.e. if there are a certain number of faults, a company can claim it was an exceptional circumstance and the incentive is adjusted[11].

Broad Measure of Customer Service

The Broad Measure of Customer Service (BMCS) is the overall measurement of how networks engage with their customers. Overall the BMCS is worth 1.5% of base revenue. It consists of three elements:

- Customer Satisfaction Survey;

[10] See example here: https://www.ofgem.gov.uk/publications-and-updates/bpi-report-wpd-south-west-one-exceptional-event-claim-lockleaze-30-july-2010

[11] https://www.ofgem.gov.uk/ofgem-publications/89071/riio-ed1draftdeterminationdetailedfiguresbycompany.pdf See page 14

- Complaints Metric; and
- Stakeholder Engagement Incentive

Customer satisfaction survey

Summary	**Financial value**
A network's customers are surveyed, and rewards and penalties are given based on pre-set baseline scores.	Symmetrical incentive +/- 1% of annual base revenue.

Every year a sample of each network's customers are surveyed by an independent company. Customers are asked to score their network out of ten (with one for very dissatisfied and ten for very satisfied). A series of questions are asked but only the answer to one question 'overall, how satisfied were you with the service provided?' is used for this incentive. Network companies that score above the average industry level earn a financial reward and those that score below the average incur a financial penalty up to +/- 1% of base revenue.

In the UK this incentive is relative: whether a company gets a reward or penalty (and their value) is dependent on how a network company scores relative to its peers. Where there are only 1-2 companies this would not be possible: for the incentive to work, a target would need to be set by the regulator.

Surveying customers can be a problematic way of deciding on an award. The average customer does not necessarily understand the role of the network company (versus a supply or generation company) and, as a result, responses may be influenced by events entirely beyond the network's control (e.g. a news story about an energy supplier not related to the network companies may skew results). To address this, consumers that are responding to the survey are given a small amount of information about how the UK energy sector works.

Measure of Customer Service: Complaints Metric

Summary - A penalty for failing to adequately respond to and resolve customer complaints.	**Financial value -** Asymmetrical penalty only. A maximum of -0.5% of allowed revenue.

A penalty for poor performance when responding to customer complaints. The penalty is dependent on a customer complaints metric consisting of four elements as set out below:

The percentage of total complaints outstanding after one day.	**10%**
The percentage of total complaints outstanding after 31 days.	30%
The percentage of total complaints that are repeat complaints.	50%
The number of Energy Ombudsman (EO) decisions against the DNO as a percentage of the total complaints.	10%

This matrix is used to calculate an overall Complaints Metric score. Therefore, a high Complaints Metric score is considered poor performance. Networks that perform at or above target levels will not be exposed to any financial penalty. Those that fail to achieve target levels of performance will face a penalty up to a maximum of -0.5% of annual base revenues.

Broad measure of Customer Service: Stakeholder Engagement Incentive

Summary -An annual reward for the quality of a network companies stakeholder engagement

Financial value - Reward of up to 0.5% of annual base revenue.

The Stakeholder engagement incentive[12] is designed to encourage network companies to engage effectively with a wide range of stakeholders and use the outputs from this process to inform how they plan and run their business.

To achieve an award, network companies publish an annual stakeholder engagement plan setting out what they have done and what they intend to do over the next year. They also present their stakeholder strategy to an independent panel (usually chaired by Ofgem and made up of experts from Government, the charity sector and customer service industry). The panel will score each network based on the presentation and published plan. This score will determine the level of reward that a network company receives.

A key part of achieving an award under this incentive is to demonstrate how a network fulfils its social obligations by providing help to its vulnerable customers (including those in fuel poverty).

Asset health

Summary - Pre-set agreed minimum standards for each type of asset (cables, transformers etc.). Rewards for overachieving and penalties for under achieving these minimum standards.

Financial value - A reward/penalty of +/- 2.5% of the costs associated with the over/under delivery of the risk deliverable[13].

Asset health data is used by network companies to assist with their identification of capital programmes for the reduction of network risk. The asset Health Index (HI) has been used to track changes in asset health relative to the targets for the price control. The Health Index is a composite measure of age, asset condition and fault history among other things. Criticality measures the impact of asset failures.

Network companies are required to clearly explain their methodologies for assessing HI and criticality index ratings when they submit their business plans as part of the price control process.

[12] https://www.ofgem.gov.uk/ofgem-publications/88616/serewarddecision.pdf

[13] Note that this is different (and less than) a % of base revenue, see details for explanation

Companies must demonstrate how they manage risk using their allowed expenditure. Risk index forecasts are used to establish each network's agreed deliverable.

Ofgem will measure the difference in the networks' forecasts for the risk index that will result, depending on whether planned network investment has or has not taken place. This provides an asset risk score improvement which each network is required to deliver against. Companies are also required to forecast their expected total asset risk score midway through the price control period to allow Ofgem to monitor ongoing performance.

If a company achieves its risk deliverable there will not be any financial reward or penalty at the end of the period. If a company has not delivered the agreed total asset risk score improvement and does not have a reasonable justification for not delivering, the company will also be subject to a penalty of up to 2.5% of the avoided costs associated with the under delivery. Conversely, where a company has delivered more than the agreed total asset risk score improvement, and this improvement has been justified, the company will receive a reward of 2.5% of the incremental costs associated with over delivery. The mechanism will only come into effect if the under or over delivery is of a level considered material.

Time to connect incentive

Summary - Reward based on time taken from request to final connection for minor customers.

Financial value - Asymmetrical - Reward only
Maximum 0.4% of base revenue.

The Time to Connect incentive measures the time taken from initial application received to the issue of a quotation and the time taken from quotation acceptance to connection completion. The incentive aims to shorten the end-to-end process of connecting to the network.

The Time to Connect incentive targets are based on performance data captured in previous price controls. The target values will decrease across a period, so that quotes will be issued, and connections will be completed in increasingly shorter timescales for network companies to be eligible for a reward. The incentive is reward only, with a maximum reward of 0.4% of base revenue per annum, per distribution licensee.

Incentives on connection engagement (ICE)

Summary - Penalty for failing to meet pre-agreed standards on connecting major new connections.

Financial value - A penalty of up to 0.9% of base revenue, per annum.

The ICE is introduced to focus companies on understanding and meeting the needs of major connections customers. Networks are expected to set out their approach for meeting the requirements of these customers as part of the submission of their business plans.

The intention of this incentive is to replicate the type of activities that network companies are expected to undertake in market segments that are subject to effective competition. For example, a network company seeking to win work from competitors should take steps to understand the needs of its customers, make improvements to their service where required and assure itself that these changes have delivered benefits to customers.

Under the ICE, each network company will be required to submit evidence of how they have identified, engaged with and responded to the needs of their customers. These will be assessed against a set of minimum requirements. The minimum requirements are likely to require each network company to make a submission demonstrating how they have engaged with a broad range of customers, established relevant performance indicators and developed a forward-looking work plan of actions to improve performance (with associated delivery dates). DNOs are required to make their submissions on a periodic basis. Subsequent submissions should demonstrate performance against their relevant performance indicators and progress against their work plan of actions.

Separate submissions will be required for different market segments, each segment representing a different type of customer (e.g. metered demand, DG, and unmetered). The network company will incur a penalty if they fail to satisfy the minimum requirements for that market segment.

The ICE is a penalty only incentive. The maximum penalty under the incentive is 0.9% of base revenue, per annum, per licensee. However, the maximum penalty that is applied to a network will be proportionate to the market segments that have passed the Competition Test (i.e. if a network company has not passed the Test for any market segments, then they will be exposed to penalties of 0.9% of base revenue per annum. A network company that has passed all market segments will face no penalty).

Guaranteed standards of performance

Summary - Set levels of service covering range of outputs. Networks must make a pre-set penalty payment if standards are not met.

Financial value - Penalty only set penalty level for each breach overall exposure, can therefore vary. Estimated maximum penalty approximately 1% of base revenue.

Guaranteed standards of performance (usually referred to as 'guaranteed standards') are minimum levels of service that each network company must meet when a customer experiences an interruption or requires a connection. These standards are set out in statutory regulations, and after price control negotiations they are usually amended. Hence the guaranteed standards have recently been amended:

Electricity (Standard of Performance) regulations 2015 [14] These are the reliability standards including standards that must be met in case of severe weather. This includes a maximum number of hours before a customer's power should be restored in 'normal' circumstances (recently reduced to 12 hours[15]) and in severe weather conditions.

[14] http://www.legislation.gov.uk/uksi/2015/699/regulation/22/made

[15] https://www.ofgem.gov.uk/ofgem-publications/94358/notificationrevisedstandards2015-pdf

Electricity (Connection Standards of Performance) Regulations 2015[16] The connection standards which cover the whole connections activity from issuing a quote, completion of work and fixing faults.[17]

If a network fails to meet these standards its customers are entitled to receive a fixed payment. Customers must apply for a payment: it is not given automatically unless they are on a priority services register[18].

Losses through the network

Summary - A losses reduction mechanism consisting of four components: license obligation, loss reduction expenditure in the business plans, annual reporting and discretionary reward.

Financial value - A pot of up to £32 million across all distribution networks for the whole eight-year period.

System losses are the largest component of a company's carbon footprint. Due to the way the energy market is structured the UK electricity networks do not bear any of the costs of the electricity lost on their networks and therefore have no inherent incentive to manage losses efficiently.

As part of the price control setting process networks are required to set out a strategy for reducing losses on their networks. This strategy statement should demonstrate their overall approach, as well as set out specific projects or actions. This forms part of Ofgem's decision on allowed revenue. During the price control companies must produce an annual report on their losses reduction activities undertaken in the year, setting out improvements achieved in the year and cumulatively, and actions planned for the following year.

Network companies also have a general obligation as part of the terms of their license to develop and maintain an efficient, coordinated and economical network, minimising investment and system losses.

Losses discretionary reward - A losses discretionary reward of up to £32 million, awarded in three tranches over the eight years of the price control across all distribution networks, was recently introduced. The intention is to encourage networks to undertake new and innovative ways of reducing losses over and above those set out in their business plans. The discretionary reward is new, and the details are still being consulted on by Ofgem[19]. The categories against which the DNOs' performance may be measured include:

- Companies' understanding of their losses.
- An expert judgement on the effectiveness of actions taken to reduce losses, including any actions which have achieved losses reductions which are substantially greater than that forecast.

[16] http://www.legislation.gov.uk/uksi/2015/698/made

[17] See here https://www.ofgem.gov.uk/ofgem-publications/47068/riioed1decoutputsincentives.pdf page 130 for a full list of Connection minimum standards and the fixed penalty for a breach

[18] Each network maintains a register of its most vulnerable customers, elderly, disabled etc. They receive priority treatment and the network is obliged to periodically check up on them.

[19] https://www.ofgem.gov.uk/publications-and-updates/consultation-draft-riio-ed1-losses-discretionary-reward-guidance-document

- The demonstrable engagement by networks on losses with their stakeholders (e.g. connection customers, supply chain partners) on losses.
- Innovative approaches to losses reduction (outside of any projects funded through the innovation stimulus mechanisms).
- Performance against the strategy set out to address losses.
- Sharing of best practice with other companies.

Previous price controls

In previous price control periods Ofgem introduced a full losses incentive mechanism[20] which attempted to measure actual losses by comparing the units entering and units exiting a distribution network using settlement data (administered by an independent settlement body).

However, over the course of several years there were a number of problems with the settlement data which significantly skewed results by many millions of pounds. These issues led to years of legal battles between, suppliers, networks and Ofgem.

Due to these issues with the settlement data Ofgem removed the losses incentive for the RIIO-ED1 period. Ofgem's view is that once the smart metering programme is completed, measuring network losses should be far easier and therefore a full losses incentive mechanism can be reintroduced in the next price control period.

Undergrounding assets

Summary - Allowance for undergrounding of overhead lines in areas of outstanding natural beauty.

Financial value - Allowance ranging from £5 million to £11 million.

This is an allowance for undergrounding of overhead lines in Areas of Outstanding Natural Beauty and National Parks, with activities prioritised by local groups.

Ofgem set the funding pot at £103.6 million. This works out at between £5m – £11m per network. This has been calculated in line with the previous price control period and is based on the length of overhead lines to be undergrounded and the number of customers in the network's region.

Compliance with health and safety regulations

Summary - Networks are required to comply with health and safety regulations monitored by a separate regulator, the Health and Safety Executive (HSE).

Financial value - No specific financial incentive but a network risks fines if it fails to comply with regulations as well as significant reputational damage.

[20] https://www.ofgem.gov.uk/electricity/distribution-networks/losses-incentive-mechanism

The primary output for health and safety is compliance with the safety requirements set out in legislation and enforced and regulated by the Health and Safety Executive (HSE).

In addition, secondary deliverables on asset health, criticality and composite risk also include elements of safety performance. These indices provide a framework for managing network risks including some safety implications and provide a useful means of monitoring the network companies' compliance with safety requirements.

Networks must comply with all health and safety legislation. The HSE enforces regulations that are contained within this and has powers to secure compliance with the law.

Business carbon footprint including SF6

Summary - A measure of a network's carbon emissions including SF6 through all its operational activities both field and business activities.

Financial value - Reputational only – each network's figures published and ranked in a league table.

The Business Carbon Footprint (BCF) Scheme seeks to encourage all networks to reduce their carbon emissions by publishing an annual league table of the percentage change they have made to their carbon emissions.

The league table includes details of proactive actions taken by the network companies to reduce their carbon emissions. Ofgem use the international Green House Gas Protocols[21] as a framework to report against the BCF. The BCF table uses the units tCO2e (tonnes of carbon dioxide equivalent) which allows comparison of emissions of all greenhouse gases relative to one unit of CO2. It is calculated by multiplying the greenhouse gas's emissions by its 100-year global warming potential. All measurements that the network company takes must be converted into tCO2e for recording in the table.

The electricity distribution networks must report their BCF against the following categories:

- Buildings energy usage.
- Transport emissions.
- Fugitive emissions (mainly SF6 but could also include other emissions).
- Fuel combustion (non-building or transport).
- Losses.

Losses are included as part of the BCF measure

[21] http://www.ghgprotocol.org/

Theft investigation

Summary -Encourage suppliers and electricity distribution companies to investigate and pursue any case of theft of electricity on the network.

Financial value -Potential savings from theft, which has been estimated to cost £400 million per year in the UK.

Theft of electricity increases prices for customers and reduces safety. It leads to misallocation of costs among suppliers, which can distort competition and hamper the efficient functioning of the market. It also has links to organised crime, in particular cannabis cultivation.

Therefore, Ofgem introduced a new electricity supply licence conditions to strengthen the obligations on suppliers to investigate, detect and prevent electricity theft. The effect of the modification is to ensure that suppliers make reasonable efforts to tackle theft and protect consumers' interests in undertaking this activity. Suppliers are required to put in place a central service to analyse data and provide information to suppliers (and network companies) to help them meet their obligations to detect theft.

Networks do not currently have a specific incentive to tackle electricity theft, but they should maintain a level of support for suppliers in identifying and resolving unregistered premises and recovering appropriate costs. Some networks provide revenue protection services which are used by suppliers to help detect theft and are often helpful in identifying theft proactively.

Networks are required to tackle theft where a supplier is "not responsible". Networks are be able to recover their reasonable costs associated with this activity, but currently have no additional incentive and therefore tend not to fully investigate and seek prosecution.

Worst served customers

Summary - Additional funding to improve the reliability performance experienced by a subset of customers experiencing a specific level of interruptions.

Financial value - £76.5 million over RIIO-ED1 price control period across all distribution networks on a 'use it or lose it' basis.

The worst served customer mechanism is designed to reduce the number of interruptions experienced by those customers who have in the past experienced an unusually poor level of service from their network company. This mechanism is designed to add to the interruption Incentive scheme (IIS), by providing additional incentives for those customers that are still receiving a poor service.

Worst service is defined as a customer experiencing on average at least four higher voltage interruptions per year over a three-year period; i.e. 12 or more over three years and a minimum of three higher voltage interruptions in each year.

Worst served customers is an output mechanism rather than an incentive. For the recently commenced price control (RIIO-ED1), Ofgem set a total value across all DNOs of £76.5 million. This

funding is provided on a 'use it or lose it' basis. The distribution of this pot is based on the number of worst-served customers (as defined by Ofgem) within each network's area.

Networks must demonstrate that this funding is used for improving the service to the defined worst served customers. If they don't use the funding for this purpose during the price control period, they lose it. In previous price controls there was a cap on how much a network could spend per worst served customer (of circa £1,000). For RIIO-ED1 price control this cap was removed. Some worst served customers would require more extensive and costly improvements and a cap meant that a network could not fully solve their issue. Ofgem agreed that overall customers' needs were served by removing the cap.

Transmission Incentives

This section outlines some additional incentives on the transmission networks

Energy not supplied (ENS)

Summary - Reward for a network delivering a lower level of ENS than the set target with a licence condition for minimum standard of performance.

Financial value - +/- £16,000 for every MWh over or under a set target (before tax and efficiency incentive rate) (maximum penalty of 3% of base revenue)

The company is held to account for delivering an output on the level of energy not supplied (ENS) each year at target level of 316MWh per annum. The incentive rate is £16,000 per MWh which is Ofgem's estimate on the value of customers place on electricity when they are without supply. The company will gain reward for delivering a lower level of ENS and incur a penalty for each MWh worse than the 316MWh target. The incentive has a natural cap, as the company cannot reduce ENS below zero. A 3% of revenue collar on financial penalties is applied to limit the downside risk and a licence condition for minimum standard of performance.

Adjusting the incentive strength by the efficiency incentive rate

VOLL is defined is the theoretical price that consumers would be willing to pay to maintain supply.

In applying the ENS scheme the VOLL will be adjusted in £/MWh by the efficiency incentive rate. For example, if the efficiency incentive rate (aka sharing factor) is set at 50%, and the VOLL is set at an indicative level of £16,000/MWh the transmission owners would face a reward/penalty of +/- £8,000/MWh.

Applying a collar on the maximum penalty faced by the businesses

The collar is set at a level that provides protection for low probability, high impact events. The decision to set the level of the collar of 3% is based on:

- The context in which the current cap was set and how it is impacted by Ofgem's change to the incentive rate (in £/MWh).
- The resulting range of ENS over which the businesses will be incentivised, and the likelihood of the businesses reaching the cap based on historical performance. Based on an incentive rate of £16,000/MWh adjusted by a 50% efficiency incentive rate, a 3% collar would only

have been triggered once in the last 20 years for one of the transmission companies SHETL22 and not at all for NGET23 and SPTL24.

In circumstances where a transmission network's performance triggers the collar, it would be required to demonstrate that it had taken all reasonable preventative and mitigating actions both before and after loss of supply events to minimise unsupplied energy. In cases where Ofgem consider that the network has not done this, it would have the option to commence licence investigation procedures.

Exclusions

There are several exclusions in relation to customer choice connections and events lasting less than or equal to three minutes. Other cases, such as extreme weather events, should be considered individually before deciding whether to exclude any ENS from this incentive.

Network Output Measures (NOMs)

Summary - Set financial reward for justified over and under delivery and a financial penalty for unjustified over and under delivery.

Financial value - 2.5% of the value of the additional or avoided costs.

The NOMs are secondary deliverables that provide Ofgem with a measure to monitor and assess transmission owners' asset renewal performance over the longer-term. The agreed NOMs are targets and transmission network owners are obliged to deliver these targets for consumers.

The introduction of financial incentives on transmission owners' actual NOMs against their target was introduced to encourage them to make the most appropriate asset management decisions. This is a symmetrical incentive rewarding justified over delivery and penalising unjustified under delivery.

Transmission owners are expected to make asset management decisions which are based on the latest information, and in the best interest of their consumers. Transmission owners can trade-off between asset categories to deliver an equivalent or better outcome to the NOMs target. Ofgem does not limit these trade-offs, it is left to transmission owners to justify if they need to over-deliver in one asset category and under-deliver in another, and how the overall delivery equates to an equivalent or better level of the network risk.

A fixed level of rewards and penalties is set out to provide strong incentives for TOs to deliver the NOMs target while protecting them from financial stress relating to the non-delivery. The value of any penalty or reward will be 2.5% of the value of the additional or avoided costs.

[22] Scottish Hydro – North of Scotland (owned by SSE plc)

[23] National Grid Electricity Transmission – England and Wales

[24] Scottish Power Transmission – South of Scotland

Environmental discretionary reward

Summary - A reputational incentive on promoting low carbon energy flows and a financial reward to help achieve a greater contribution to environmental objectives.

Financial value - Maximum annual financial reward of £4 million plus any applicable rolled over amounts.

The Environmental Discretionary Reward (EDR) offers networks a maximum annual financial reward of £4 million plus any applicable rolled over amounts from previous years across all applicants.

The first stage of the assessment process will involve an initial assessment of each application to be undertaken by Ofgem with an expert panel to act in an advisory capacity in the decision-making process.

The overall percentage score is based on evidence provided by the applicant under the following categories:

- Strategic understanding and commitment to low carbon objectives.
- Whole electricity system planning.
- Connections for low-carbon generators.
- Collaboration on innovation.
- Network development solutions that avoid the need to reinforce the network.
- Direct environmental impact.
- Business greenhouse gas emissions.

A company will only be eligible for a financial reward if it achieves a leadership score and produces a satisfactory executive-level annual statement.

Network Innovation

Network Innovation Competition

Summary - Annual competition where network companies submit bids to access a set pot of funding for large scale innovation projects

Financial value - Total of up to £90m per annum across all electricity networks (distribution and Transmission)

The Network Innovation Competition (NIC) is an annual competition for funding larger-scale innovative projects, particularly focused on (but not necessarily limited to) projects that deliver low carbon and environmental benefits.

Ofgem set aside a pot of money each year (paid for by all customers) and run an annual competition where network companies can submit bids to receive funding for an innovative project. The companies are expected to provide some funding of their own (at least 10%) and are encouraged to work with partner organisations who provide some funding and/or expertise. Partner organisations can include academic institutions, local government, third sector and other non-network companies.

An Ofgem convened independent expert panel judges the submitted bids and decides which projects get funding. A set amount of funding can be awarded each year, but it does not have to all be used, and the panel will only except bids that are truly innovative (i.e. not merely replicating business as usual) which it thinks could deliver long-term benefits to customers of electricity networks.

A key aspect of the NIC is that companies are required to share their learning with other networks and more widely. This is not just about publishing information on a website but running workshops and seminars to disseminate information on the project.

The NIC launched in 2013-14 at the start of the Transmission price control (RIIO-T1). Electricity distribution companies could also submit bids from April 2015 when the distribution price control (RIIO-ED1) started. Previously there was a similar competition for Electricity distribution networks, the Low Carbon Networks fund (LCNF). There is an equivalent NIC for Gas networks. A wide range of projects have been awarded funding under the NIC[25] and the LCNF[26] before it.

Network Innovation Allowance

Summary - Funding within each network company's revenue allowance on a use-it-or lose it basis for small-scale innovation projects

Financial value - Between 0.5 -1% of base revenue which networks on a 'use it or lose it' basis

The network innovation allowance is a set allowance that Network companies receive as part of their price control revenues. When submitting their business plans as part of the price control process network companies submit an innovation strategy. Based on its perception of the strength of this strategy, Ofgem decides how much, between 0.5 and 1% of annual base revenue, that a company receives as an innovation allowance for the price control period.

Networks use the allowance to fund smaller projects than the NIC, it can also be used to help with the costs of preparing submissions for the NIC (as this can be a costly process). Like with the NIC, networks are required to share any learning from these projects.

Smart grids

Summary -Policy driven by Government and the regulator to develop a more integrated and flexible, i.e. 'smarter' network.

Financial value - No set financial value.

[25] https://www.ofgem.gov.uk/network-regulation-riio-model/network-innovation/electricity-network-innovation-competition

[26] https://www.ofgem.gov.uk/electricity/distribution-networks/network-innovation/low-carbon-networks-fund

At the latest electricity distribution price control (RIIO-ED1) network companies had to produce a strategy demonstrating how they would use smart grid solutions as part of their core business activities. Ofgem made it clear that Networks that failed to consider fully the use of such solutions in their core business risked falling behind its assessment of efficient cost. In their business plan submissions for the RIIO-ED1 process networks were expected to:

- Demonstrate consideration of alternative solutions in cost benefit analysis to justify expenditure;
- Clearly articulate a strategy for the deployment of smart grid solutions;
- Demonstrate flexibility of investment plans to different low carbon scenarios within the price control period;
- Outline a strategy for how they will use the RIIO-ED1 price control period to prepare for future challenges in future price control periods - RIIO-ED2 and ED3.
- Set out a clear strategy for the intelligent use of data alongside analysis demonstrating the cost of this data and supporting systems is outweighed by the benefits to customers; and
- Set out in their innovation strategy how they will build on current learning and smart grid deployment to test new techniques.

Appendix 3 - Extract from Standard conditions of the UK Electricity Distribution Licence

CHAPTER 12 - Standard conditions 44 to 49: Provision of regulatory information (Version dated 01 January 2017)

Condition 44. Regulatory Accounts

Introduction

44.1 This condition applies to Regulatory Accounts prepared for Regulatory Years beginning on and after 1 April 2015 and requires the licensee to:

(a) prepare and publish Regulatory Accounts within the meaning set out in Part A of this condition; and

(b) maintain (and ensure that any Affiliate or Related Undertaking of the licensee maintains) such accounting records, other records, and reporting arrangements as are necessary to enable the licensee to comply with that obligation.

Part A: Preparation of Regulatory Accounts

44.2 For the purposes of this condition, but without prejudice to paragraph 44.9, the licensee must prepare Regulatory Accounts for each Regulatory Year.

44.3 Except and so far as the Authority otherwise consents, the licensee must comply with the obligations imposed by Part A of this condition.

44.4 The licensee must keep or cause to be kept, for a period approved by the Authority that is not less than the period referred to in section 388(4)(b) of the Companies Act 2006, and in the manner referred to in that section 388, such accounting and other records as are necessary to ensure that all of the revenues, costs, assets, liabilities, reserves, and provisions of, or reasonably attributable to, each of the Distribution Business Activities of the licensee are separately identifiable as such in those records (and in those of any Affiliate or Related Undertaking of the licensee).

44.5 The Regulatory Accounts must be prepared on a consistent basis derived from the accounting and other records referred to in paragraph 44.4

44.6 The Regulatory Accounts must be prepared under the same Applicable Accounting Framework as the most recent or concurrent statutory accounts of the licensee and must comprise the accounting items set out at paragraph 44.7, supported by the explanatory notes mentioned at paragraph 44.8.

44.7 The accounting items to which paragraph 44.6 refers are:

(a) a profit and loss account (or, as appropriate, a statement of profit or loss and other comprehensive income);

(b) a statement of total recognised gains and losses (or, as appropriate, a statement of changes in equity and, if appropriate, a statement of recognised income and expense);

(c) a balance sheet (or, as appropriate, a statement of financial position);

(d) a cash flow statement (or, as appropriate, a statement of cash flows);

(e) a Corporate Governance Statement;

(f) a Strategic Report; and

(g) a Directors' Report.

44.8 The explanatory notes to which paragraph 44.6 refers must:

(a) provide a summary of the accounting policies adopted by the licensee for the purpose of producing Regulatory Accounts;

(b) disclose, in relation to the accounts to which paragraph 44.7(a) refers, Segmental Information for each of the Distribution Business Activities of the licensee for each of the disclosure lines in the relevant account or statement down to the total operating profit level; and

(c) disclose, in relation to the accounts to which paragraph 44.7(c) refers, Segmental Information for each of the Distribution Business Activities of the licensee for gross additions to tangible and intangible assets in the case of a balance sheet, or for gross additions to non-current assets by category in the case of a statement of financial position.

Part B: Consistency with the statutory accounts

44.9 Regulatory Accounts prepared in respect of a Regulatory Year under Part A of this condition must, so far as is reasonably practicable and except with the Authority's approval, having regard to the purposes of this condition:

(a) have the same content and format as the most recent or concurrent statutory accounts of the licensee prepared under Chapter 4 of Part 15 of the Companies Act 2006 and follow the reporting requirements of the Applicable Accounting Framework, subject to the inclusion of Segmental

Information as prescribed in paragraphs 44.8(b) and (c);

(b) comply with all relevant accounting and reporting standards currently in force under the Applicable Accounting Framework as set out in section 395 of the Companies Act 2006; and

(c) also be prepared as group accounts in the format required under the Applicable Accounting Framework if the holder of this licence is a parent undertaking as defined in Section 1162 of the Companies Act 2006 and itself prepares group accounts under the Applicable Accounting Framework.

Part C: Audit and delivery of Regulatory Accounts

44.10 Unless the Authority otherwise consents, the licensee must:

(a) procure an audit by an Appropriate Auditor of such parts of its Regulatory Accounts and the Directors' Report as would be required by the Companies Act 2006 if the licensee were a Quoted Company and they were the licensee's statutory accounts drawn up to 31 March and prepared

under Part 15 of the Companies Act 2006;

(b) procure a report by the Appropriate Auditor, addressed to the Authority, that states whether in his opinion those accounts fairly present the licensee's financial position, financial performance, and cash flows in accordance with the requirements of this condition; and

(c) deliver those accounts and the Appropriate Auditor's report required under paragraph 44.10(b) to the Authority as soon as is reasonably practicable and in any event before the date of their publication under F of this condition.

Part D: Terms of appointment of Appropriate Auditor

44.11 For the purposes of paragraph 44.10, the licensee must, at its own expense, enter into a contract of appointment with an Appropriate Auditor that includes a term requiring that the audit of the licensee's Regulatory Accounts must be conducted by that Appropriate Auditor in accordance with all such relevant auditing standards in force on the last day of the Regulatory Year to which the audit relates as would be appropriate for accounts prepared in accordance with the provisions

of Part 15 of the Companies Act 2006.

Part E: Agreed Upon Procedures: prohibition of cross-subsidy and discrimination

44.12 The licensee must at its own expense enter into a contract of appointment with an Appropriate Auditor for the completion of Agreed Upon Procedures in relation to the prohibition of cross-subsidy and discrimination generally and in particular under paragraph 9 of standard condition

4 (No abuse of the licensee's special position) and under standard conditions 19 (Prohibition of discrimination under Chapters 4 and 5) and 39 (Prohibition of discrimination under Chapter 9).

44.13 The contract must require that the Agreed Upon Procedures are conducted in relation to each Regulatory Year and that the licensee will arrange for the Appropriate Auditor to address a report to the Authority by 31 July following the end of each Regulatory Year that:

(a) states that he has, in a manner consistent with the relevant auditing standards, completed the Agreed Upon Procedures issued by the Authority in respect of the Regulatory Year under report; and

(b) sets out his findings.

44.14 If the Authority is satisfied that the report referred to in paragraph 44.13 demonstrates that the licensee has complied with the obligation to avoid discrimination and cross-subsidies that is specified in Article 31 of Directive 2009/72/EC of the European Parliament and of the European Council of 13 July 2009 and is imposed on the licensee by the standard conditions of this licence referred to in paragraph 44.12, the report will be deemed to represent the results of an audit of that obligation, as required by the Article.

Part F: Publication and provision of Regulatory Accounts

44.15 Unless the Authority after consulting with the licensee directs otherwise, the licensee must publish its Regulatory Accounts:

(a) as a stand-alone document in accordance with this condition;

(b) by 31 July after the end of the Regulatory Year to which the accounts relate;

(c) on, and in a way that is readily accessible from, its Website or a Website of an Affiliate or Ultimate Controller of the licensee provided that the link is both clear and readily accessible; and

(d) in any other manner that, in the opinion of the licensee, is necessary to secure adequate publicity for the accounts.

44.16 The licensee must provide a copy of the Regulatory Accounts free of charge to any person who requests a copy.

Part G: Definitions

44.17 For the purposes of this condition:

i. **Applicable Accounting Framework** means either:

(a) in respect of any reference to statutory accounts of the licensee (except for group accounts):

(i) individual accounts prepared in accordance with section 396 of the Companies Act 2006; or

(ii) individual accounts prepared in accordance with international accounting standards, or

(b) in respect of any reference to statutory accounts of the licensee that are group accounts:

(i) group accounts prepared in accordance with section 404 of the Companies Act 2006; or

(ii) group accounts prepared in accordance with international accounting standards.

ii. **Demand Customer** means, in relation to any energised or de-energised Exit Point on the licensee's Distribution System, the person who is taking, or is deemed to be taking, a supply of electricity through that Exit Point.

iii. **Distribution Business Activities** means the following activities of the licensee:

(a) the distribution of electricity through the licensee's Distribution System to Demand Customers;

(b) the distribution of electricity through the licensee's Distribution System in respect of Distributed Generation, together with such of the activities covered by sub-paragraphs (c) and (d) of this definition as are directly associated with that activity;

(c) the provision of Directly Remunerated Services (other than any such services falling within the next sub-paragraph;

(d) the provision of Metering Equipment and Metering Services (including the service of providing Legacy Metering Equipment but excluding any such provision falling within subparagraph (b) of this definition), together with the provision of Data Services;

(e) any De Minimis Business of the licensee;

(f) any other activities to which the Authority has consented in accordance with paragraph 29.4(c) of standard condition 29; and

(g) any Distribution Business of the licensee in respect of which the activities take place outside the licensee's Distribution Services Area.

iv. **Quoted Company** has the meaning given to that term in section 385 of the Companies Act 2006.

v. **Segmental Information** means such financial and descriptive information in respect of the Distribution Business Activities of the licensee as would be disclosable under International Financial Reporting Standard 8 (or Statement of Standard Accounting Practice 25) if each of those activities were an operating segment (or reportable segment) of the licensee within the meaning of those respective standards.

vi. **UK Listing Authority** means the Financial Conduct Authority (FCA) acting in its capacity as the competent authority for the purposes of Part VI (Official Listing) of the Financial Services and Markets Act 2000.

Part H: Interpretation

44.18 The requirement under paragraph 44.7 for the licensee to include a Strategic Report, a Corporate Governance Statement, and a Directors' Report in its Regulatory Accounts must be read as if the requirement applied to the licensee as a Quoted Company, whether or not it is such a company, such that:

(a) the Corporate Governance Statement, has the coverage and content of the corporate governance statement that a Quoted Company is required to prepare under the UK Corporate Governance Code issued under the UK Listing Authority's listing rules and interpretations on corporate governance;

(b) the Strategic Report has the coverage and content of the Strategic Report that a Quoted Company is required to prepare under sections 414A, 414C and 414D of the Companies Act 2006; and

(c) the Directors' Report, has the coverage and content of the directors' report that a Quoted Company is required to prepare under sections 415, 416, 418(2), and 419(3) and (4) of the Companies Act 2006.

44.19 Regulatory Accounts prepared by the licensee in respect of the Regulatory Year beginning on 1 April 2014 are subject to the provisions of this condition in the form in which it was in force at 31 March 2015.

Condition 45. Data Assurance requirements

Introduction

45.1 This condition requires the licensee to undertake processes and Data Assurance Activities for the purpose of reducing the risk, and subsequent impact and consequences, of any inaccurate or incomplete reporting, or any misreporting, of information to the Authority.

Part A: Licensee's obligations under this condition

45.2 The licensee must:

(a) comply with the provisions of the Data Assurance Guidance (the "DAG"), a document that will be incorporated into this licence by way of a direction as set out in Part C of this condition;

(b) carry out a Risk Assessment in accordance with such provisions and timescales as are specified for that purpose in the DAG, and ensure that it has used its best endeavours, in accordance with the DAG, to manage such risks as it has identified in that assessment;

(c) if directed by the Authority, procure an independent review of its Data Assurance Activities in accordance with such provisions and timescales as are specified for that purpose in the DAG; and

(d) provide to the Authority, in accordance with such provisions and timescales as are specified for that purpose in the DAG, reports that variously contain:

(i) the results of the licensee's Risk Assessment;

(ii) a description of the Data Assurance Activities that the licensee intends to undertake concerning expected future Data submissions for the relevant reporting period set out in the DAG;

(iii) a description of the Data Assurance Activities undertaken by the licensee concerning previously submitted Data for the relevant reporting period set out in the DAG; and

(iv) if required, the details and results of any independent review procured by the licensee of its Data Assurance Activities.

45.3 The licensee must have in place and maintain appropriate systems, processes, and procedures to enable it to perform its obligations under paragraph 45.2.

45.4 The licensee must comply with any direction given by the Authority that requires it to carry out (or, where appropriate, to procure and facilitate the carrying out of) a specific Data Assurance Activity in accordance with the provisions of Part D of this condition.

Part B: Scope and contents of the Data Assurance Guidance

45.5 The purpose of the DAG is to establish a framework of processes and practices by which the licensee must comply with its obligations as set out in paragraph 45.2(b) to (d).

45.6 Subject to paragraphs 45.8 and 45.9, the DAG may include, or make provision for, any of the following matters:

(a) the Data to which the Risk Assessment applies;

(b) the format of the Risk Assessment;

(c) the frequency with which and the timescales within which the Risk Assessment is required to be carried out;

(d) the format of any independent review that may be required of the licensee's Data Assurance Activities and the associated reporting requirements;

(e) the format of the reporting requirements detailed in paragraph 45.2(d);

(f) the frequency with which and the timescales within which the licensee must report on its Data Assurance Activities to the Authority; and

(g) the time period(s) to which required reports relate.

45.7 Reference in paragraph 45.6 to the format of an assessment, review, or reporting requirement includes reference to its form, layout, scope and content.

45.8 The provisions of the DAG must not exceed what is required to achieve the purposes of this condition, having regard to the materiality of the costs likely to be incurred by the licensee in complying with those provisions and the impact on consumers of Data reporting errors.

45.9 Nothing in this condition requires the licensee to provide any documents or give any information that it could not be compelled to produce or give in evidence in civil proceedings before a court.

Part C: The process to issue and modify the Data Assurance Guidance

45.10 The Authority will issue, and may modify, the DAG by issuing a direction for that purpose to every licensee in whose licence this condition has effect.

45.11 A direction issued by the Authority under paragraph 45.10 will be of no effect unless, before issuing it, the Authority has:

(a) by Notice to all licensees in whose licence this condition has effect set out the text of the proposed DAG or modifications to it that it proposes to direct;

(b) specified in the Notice the reasons for the Authority's proposals;

(c) specified in the Notice the date or dates on which it proposes that the new or modified provisions of the document should take effect;

(d) specified in the Notice the period (which may not be less than 28 days from the date of the Notice) within which the licensee may make representations to the Authority about its proposals; and

(e) considered any representations duly received in response to the Notice.

Part D: Authority's power to specify Data Assurance Activity

45.12 The Authority may, after consulting with the licensee, issue a direction, in accordance with the provisions of paragraph 45.13, requiring the licensee to carry out (or, where appropriate, to procure and facilitate the carrying out of) such Data Assurance Activity as may be specified in the direction.

45.13 The requirements for the direction under paragraph 45.12 are that it must:

(a) contain a description of the Data Assurance Activity to be carried out by the licensee (or, where appropriate, by a person nominated by the Authority) for the purpose of assuring the accuracy and completeness of Data provided to the Authority;

(b) if it refers to a person nominated by the Authority, specify the steps that must be taken by the licensee to procure and facilitate the carrying out of

that activity by that person;

(c) contain a description of the Data to which the activity that is described in the direction must apply;

(d) contain an explanation of why the Authority requires the licensee to carry out that activity;

(e) specify any relevant dates by which that activity must be completed; and

(f) specify the form and content of any information relating to that activity that the licensee must provide to the Authority.

45.14 The Authority may, following the submission of Data, appoint or nominate a person (Examiner) to undertake a review of such Data or the systems or processes used to generate it.

45.15 Subject to paragraph 45.18, the licensee must cooperate fully with an Examiner so as to enable him to carry out, complete, and report to the Authority on any review or examination specified by the Authority.

45.16 The licensee's obligation to cooperate fully with an Examiner under paragraph 45.15 includes an obligation to ensure, so far as it can, that the following persons also cooperate fully with that Examiner:

(a) any Affiliate or Related Undertaking of the licensee;

(b) any person from whom the licensee procures reporting services or who measures and records Data on behalf of the licensee; and

(c) any auditor of such person, or of the licensee, or of any Affiliate or Related Undertaking of the licensee.

45.17 The licensee's obligation under paragraphs 45.15 and 45.16 to cooperate or ensure cooperation with an Examiner includes, so far as may be necessary or expedient for such purpose, and in each case subject to reasonable Notice to the licensee:

(a) providing access to management, employees, agents, or independent contractors of the licensee sufficient to enable the Examiner to make any enquiries and to discuss any matters that he reasonably considers to be relevant to the carrying out of the examination;

(b) giving the Examiner access at reasonable hours to any premises occupied by the licensee or by any other person in performing the obligations set out in this condition; and

(c) allowing the Examiner at reasonable hours:

(i) to inspect and make copies of, and take extracts from, any documents and records of the licensee maintained in relation to the Data (other than information that is subject to legal privilege);

(ii) to carry out inspections, measurements, and tests on or in relation to any systems maintained and operated for or in relation to the Data; and

(iii) to take onto such premises or onto or into any assets used for the purposes of the licensee such other persons and such equipment as may be necessary or expedient for the purpose of carrying out the examination.

45.18 The licensee is not required to perform its obligations in relation to an Examiner and his functions unless the Examiner has entered into an agreement with the licensee to maintain confidentiality on reasonable terms.

Part E: Derogations

45.19 The Authority may, after consulting with the licensee, give a direction ("derogation") to the licensee that relieves it of its obligations under this condition to such extent, for such period of time, and subject to such conditions as may be specified in the direction.

Part F: Interpretation

45.20 For the purposes of this condition:

i. **Data** means information contained in any submissions to the Authority under this licence in respect of which the licensee must carry out a Risk Assessment, as specified in the Data Assurance Guidance (DAG), as may be further clarified in the DAG.

ii. **Data Assurance Activity** means, in respect of Data, an activity undertaken by or on behalf of the licensee in order to verify or provide assurance that Data meets the required level of accuracy and reliability (as may be further clarified in the DAG).

iii. **Examiner** means a member of the Authority's staff, or any other person, whose degree of knowledge and experience is appropriate for the purposes of the relevant review.

iv. **Risk Assessment** means an assessment of the likelihood and potential impact of any inaccurate or incomplete reporting, or any misreporting, of Data by the licensee to the Authority under this licence (as may be further clarified in the DAG).

Condition 46. Regulatory Instructions and Guidance

Introduction

46.1 This condition sets out the scope, contents, and common governance arrangements for the Regulatory Instructions and Guidance ("RIGs") published by the Authority pursuant to this condition.

46.2 The RIGs are the primary means by which the Authority directs the licensee to collect and provide to it the information that the Authority needs to administer:

(a) the Charge Restriction Conditions (and such standard conditions as may be relevant) of this licence; and

(b) where not referenced in the Charge Restriction Conditions of this licence, the ED1 Final Determination.

Part A: Licensee's obligations under this condition

46.3 Unless and so far as the Authority otherwise consents, the licensee must:

(a) measure and record or, where permitted in the RIGs, estimate the information detailed in the RIGs ("Specified Information");

(b) provide such information to the Authority in respect of such periods and within such timeframes as are specified in the RIGs; and

(c) have in place and maintain appropriate systems, processes, and procedures to enable it to carry out its obligations in sub-paragraphs (a) and (b).

46.4 To facilitate compliance with paragraph 46.3, the accounting records and other records kept by the licensee with respect to the Specified Information must:

(a) be so arranged as to ensure that such information can be separately identified and reasonably attributed as between the licensee's business and the business of any Affiliate or Related Undertaking of the licensee; and

(b) be maintained for a period of eight Regulatory Years, or such shorter period as may be set out in the RIGs, from the date that the records are made.

Part B: Scope and content of the RIGs

46.5 Subject to paragraph 46.6, the matters that may be included, or for which provision may be made, in the RIGs are:

(a) instructions and guidance on the establishment of systems, processes, procedures, and ways for recording and providing Specified Information;

(b) instructions and guidance on the standards of accuracy and reliability that are applicable to the recording of Specified Information (including different classes of such information);

(c) a timetable for the development of such systems, processes, and procedures as are required to achieve such standards;

(d) instructions on when the licensee must at its own expense enter into a contract of appointment with an Appropriate Auditor, and on compliance with the Agreed Upon Procedures;

(e) the methodology for calculating or deriving numbers comprising Specified Information;

(f) provision with respect to the meaning of words and phrases used in defining Specified Information;

(g) requirements as to the form and manner in which, or the frequency with which, Specified Information must be recorded;

(h) requirements as to the form and manner in which, or the frequency with which, Specified Information must be provided to the Authority; and

(i) explanation of why the Specified Information is required for the purposes of the RIGs.

46.6 No Specified Information may exceed what could be requested from the licensee by the Authority under standard condition 6 (Provision of Information to the Authority).

46.7 Subject to paragraph 46.19, Specified Information collected in relation to the Regulatory Year commencing in 2014 must be reported according to the relevant reporting requirements provided for in these standard conditions in the form in which they were in force at 31 March 2014.

46.8 If, having first consulted with the licensee, the Authority specifies by direction that the licensee must report Specified Information for the Regulatory Year commencing in 2014 according to requirements that are different from those referred to in paragraph 46.7, the licensee must comply with that direction.

Part C: The process to issue and modify the RIGs

46.9 The Authority will issue, and may modify, the RIGs by issuing a direction for that purpose to every licensee in whose licence this condition has effect.

46.10 A direction issued by the Authority under paragraph 46.9 will be of no effect unless, before issuing it, the Authority has:

(a) by Notice to all licensees in whose licence this condition has effect, set out the text of the proposed RIGs (or modifications to it) that it proposes to direct;

(b) specified in the Notice the reasons for the Authority's proposals;

(c) specified in the Notice the date on which it proposes that the provisions (or modified provisions) of the document should take effect;

(d) specified in the Notice the period (which may not be less than 28 days from the date of the Notice) within which the licensee may make representations to the Authority about its proposals; and

(e) considered any representations duly received in response to the Notice.

46.11 The requirements for the issuing of new RIGs or modification of existing RIGs set out in paragraph 46.10 may be satisfied by actions taken by the Authority before as well as after the coming into effect of this condition.

Part D: Requirements for new or more detailed information

46.12 This Part D applies if any modified or new RIGs have the effect of introducing a requirement to provide:

(a) a new category of Specified Information; or

(b) an existing category of Specified Information to a greater level of detail,

and such category of Specified Information has not previously been collected by the licensee, whether under the provisions of the RIGs or otherwise.

46.13 Where this Part D applies, the licensee may provide estimates to the Authority in respect of the relevant category of Specified Information for any Regulatory Year specified by the Authority.

46.14 The estimates that are mentioned in paragraph 46.13 may be derived from such

other information available to the licensee as may be appropriate for that purpose.

Part E: Compliance with the provisions of the RIGs

46.15 The licensee must at all times comply with the provisions of the RIGs for the time being in force pursuant to this condition.

46.16 Nothing in this condition requires the licensee to provide any documents or give any information that it could not be compelled to produce or give in evidence in civil proceedings before a court.

Part F: Events with a material impact on information

46.17 This paragraph applies where there has been a change in the industry's or the licensee's processes or procedures that has a significant effect on the calculation of one or more items to be

considered by the Appropriate Auditor carrying out the Agreed Upon Procedures ("Specific Items") and the RIGs do not provide adequate or sufficient guidance in relation to the collection and reporting of such items.

46.18 For the purposes of paragraph 46.17, a "significant effect" means a change to the calculation of one or more Specific Items such that its effect on the calculation of

Allowed Distribution Network Revenue for any Regulatory Year exceeds, or is likely to exceed, 1 per cent of Base Demand Revenue for that Regulatory Year.

46.19 Where paragraph 46.17 applies, the licensee must request guidance from the Authority in relation to the treatment of the item or items in question.

46.20 On receiving a request for guidance, the Authority:

(a) having regard to whether the change to the calculation of one or more Specific Items has material implications for other Distribution Services Providers; and

(b) after consultation with the licensee and, where appropriate because of paragraph 46.20(a), other Distribution Services Providers, may, by Notice to the licensee and (where relevant) other Distribution Services Providers, direct how such Specific Items should be reported for the purposes of this condition.

Part G: Derogations

46.21 The Authority may, after consulting with the licensee, give a direction ("derogation") to the licensee that relieves it of its obligations under this condition to such extent, for such period of time, and subject to such conditions as may be specified in the direction.

Part H: Interpretation

46.22 For the purposes of this condition:

i. **Allowed Distribution Network Revenue** means the revenue calculated in accordance with the formula for Art as set out in Part B of Charge Restriction Condition 2A (Restriction of Allowed Distribution Network Revenue).

ii. **Base Demand Revenue** means the revenue calculated in accordance with the formula set out in Part C of Charge Restriction Condition 2A.

iii. **Specific Items** means items to be audited by the Appropriate Auditor carrying out the Agreed Upon Procedures.

iv. **Specified Information** means information (or a category of information) that is so described or defined in the RIGs

Appendix 4 - RIIO-1 price controls – overview of the regulatory instructions and guidance (RIGs)

Background

The RIIO-1 price control review set the outputs that the 14 electricity distribution network operators (DNOs) and electricity transmission network operators (TO's) need to deliver for their consumers and the associated revenues they can collect.

Ofgem monitors and evaluates the TO and DNO licensees' performance over RIIO-1. The main reporting route is the Regulatory Instructions and Guidance (RIGs), which provide a common framework for licensees to report relevant performance, cost and financial information.

The RIGs specify the information Ofgem wants and provides guidance on how to provide this information. Ofgem collects this information to enable them to:

- monitor licensees' delivery of their price control outputs and associated deliverables
- monitor the rewards and penalties the licensees' have received for this performance
- monitor licensees' delivery of wider price control commitments
- monitor compliance with licence requirements
- collect information for use in the annual iteration process to calculate revenue
- have visibility of the licensees' latest forecasts on key deliverables
- inform the assessment in the next price control review.

Ofgem may publish information licensees provide in the RIGs. This will primarily be to inform stakeholders of their performance against their price control commitments.

Legal framework

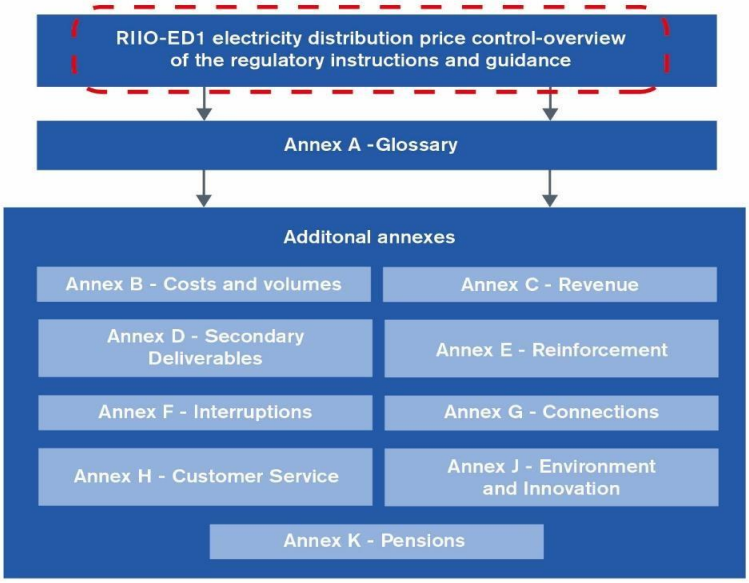
RIGs are documents associated with the electricity distribution and transmission licences, and the licensees are required to comply with them as if they were part of the licence. For example, standard licence condition 46 (Regulatory Instructions and Guidance) of the electricity distribution licence sets out the scope, contents and common governance arrangements for the RIGs. The RIGs may be revised and reissued in accordance with Part C of condition 46.

The information a licensee provides must relate to its licensed distribution business and any affiliates or related undertakings. Where appropriate, the specified information a licensee provides to Ofgem must comply with the requirements under standard licence condition 45 (Data Assurance requirements). Standard licence condition 45 and its associated data assurance guidance (DAG) specify the information in these RIGs where the DAG applies. The DAG requires the DNO to perform a risk assessment and carry out data assurance activities on the information it provides.

Structure of the RIGs

Figure 1 shows all the instructions and guidance documents for the RIIO-Electricity Distribution (ED)1 RIGs. The RIGs also include reporting packs and commentaries DNOs must use to submit the information. A similar structure exists for reporting of data by electricity transmission licensees.

Figure 1: Map of the RIIO-ED1 instructions and guidance



Content and submission of information

The RIGs comprise instructions and guidance on how to report and, where applicable, derive information, including a list of definitions. They also include reporting packs (in Microsoft Excel) for the submission of numerical information, and commentary sheets for companies to provide information to support the reporting packs.

The purpose of commentaries is for the licensees to provide evidence and explanation of the information they are submitting. The commentaries include specific instructions on what should be included. Not all reporting packs have associated commentaries.

The purpose of the instructions and guidance is to provide licensees with the information they need to accurately complete the reporting packs. The instructions and guidance provide, where applicable, information on:

- requirement for historical and forecast data
- reporting units and the methodology for calculating or deriving required numbers
- the provision of the data to Ofgem (format, frequency etc.)
- any audit or examiner requirements
- reasons for the data requirement and definitions of the terms used in the RIGs.

Submission of completed reporting packs and commentaries

Information is normally provided for a regulatory year. The regulatory year for the provision of information runs from 1 April in one calendar year to 31 March in the next. For specified information, the instructions and guidance may reference a shorter time for the recording and reporting of information.

Table 1 below lists reporting packs required for DNO's and specifies the period covered by each reporting pack and the submission deadline. DNOs are required to submit completed reporting packs and commentaries no later than the deadline specified. When submitting these DNOs must ensure that any additional submission requirements outlined in the annexes have been met, e.g. audits. Reporting packs for TO's follow a similar structure.

Table 1: DNO RIGs reporting packs, commentaries and timeframes

Instructions and guidance	Reporting pack	Period	Submission deadline
Costs and Volumes	Costs and Volumes	Regulatory year	31 July
Revenue	Revenue	Regulatory year	31 July
Secondary Deliverables	Secondary Deliverables	Regulatory year	31 July
Reinforcement	Reinforcement Load Index (LI)	Regulatory year	30 September
Interruptions	Quality of Service - Interruptions	Regulatory year	30 April
	Quality of Service - Interruptions Stage Data		
	Guaranteed Standards of Performance	Regulatory year	31 July
	Occurrences Not Incentivised		
	Quality of Service - HV Disaggregation	Regulatory year	30 November
Connections	Connections	Regulatory year	31 July
	Connections – Guaranteed Standards	Quarterly	31 July
Customer Service	Customer service	Complaints and customer satisfaction – quarterly, Telephony – monthly	31 July
Environment and Innovation	Environment and Innovation	Regulatory year	31 July
Pensions	Pensions	-	2017, 2020, and 2023

The structure of the reporting packs

Most of the reporting packs contain the following common worksheets:

- Navigation – provides a reference and link to each table in the reporting pack
- Changes log – for licensees and Ofgem to log changes that are made to the template, e.g. correcting an error in a formula

- Data change log – for licensees to record any changes that it has made to historical, and therefore previously submitted, data.

Cells in the worksheets are colour coded to reflect the action required. Licensees are only required to enter values related to the regulatory year under report, and any previous regulatory years, unless specified in the guidance, i.e. where forecasting is required.

Dealing with errors in the reporting packs - Where a licensee identifies an error in a reporting pack, e.g. a cell incorrectly linking to another cell, they must notify Ofgem of the error as soon as possible. Where Ofgem identifies an error in a reporting pack Ofgem will notify all licensees. The change must be logged in the "changes log" worksheet in the relevant reporting pack.

Complying with definitions - Definitions are included in a separate Glossary. Licensees must comply with the definitions when entering data in the reporting packs. They should consult Ofgem for clarification where there is doubt or uncertainty.

Accounting policies - Licensees should enter all costs on a cash basis and exclusive of atypical items except where specifically instructed to report data. On a cash basis means exclusive of all provisions and accruals and prepayments that are not incurred as part of the ordinary level of business.

Use of estimates, apportionments and allocations - In certain circumstances licensees may not be able to measure or record actual information. For example, forecast information or 'counterfactual' information about alternatives that were discounted. In circumstances where licensees are not able to measure and record actual information they may estimate the information they provide in the RIGs. Where estimated data is submitted licensees must provide the reason why the information could not be measured or recorded and the method it used to derive any estimate.

Licensees must also identify in the commentaries where they have used apportionments or allocations when completing the RIGs.

Accuracy of reporting - Where appropriate, licensees are required under standard licence condition 45 (for DNO Data Assurance requirements) to perform a risk assessment and carry out data assurance activities on specified information submitted in the RIGs. The data assurance activities carried out should ensure the accuracy of the information submitted.

Ofgem agreement is needed before a licensee can resubmit any RIGs information. The licensee must resubmit the relevant reporting pack (and commentary where appropriate) in full. It must provide an accompanying list of input cells it has changed, with a commentary explaining the reasons for the changes.

Provision of historical data - All historical expenditure should be input in nominal terms, i.e. in the prices of the year to which the data relates. At each submission a licensee may resubmit values included in previous submissions. Changes to historical values may be:

- Due to finding an error in the recording or reporting of information.
- To take account of a direction by Ofgem to revise data in line with figures used in the price control financial model (PCFM).[27]

[27] The PCFM is the financial model which derives the incremental changes to base revenue (MOD) during the RIIO price control period.

Where a previously submitted value has been changed the licensee must notify Ofgem of this change and the reason for it by recording in the "data change log" in the reporting pack.

Provision of forecast data - Licensees are required to provide forecasts in the RIGs. The purpose of requesting forecasts is to help Ofgem better understand the implementation of the price control and any changes to planned activities, and to allow Ofgem to examine the robustness of licensees' forecasting processes over time.

Reporting of forecast expenditure should be in a constant base year price (currently 2012-13 prices) and include the expected impact of real price effects but not the impact of economy-wide inflation.[28]

[28] Real price effects are the changes in prices of inputs purchased, relative to economy-wide inflation. When considering the impact of real price effects DNOs should reference economy-wide inflation as measured by the retail prices index (RPI).

Appendix 5 - Example of published regulatory accounts

An extract from National Grid's regulatory accounts is set out below and the full document can be found at the following link: http://investors.nationalgrid.com/news-and-reports/reports/2016-17/uk

National Grid Electricity Transmission plc
Regulatory Accounting Statements 2016/17

Company number 2366977

Contents

Appendix 6 - Example of Licensee Financial Model and Revenue calculations

The Price Control financial models for each regulated company are updated each year and are published on Ofgem's website. As an example, the link for the National Grid Electricity Transmission (NGET) model is set out below.

https://www.ofgem.gov.uk/publications-and-updates/riio-et1-financial-model-following-annual-iteration-process-2017

The revenue calculation formula for NGET is set out on page 90 of their licence (link follows) and an extract is provided below.

https://epr.ofgem.gov.uk/Content/Documents/National%20Grid%20Electricity%20Transmission%20Plc%20-%20Special%20Conditions%20-%20Current%20Version.pdf

3A.3 Maximum Revenue, in Relevant Year t, is derived in accordance with the following formula (in this condition, the "Principal Formula"):

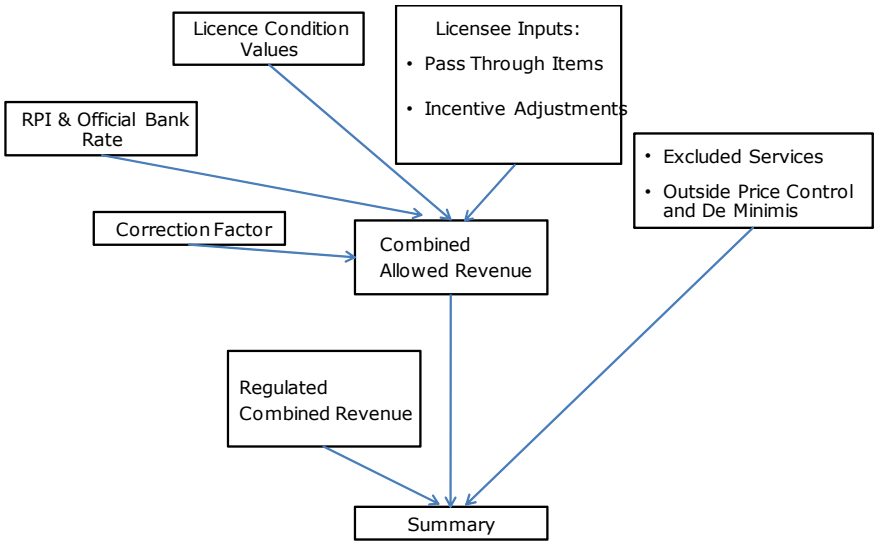
$$TO_t = BR_t + PT_t + OIP_t + NIA_t + NICF_t + TIRG_t + DIS_t + TS_t - K_t$$

3A.4 In the Principal Formula:

TO_t	means the amount of Maximum Revenue in Relevant Year t.
BR_t	means the amount of Base Transmission Revenue in Relevant Year t as derived in accordance with the formula set out in Part C of this condition.
PT_t	means the allowed pass-through items revenue adjustment made in Relevant Year t as derived in accordance with Special Condition 3B (Calculation of allowed pass-through items).
OIP_t	means the outputs incentive revenue adjustment made in Relevant Year t as derived in accordance with the formula set out in Part D of this condition.
NIA_t	means the revenue adjustment made in Relevant Year t in respect of the Network Innovation Allowance as derived in accordance with Special Condition 3H (The Network Innovation Allowance).
$NICF_t$	means the revenue adjustment made in Relevant Year t in respect of the allowance given under the Network Innovation Competition as derived in accordance with Special Condition 3I (The Network Innovation Competition).
$TIRG_t$	means, for each Relevant Year t, the aggregate of the annual revenue allowances for each transmission investment project specified in Annex A of Special Condition 3J (Transmission Investment for Renewable Generation), as derived in accordance with that condition.
DIS_t	means the adjustment as a result of: (a) the total amount charged to the licensee in Relevant Year t-1 by Scottish Hydro Electric Transmission Plc and SP Transmission Ltd in respect of Site-Specific Charges (as such charges are defined in Schedule Ten of the STC) minus (b) the total income recovered by the licensee in respect of Excluded Services in Relevant Year t-1 from customers in the respective Transmission Areas of each of Scottish Hydro Electric Transmission Plc and SP Transmission Ltd.

TS_t	means the adjustment as a result of : (a) the total amount charged to the licensee in Relevant Year t-1 by Scottish Hydro Electric Transmission Plc, SP Transmission Ltd and any Offshore Transmission Owner in respect of Transmission Owner Final Sums (as such charges are defined in schedule nine of the STC) minus (b) an amount equal to the income received by the licensee in Relevant Year t-1 in respect of users who reduce TEC or developer capacity (as defined in the CUSC) or who terminate relevant bilateral agreements for connection and/or access rights to the GB transmission system in the respective Transmission Areas of each of Scottish Hydro Electric Transmission Plc, SP Transmission Ltd and any Offshore Transmission Owner (for the avoidance of doubt, including any amounts that are treated as capital contributions).
K_t	means the correction term in Relevant Year t as derived in accordance with the formula set out in Part E of this condition.

Finally, the schematic for the NGET revenue calculation is shown below. This summarises the key elements of the NGET revenue calculation.



Appendix 7: Review of other international performance databases

Introduction

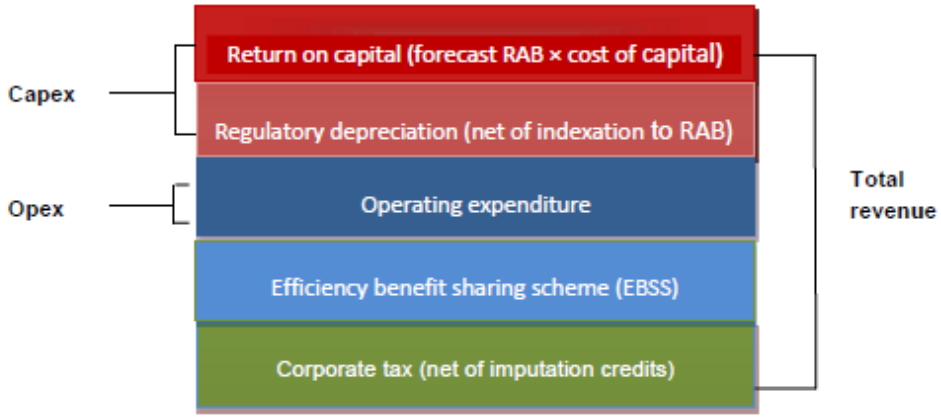
A review of alternative approaches to performance databases from Australia, Europe, North America, Asia and Africa was undertaken. Australia was selected for further examination.

In Australia, the independent Australian Energy Regulator (AER) regulates electricity network revenues with the goal of ensuring that consumers pay no more than necessary for the safe and reliable delivery of electricity services. The AER applies incentive-based regulation across all the 7 transmission companies and 13 distribution companies they regulate.

The AER determines the revenues that an efficient business would require at the start of each five-year regulatory period. The business is then given financial rewards when it improves its efficiency and spends less than the forecast during the regulatory period—while maintaining or improving its service standards. If the business spends less than the forecast, it can keep the difference between the forecast and its actual expenditure until the end of the regulatory control period. Conversely, if its spending exceeds the forecast, it must carry the difference itself until the end of the period.

An AER determination does not set network expenditures or costs but establishes a cap on the maximum revenue that a network can recover from its customers during the regulatory control period. The key components of the Australian price control mechanisms are set out below. While the UK RIIO regime incentivises outputs, the Australian regime is a more traditional approach which focuses on efficiency benefits, although the efficiency benefit sharing scheme (EBSS) can include some service performance incentive elements.

Diagram 1: Australian T&D price control components



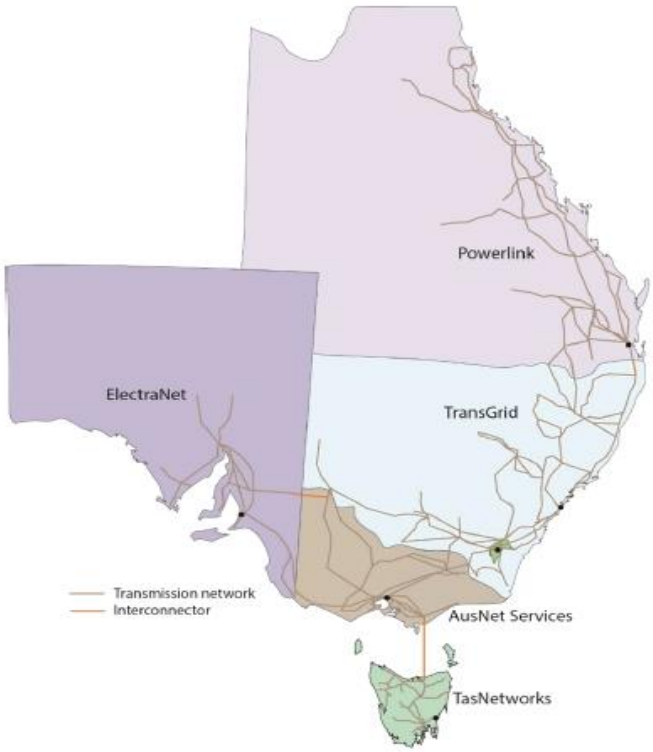
Performance indicators

The AER undertakes annual reporting of T&D performance. Results are published for the companies in the National Electricity Market, as shown in the following diagrams 12 and 13. The AER website provides the latest annual reports for transmission and distribution[29].

[29] AER Performance benchmarking reports
https://www.aer.gov.au/system/files/AER%202017%20distribution%20network%20service%20provider%20benchmarking%20report.pdf
https://www.aer.gov.au/system/files/AER%202017%20transmission%20network%20service%20provider%20benchmarking%20report.pdf

Diagram 2: Australian Electricity Distribution companies in the NEM

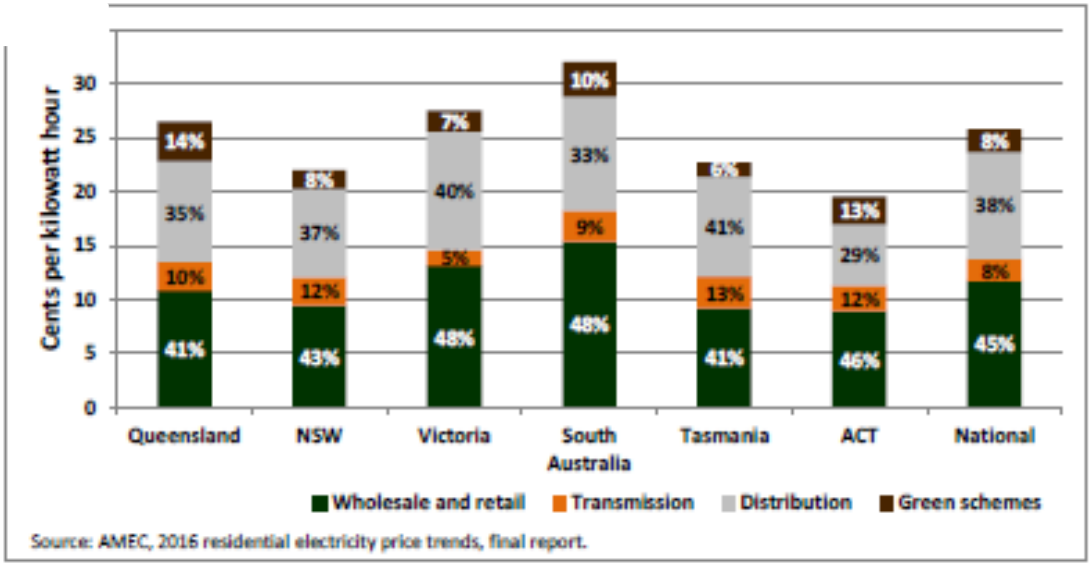
Diagram 3: Australian Electricity Transmission companies in the NEM



AER T&D Performance reports

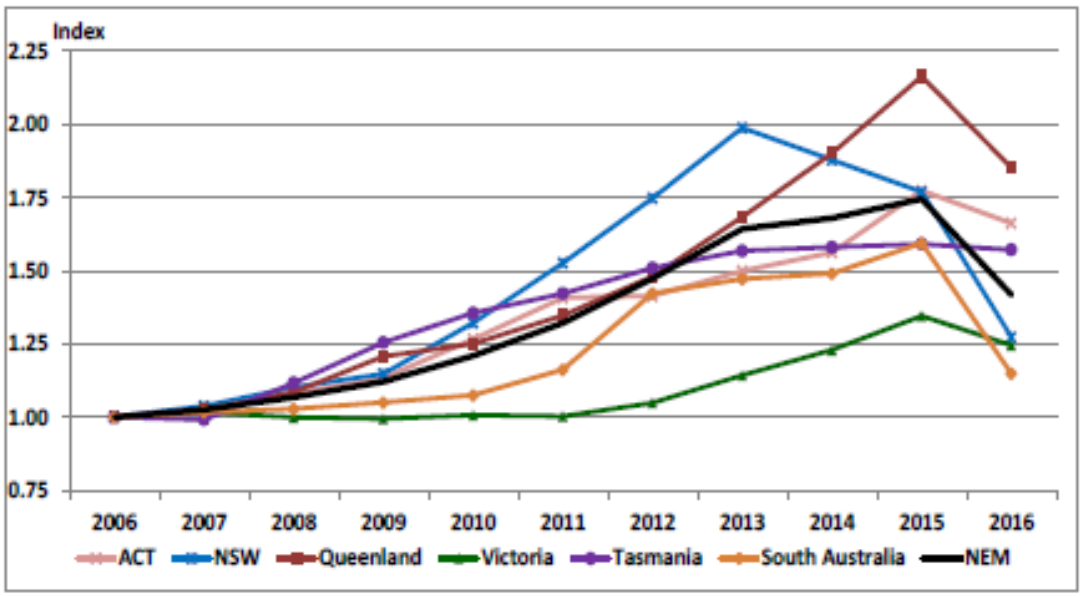
The reports provide information on the impact of regulation on network efficiency, charges and ultimately electricity prices. The following diagram shows the proportion of Australian retail electricity bis that are attributable to network revenues. These revenues are paid by electricity consumers through their electricity bills and typically account for 40 to 55 per cent of the retail cost of electricity.

Diagram 4: Network revenue as a proportion of retail energy bills - 2016



The individual revenue profiles for distribution companies are illustrated in diagram 15 below showing that prices and revenues for distribution companies have recently declined.

Diagram 5: Distribution company revenues

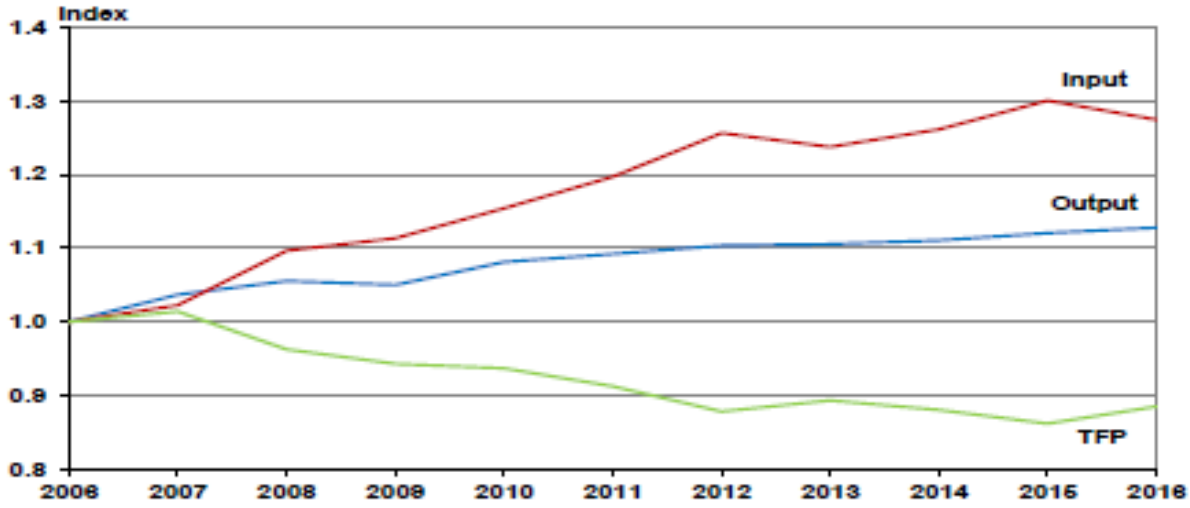


Source: AER economic benchmarking Regulatory Information Notice responses

The AER performance analysis uses productivity measurements to identify the efficiency gains that are being realised by regulation and improved business performance. Diagram 16 sets out the 2.7% increase in total factor productivity (TFP) productivity that took place in 2016 in the Australian electricity distribution industry. This increase was largely attributed to an 8% decrease in opex. This is the highest rate of increase over the last 11 years (TFP last increased over 2013 by 1.7 per cent

and fell in all other years except 2007). It is a significant improvement relative to the long-term trend over 2006-16 of a 1 per cent annual average decline.

Diagram 6: Distribution industry, input, output and total factor productivity (TFP), 2006-16



The AER performance report users several measures to produce useful analysis and bench-marking between organisations. Due to the diversity of population and geography, companies are difficult to compare. The approach AER has adopted is to define common inputs and outputs for each company, and then to derive 'partial performance indicators' for comparison.

- The **output measures** include factors such as customer numbers, circuit line length, maximum demand, circuit throughput, and reliability.
- The **input measures** include opex, RAB, depreciation and asset cost
- The **partial performance indicators** provide a simple visual representation of input costs relative to a particular output.

Partial performance indicator examples for distribution companies

The total cost (opex and asset cost) is the main input used in this example. It is compared with several outputs, including customer numbers, maximum demand and circuit line length. The analysis also compares total costs per customer with unplanned minutes off supply per customer, to provide a 'per customer' reliability metric.

On a 'per customer' metric, large rural companies will perform poorly relative to companies in suburban and metropolitan areas. Typically, the longer and sparser a network, the more assets it must operate and maintain per customer. The 'per MW' metric exhibits a similar pattern. Conversely, on 'per km' metrics, large rural companies will perform better because their costs are spread over a longer network.

These indicators are plotted against customer density to demonstrate these effects. Using a five-year average mitigates against the effect of one-off changes in opex or assets in a particular year. Some example diagrams are shown below. Further detail can be obtained from the AER reports.

Diagram 7: Total cost per customer ($2016) against customer density (average 2012–16)

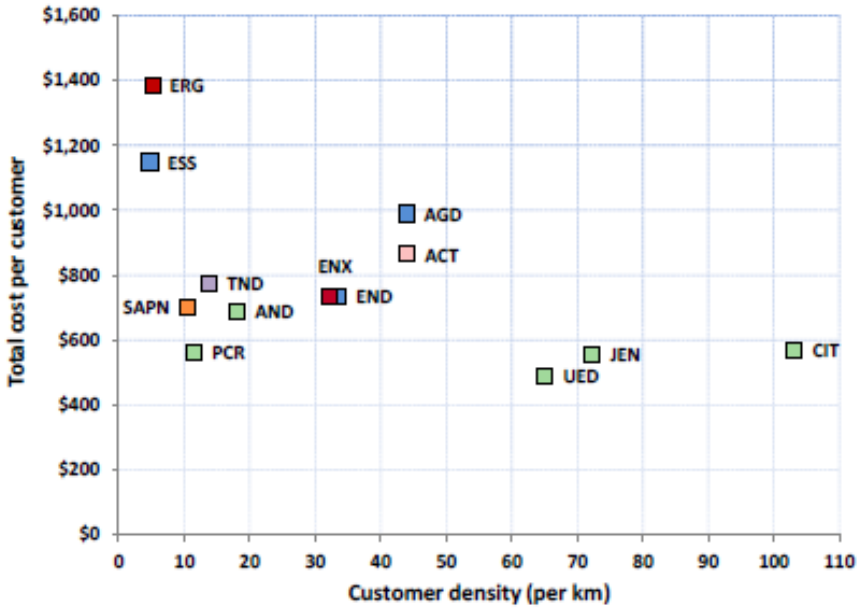
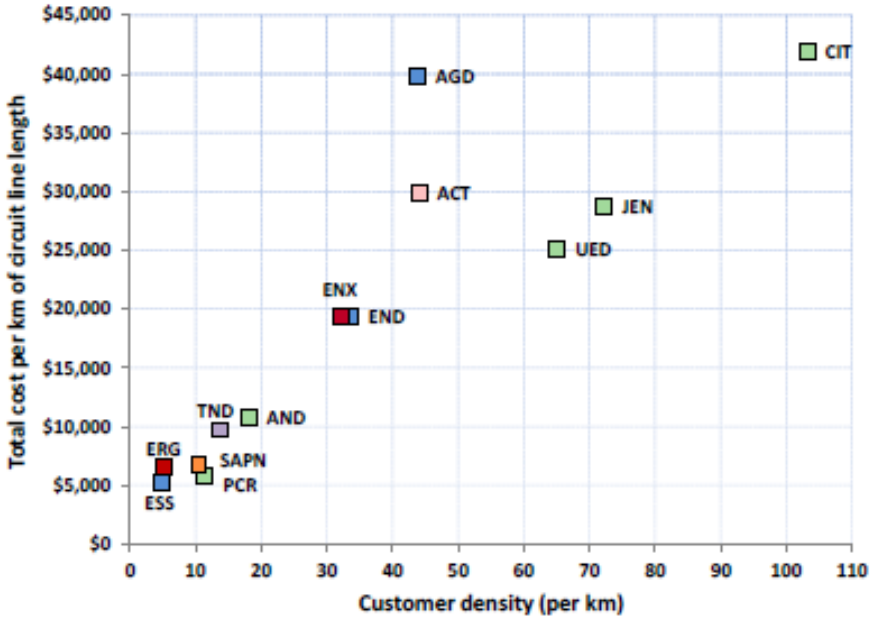


Diagram 8: Total cost per kilometre of circuit line length ($2016) against customer density (average 2012–2016)



Distribution service performance indicators (System Target Performance incentive scheme)

This scheme provides a reward/penalty to improve network reliability, by focussing on unplanned outages. It is designed to encourage transmission companies to seek to reduce the number of unplanned network outages and to promptly restore the network in the event of unplanned outages that result in supply interruptions. This component, designed to indicate potential reliability issues, uses four parameters to measure performance.

- SAIFI – System Average Interruption Frequency Index, the number of times the average customer will experience unplanned power outages during the year.
- SAIDI – System Average Interruption Duration Index, the time the average customer is without power each year due to unplanned outages. •

- MAIFI – Momentary Average Interruption Frequency Index, the average number of short interruptions (under one minute) that a customer would experience during each year.
- Customer service measures (telephone answering) – How quickly distributors answer customers' fault lines calls to their call centres

Transmission service performance indicators (System Target Performance incentive scheme)

This scheme provides a reward/penalty to improve network reliability, by focussing on unplanned outages. It is designed to encourage transmission companies to seek to reduce the number of unplanned network outages and to promptly restore the network in the event of unplanned outages that result in supply interruptions. This component, designed to indicate potential reliability issues, uses four parameters to measure performance.

- The **average circuit outage rate parameter** measures the average number of times unplanned outages render circuits unavailable. An increase in the frequency of unplanned outages may be a lead indicator of a future reliability problem. This parameter does not measure outage duration or account for whether the outage caused a loss of supply or market impact.
- The **loss of supply event frequency parameter** measures the number of unplanned outages resulting in a loss of supply. It measures the number of small events (small loads interrupted for short periods) and large events (large loads interrupted for even a short duration, or a customer with a moderate load interrupted for a long duration). The parameter is designed to encourage companies to reduce the duration of moderate and small customer interruptions through fast response times and to reduce the frequency of large customer interruptions through improved reliability.
- The **average outage duration parameter** measures the average duration (in minutes) of unplanned outages causing a loss of supply. The time a company takes to restore network equipment is used as a proxy for the effectiveness of the TNSP's operational response to unplanned events. The parameter focuses on loss of supply events to encourage companies to focus on those unplanned outages which most adversely affect customers.
- The **proper operation of equipment parameter** counts the number of times protection or control systems fail as well as occurrences of incorrect operational isolation of equipment during maintenance. Incorrect operation of equipment can cause unplanned outages of primary transmission equipment and therefore acts as a lead indicator of reliability. There is no incentive payment currently associated with this parameter only for reporting as a trend indicator.

Data collection

With respect to electricity transmission and distribution companies AER has a power under the National Electricity Law (NEL) to issue Regulatory Information Instruments such **as regulatory information notices (RINs)** to obtain information they consider reasonably necessary to perform their functions. The National Electricity Rules (NER) also provides for the development of guidance setting out the data requirements T&D companies must provide on an annual basis.

Data to be provided - The RINs require T&D companies to provide AER with annual data including:

- **Financial information** - regulatory and disaggregation financial statements (income, balance sheet, cash flow), operations and maintenance expenditure disaggregation including causal and non-causal allocations, historic operating and capital expenditure; prescribed transmission services (regulatory adjustments, price reduction/recovery, revenue analysis, pass throughs), asset statements, provisions, related party transactions and revenue reconciliation.
- **Non-financial information** - current map of the network and a one-year demand forecast.

- **Service performance information** - inputs (performance against the service target performance incentive scheme parameters, exclusions as defined under the scheme), service results, revenue impact calculation, outcomes (total performance, s-factor, financial incentives).
- **Assurance requirements** - audit of financial information, arithmetic accuracy and reconciliation of statutory financial statements, and a directors' responsibility statement.

Data submission requirements - The RINS also require the companies to comply with a number of other requirements, including:

- Accounting principles and policies - information must be provided in a way that ensures AER understands the required regulatory information and can make comparisons over time.
- For the purposes of the efficiency benefit sharing scheme, a company must set out in its certified annual statement any changes to its capitalisation policy that occurred during the relevant reporting period.
- Except where the guideline prescribes otherwise, the regulatory information requirements should be completed according to applicable Australian accounting standards.
- Each company must comply with the cost allocation methodology prescribed by the AER.
- Each company shall ensure that all information provided is verifiable. 'Verifiable' means, at least, information can be traced to a source document or assumption, by an independent party such as an auditor.
- AER may request further information, including the underlying schedules and accounting records.

Assurance requirements - AER may request or undertake verification or independent audit of any information sought by or provided to it. It will require an audit to be performed and accompany the submission of regulatory information. The scope of the audit must cover the following matters:

- the basis and application of the cost allocation methodology
- arithmetic accuracy
- reconciliation to statutory financial statements.

The audit must include an assessment of whether an appropriate sample of all allocations of shared costs accords with an approved cost allocation methodology.

Disaggregation—reporting by business segment - Regulatory financial statements are to be prepared by disaggregating base company accounts and applying, where necessary, regulatory accounting adjustments to the business segments to derive regulatory financial statements. There should be an audit trail between the regulatory financial statements and the accounting records that underlie the base accounts.

Financial Reporting statements

The following table sets out the main reporting requirements for transmission and distribution companies. They are required to be submitted within four months of the regulatory year end.

Type	Pro forma statement
Regulatory financial statements	Income statement
Disaggregation statement	Income statement
Workpapers supporting the disaggregation statements	Operations and maintenance expenditure
	Causal allocations

Type	Pro forma statement
	Non-causal allocations
Prescribed transmission services	Regulatory adjustment journals
	Price reduction/recovery
	Discount
	Revenue analysis
	Asset aging schedule
Provisions schedules: Disaggregation statements	Provisions summary and Provisions Reconciliation
Other Information	Related party transactions
	Revenue reconciliation
Non-financial schedules	Current map of the network
Historic operating expenditure (opex)	Historic opex by category—summary
	Historic opex by category base year
	Historic opex by category 1st FY
	Historic opex by category 2nd FY
	Historic opex by category 3rd FY
	Historic opex by category 4th FY
	Historic opex by category 5th FY
Historic capital expenditure (capex)	Historic capex by category
	Historic capex by asset class
	Historic capex—network
	Historic capex—non-network
Commentary	Commentary on opex
	Commentary on historic capex
Instructions	Opex instructions
	Historic capex instructions

Service reporting information

The service indicators for transmission and distribution company under the service incentive scheme (as detailed in the previous section) must be reported annually. Each company must report its performance both with and without any proposed exclusions.

The companies should also report any events that were beyond their control and that they consider should be excluded from performance results. The primary drivers of performance in the present calendar year are to be reported, including reasons for any significant changes in performance from the previous calendar year.

The AER will provide each company with a customised service performance reporting template and each company must use this template to report relevant service performance information. Each company's service performance reporting template will be customised to allow for the differences in the performance incentive scheme parameters, weightings and values that apply under the service target performance incentive scheme

Finally, AER will conduct an annual review of the service performance information in accordance with the service target performance incentive scheme.

Appendix 8: Suggested China T&D data collection schedules

Section 7 of this document proposed performance indicators for each of the following categories:

A. **Assets** – including regulated asset value, capex, depreciation, and asset condition

B. **Costs** – opex, broken down by various categories

C. **Network revenue** – including revenue calculation and overall financial model

D. **Electricity revenue** – electricity sales and technical/non-technical losses

E. **Service and outputs** – including quality of service, customer service and other performance indicators

F. **System parameters** – generation/demand energy requirements and T&D system parameters

This appendix suggests the associated 'raw' data categories, together with historical and forecast information, that will be required to support this more detailed analysis.

It is important that regulatory authorities collect both the raw data and the associated performance indicators to undertake regulatory supervision. Having verifiable raw data will enable performance indicators to be calculated and analysed, and for performance indicators to be adjusted if necessary.

A. Assets

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) 5-year period to show trends.
- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.
- Asset value data for each of the following categories to be provided separately for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.
- Asset value data to be provided for each asset class and each voltage category
- Depreciation data to be provided for each asset class and each voltage category
- Asset age/condition data to be provided for each class of asset by each voltage category
- A complete reconciliation is required between initial asset value and final asset value for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Regulated asset value						
1. Initial asset value	Value of assets by each voltage and plant type category at start of year					
2. Plus additional capex comprising a, b, and c below						
a. Load related capex	Capex related to new generator and demand connections					

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
b. Non-load related capex	New capex related to refurbishment, and asset replacement					
c. Other non-load related capex	Other new capex not related to network assets e.g. IT systems, offices					
3. Less disposals/write downs (actual)	Assets removed from asset valuation over the year					
4. Less depreciation (actual)	Depreciation calculated in line with pre-set lifetimes for each category of asset					
5. Final asset value	Value of asset population at end of year by type and voltage					
Asset condition						
Average age of overhead lines (by voltage level)	Indicates expected level of opex and reliability					
Average age of cables (by voltage level)	Indicates expected level of opex and reliability					
Average age of transformers (by voltage level)	Indicates expected level of opex and reliability					
Average age of switchgear (by voltage level)	Indicates expected level of opex and reliability					

B. Costs

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) 5-year period to show trends.
- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.
- Operation & maintenance cost data for each of the following categories to be provided separately for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Cost breakdown						
4. Total direct costs as set out in a, b and c below	costs directly associated with network operation and maintenance,					
(a) Direct costs – Fault repairs	costs incurred in unplanned fault repairs					
(b) Direct costs - operation & maintenance	costs for routine operation and maintenance. This is assumed to include labour and material costs associated with operation & maintenance					

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
(c) Other direct costs	other direct costs associated with operation & maintenance activities					
5. Total support costs as set out in a and b below	support costs indirectly associated with network operation & maintenance					
(a) Support & overhead costs	support and overhead costs indirectly associated with network operation & maintenance e.g. head office costs, corporate costs					
(b) R&D support costs	R&D costs indirectly associated with network operation and maintenance					
6. Non-controllable costs	non-controllable costs associated with network operation and maintenance e.g. lease payments, local taxes, regulatory charges					
Total operation & maintenance cost	total cost of network operation and maintenance					

C. Network revenue

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) 5-year period to show trends.
- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.
- Revenue data for each of the following categories to be provided separately for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.
- A complete reconciliation is required between revenue values for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.
- Network charges should reconcile to revenue values for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue calculation						
Total revenue	Forecast, approved, or actual					
Actual rate of return	Forecast, approved, or actual					
Capex under/over performance	Shows capex under/over performance versus allowance					
Opex under/over performance	Shows opex under/over performance versus allowance					
Depreciation actual v forecast	Shows depreciation increase/decrease versus allowance					
Actual tax	Shows tax increase/decrease versus allowance					

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Actual regulated asset value	Shows regulated asset value versus allowance					
Actual revenue adjustment	Shows revenue adjustment versus forecast					
Network charges						
Total network charges comprising a and b below	Shows the total network charges					
a) Network charges for generation	Shows the network charges for distributed or transmission generation					
b) Network charges for demand	Shows the network charges for distributed or transmission demand					

D. Electricity Revenue

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) 5-year period to show trends.
- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.
- Sales data for each of the following categories to be provided separately for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.
- A complete reconciliation is required between electricity sales, network losses, and electricity production for a) enterprise forecast, b) NDRC approved, and c) actual. Variations to be shown between each category.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Electricity sales						
Total forecast electricity sales for transmission, distribution	Shows increase/decrease					
Total actual electricity sales for transmission, distribution	Shows increase/decrease					
Electricity losses						
Technical losses	Measurement of losses attributed to each of transmission and distribution					
Non-technical losses	Measurement of losses attributed to metering errors, theft, etc.					

E. Service and outputs

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) five-year period to show trends.
- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reliability						
Number of customer interruptions (T&D)	The number of times an average customer will experience unplanned interruptions to supply					
Length of interruptions (T&D)	The time an average customer will experience unplanned interruptions to supply					
Energy not supplied (T)	The MWh of unsupplied energy to consumers					
Number of unplanned outages (T)	Average number of outages, indicating reliability problems					
Duration of unplanned outages (T)	Average time of outage duration, indicating time that reliability is reduced					
2. Availability						
Guaranteed users (T&D)	The number and capacity of customers where supply is guaranteed					
Guaranteed users' power consumption (T&D) [30]	Energy supplied to guaranteed users					
Energy not supplied to guaranteed users (T&D)	The MWh of unsupplied energy to guaranteed users					
3. Customer service						
Number of complaints (D)	The number of complaints together with an overview of actions taken to remedy complaints					
Customer surveys (T&D)	The overall response received from customer surveys in response to specific issues affecting them e.g. new connections, interruptions					
4. Connections						
Time to connect new demand customer (T&D)	The average time it takes to a) make offers, and b) connect new customers					
Time to connect new generator customer (T&D)	The average time it takes to a) make offers, and b) connect new customers					
5. Safety						
Compliance with safety legislation	No of violations of safety legislation					
6. Environmental						
Compliance with environmental legislation	No of violations of environmental legislation					

F. System parameters

Data requirements for each enterprise are set out below and illustrated in the following table:

- All data to be provided over a (suggested) 5-year period to show trends.

[30] Adapted from existing proposal for performance measures – definition to be confirmed

- Transmission and distribution data to be separately provided. Distribution to be defined as 132kV and below, transmission as above 132kV.
- Forecast and actual data to be provided, showing variations.

Data	Definition	Year 1	Year 2	Year 3	Year 4	Year 5
Energy requirements						
Peak demand (MW)	Total and increase/decrease in peak demand, indicates capex requirements					
Energy delivered (MWh)	Total and increase/decrease in energy delivered indicating network utilisation					
Distribution network loading	Average duration of network feeders operating at higher than planned utilisation factors, by voltage category					
Transmission network loading	Average duration of transmission network operating at higher than planned utilisation factors, by voltage category					
Distribution connected generation (MW)	Total and increase/decrease in distribution connected generation; split by renewables, and other fuel sources					
Transmission connected generation (MW)	Total and increase/decrease in transmission connected generation; split by renewables, and other fuel sources					
Capacity of non-grid connected distributed energy	Total and increase/decrease in non-grid connected distributed energy					
Grid connected distributed energy	Total and increase/decrease in non-grid energy					
Network characteristics						
Overhead line length	Total and increase/decrease in length of overhead line; split by voltage level					
Cable length	Total and increase/decrease in length of cables; split by voltage level					
Transformer capacity	Total and increase/decrease in numbers and capacity of transformers; split by voltage level					
Switchgear	Total and increase/decrease in numbers of switchgear; split by voltage level					
General information						
Geographic area	Area served by enterprise					
Total population	Total population is area served by enterprise					
Number of customers	Total customers in area served by enterprise					