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**Database Platform Development for Regulating
Transmission and Distribution (T&D) Pricing
Final Report**

Electric Power Development Research Institute. CEC

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1. Introduction

1.1 Background

China's electricity sector is undergoing a major transition from a state managed 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 during the past few years.

Currently, the price reform is one of the core contents of market-oriented reform. Since the Reform and Opening-up, China's price reform has been continuously promoted and deepened, and the majority of competitive commodity prices have been liberalized. As a typical network type of the natural monopoly industry, electricity has been the difficulty of the price reform. In 2015, the Several Opinions of the CPC Central Committee and the State Council on Further Deepening the Power Sector Reform (Zhong Fa [2015] No. 9) was issued which clearly pointed out the approach of power sector reform is "holding the middle and releasing both ends". "Holding the middle" refers to establishing appropriate T&D pricing system, providing both incentive and constraint mechanisms to grid enterprises, promoting the orderly and coordinated development of both generation and power grids, optimizing the development of electricity resources, and safeguarding the healthy and orderly development of overall power market. By July 2017, China has completed the transmission and distribution price verification work at provincial power grid level, and published to the public through development and Reform Commission (bureau) of provinces, autonomous regions and municipalities. It becomes the first fully completed task in electric power system reform since No. 9 file published, and the price of provincial transmission and distribution power grid has entered regulation phase.

To guarantee the landing of the reform target, the government continuously promoted the establishment of the price regulation system and the strengthening of the supervision means. To improve the cost supervision ability of the price departments, the NDRC Price Department plans to build database for the transmission and distribution regulation, which used as an important tool for future cost supervision and examination. Price Department entrusted China Electricity Council to study on the preliminary construction scheme of the database, and drafted the "Transmission and Distribution Price Regulation Database Preliminary Construction Plan", which gave the preliminary design of the index system and function structure of transmission and distribution cost supervision.

The transmission and distribution price supervision database platform is an authoritative and professional data application platform contributing to organize and develop the transmission and distribution price supervision widely and further. The aim of the preliminary Chinese T&D database design is to improve the routine regulatory supervision system for T&D companies. It will achieve efficient data acquisition, intelligent analysis, accurate measurement and moderate sharing. The National Development and Reform Commission price Department has further plans for the design of the transmission and distribution price supervision database platform. They plan to launch pilot projects in several selected provinces and cities in 2018. On this basis, the database will be extended to all provincial power grids nationwide.

1.2 Aim of this project

The aim of this project is to inspect the Chinese transmission and distribution price regulation database preliminary construction plan by drawing on foreign experience. Foreign experts were invited to take part in this project. Some of the practical problems with collecting and using performance information have been identified and addressed based on the experience from the regulation practice in UK and USA.

2. Review of the International regulation

2.1 Introduction of foreign experts invited

To obtain an accurate background knowledge related to the database platform improvement. Two foreign experts were involved into this project. A briefly introduction of their background is presented below. Both two experts have worked in the government authority and have been involved in policy formulation related to the electricity industry regulation. The quality of this project's achievement is assured by their rich experience and valuable data provided.

- Mr. Charles Mee - Senior Utilities Engineer at California Public Utilities Commission, USA. He has abundant experience in the incident's investigation and audited utility operations. His work experience on working for the Drafted resolutions for utility tariff filings on station power services and addressing jurisdiction coordination between the California State and the Federal governments help the project's achievement accord with practice.
- Mr. Robert Hull - A former 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.

2.2 Revenue and performance regulation in UK

The UK power sector was reformed over 25 years ago to separate electricity generation and supply from transmission and distribution networks. These networks were maintained as regulated monopolies, while competition was introduced into generation and supply. All the previous state-owned companies have been privatised, and investors in these companies have changed over the years. The key bodies involved in governance of the sector are:

- **UK Government** - The Department for Business, Energy & Industrial Strategy brings together responsibilities for business, industrial strategy, science, innovation, energy, and climate change. BEIS sets overall policy for the sector and, for example, has implemented policies to encourage the rapid growth of renewable energy from wind and solar.
- **Ofgem** - Office of Gas and Electricity Markets (Ofgem) is the National Regulatory Authority in UK. They are a non-ministerial government department and an independent National Regulatory Authority, recognised by European Union Directives. Ofgem's principal objective in carrying out our functions is to protect the interests of existing and

future electricity and gas consumers. Ofgem sets the prices that transmission and distribution companies can charge.

The regulatory regime adopted by Ofgem called RIIO (Revenue = Incentives + Innovation + Outputs) - one which has delivered reliable electricity supplies for customers, while at the same time delivering better customer service and lower costs. The RIIO model encourages network companies to manage their costs effectively by allowing them to keep a percentage of under-spend on their base revenue, or be liable to cover the same percentage of any overspend. 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.

2.3 Revenue and performance regulation in USA

Because of historical reasons, American electric power companies usually operate multiple utilities services at the same time, such as power transmission and distribution, natural gas, water supply, etc. Each kind of industry has matured and detailed accounting and statistical rules which is different from the general accounting standards of the United States. American transmission and distribution companies submit annual reports of their transmission and distribution business in a specific format every year.

In the United States, the transmission and distribution price are regulated at two levels. At the federal level, the agency responsible for the economic regulation of the power industry is federal energy regulatory commission (Ferc). At the state level, state governments regulate power companies primarily through their utility boards or similar regulators.

The UK regulatory regime is based on the equity returns, long-term debt and capital structure. Most parts of the United States have achieved the separation of plant network reform and the operation of the electricity market. Federal regulation of electricity prices is much the same between different zones. The principles of federal government's pricing are:

- Cost sharing must be coinciding with revenue.
- Cost cannot be Shared with those who do not receive benefits to service areas or power suppliers.
- When using the cost-benefit ratio to approve projects, the cost-benefit ratio cannot be set higher than 1.25.
- The process of identifying project benefits and beneficiaries must be open and transparent.
- Costs cannot be Shared outside the grid planning area where the project is located.
- The operator can adopt different cost-sharing methods for different types of transmission projects.

Regulation at each level of government in the United States is conducted primarily through open and transparent administrative litigation. During the decision-making process, every case needs to be publicized, related evidence needs to be collected. The government need to listen carefully to the argument reasons of the applicant and the proposer. Finally, make a comprehensive judgment and give the final judgment. Due to the different development history, ownership structure, service area, power grid structure and user composition between different power company, it is very difficult to monitor different power companies based on a standard indicator system. Further detailed analyse would be necessary for these projects.

3. Review of the Chinese T&D Performance Database

3.1 Introduction

In 2017, the Chinese national development and reform commission (NDRC) planned to establish a database platform to supervise T&D prices, as an important tool for auditing T&D costs in future. This database platform is aim to improve the supervisory capacity for power transmission and distribution pricing. 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.

3.2 Indicators for T&D prices regulation

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 T&D regulatory database platform.

The preliminary design of the database platform targets the key areas of financial and technical performance. It includes revenues, investment in assets, operational costs and quality of service indicators. Sixty-three indicators regarding to the T&D prices regulating was designed set with the purpose to help the government authority to regulate the T&D prices effectively. These performance indicators can be separated into six categories.

- **Asset Investments** - The asset performance indicators provide information on the asset investment that is taking place against a plan or target. They are each to be reported annually. The objectives of these indicators is 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. They also identify how the actual asset value has changed compared to the original asset values and predicted/target change in asset values.
- **Costs** – cost performance indicators provide information on a range of different cost and depreciation parameters. Most of them are set to be reported annually. The objective is to measure deviations between actual and approved values for several cost categories. These parameters allow comparisons across T&D enterprises.

- **Incomes** – income performance indicators were designed to provide information about 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.
- **Electricity Sales** - cost performance indicators were designed mainly to provide information on the difference between actual and forecast sales. They also provided information associated with the energy loss in the transmission and distribution network. Sales per unit of transformer capacity or line length will be calculated to allow comparisons between assets and enterprises. These indicators will identify the revenue and profitability at each voltage.
- **Service** - service performance indicators were 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** – special performance indicators include “Ratio of grid-connected distributed energy” and “Distributed power supply access Cost”. These two refers to the proportion of grid connected distributed power and the unit cost of connecting distribution power sources.

3.3 Data collection method

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.

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. Suggestions based on the international experiences

4.1 Comparison of T&D Performance databases

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. The performance indicators used in the UK 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.

4.2 Optimization and upgrading of the indicator system

The recommended performance measures expanded by the foreign experts will be listed below, following some preliminary opinions from the project team.

A. Assets

Performance measure	Description	Comment
Regulated asset value (T&D)		
Initial asset value	Value of asset population at start of year	The relevant data has been collected but is not set as an indicator.
Plus, additional capex (actual)		The relevant data has been collected but is not set as an indicator.
Load related capex	Capex related to new generator and demand connections	The relevant data has been collected.
Non-load related capex (asset replacement, refurbishment)	New capex related to refurbishment, asset replacement	The relevant data has been collected.
Other non-load related	Other new capex not related to network assets e.g. IT systems, offices	The relevant data has been collected.
Less disposals/write downs (actual)	Assets removed from asset valuation over the year	The relevant data has been collected.
Less depreciation (actual)	Depreciation calculated in line with pre-set lifetimes for each category of asset	The relevant data has been collected but is not set as an indicator.

Performance measure	Description	Comment
Final asset value	Value of asset population at end of year	The relevant data has been collected but is not set as an indicator.
Asset condition		
Average age of overhead lines (by voltage level)	Indicates expected level of opex and reliability	Data has not been collected.
Average age of cables (by voltage level)	Indicates expected level of opex and reliability	Data has not been collected.
Average age of transformers (by voltage level)	Indicates expected level of opex and reliability	Data has not been collected.
Average age of switchgear (by voltage level)	Indicates expected level of opex and reliability	Data has not been collected.
Actual total capex versus approved capex (by voltage)	Shows the variation in total actual capex compared with the approved level	The relevant data has been collected but is not set as an indicator.
Actual load related capex versus forecast load related capex	Shows the variation in load related capex compared with the approved level	The relevant data has been collected and it can be calculated.
Actual non-load related capex versus non-load related capex	Shows the variation in non-load related capex compared with the approved level	The relevant data has been collected and it can be calculated.
Total new capex as percentage of regulated asset value	Shows the rate of increase in regulated asset value	The relevant data has been collected and it can be calculated.
Regulated asset value per line length of each voltage level	Shows the change over time of asset cost per line length	The relevant data has been collected but is not set as an indicator.
Regulated asset value per transformer capacity of each voltage level	Shows the change over time of asset cost per transformer capacity	The relevant data has been collected but is not set as an indicator.
Regulated asset value per MWh of energy	Shows the change over time of asset cost per energy delivered	The relevant data has been collected but is not set as an indicator.

B. Costs

Performance measure	Description	Comment
Cost breakdown		
Total direct costs (forecast and actual)	Increase/decrease in costs directly associated with network operation and	Can't be collected under the existing system.

Performance measure	Description	Comment
	maintenance, and deviation from forecast value	
Direct costs – Fault repairs (forecast and actual)	Increase/decrease in costs incurred in unplanned fault repairs, and deviation from forecast value	Can't be collected under the existing system.
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	Can't be collected under the existing system.
Other direct costs (forecast and actual)	Increase/decrease in other direct costs associated with operation & maintenance activities, and deviation from forecast value	Can't be collected under the existing system.
Total support costs (forecast and actual)	Increase/decrease in support costs indirectly associated with network operation & maintenance, and deviation from forecast value	Can't be collected under the existing system.
(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	Can't be collected under the existing system.
(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	The relevant data has been collected but is not set as an indicator.
1. Non-controllable costs (forecast and actual)	Increase/decrease in non-controllable costs associated with network operation and maintenance, and deviation from forecast value	Can't be collected under the existing system.
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).	Can't be collected under the existing system.
Cost ratios		
Total O&M cost as percentage of asset value	Shows the amount of opex in relation to the regulated asset value	The relevant data has been collected but is not set as an indicator.

Performance measure	Description	Comment
O&M cost per unit of line length	Shows the amount of opex per unit of line length	The relevant data has been collected but is not set as an indicator.
O&M cost per customer	Shows the amount of opex per customer	The relevant data has been collected but is not set as an indicator.
O&M cost per MW of max demand	Shows the amount of opex per unit of maximum demand	The relevant data has been collected but is not set as an indicator.
O&M cost per MWh of energy delivered	Shows the amount of opex cost per unit of energy throughput	The relevant data has been collected but is not set as an indicator.
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	The relevant data has been collected but is not set as an indicator.
Labour productivity	Increase/decrease in labour productivity	The relevant data has been collected but is not set as an indicator.

C. Network revenue

Performance measure	Description	Comment
Revenue calculation		
Actual revenue	Shows under/over-recovery of revenue versus allowed revenue	The relevant data has been collected but is not set as an indicator.
Actual rate of return	Shows higher or lower rate of return versus approved rate of return	The relevant data has been collected but is not set as an indicator.
Capex under/over performance	Shows capex under/over performance versus allowance	The relevant data has been collected but is not set as an indicator.
Opex under/over performance	Shows opex under/over performance versus allowance	Existing similarity and more reasonable index.

Performance measure	Description	Comment
Depreciation actual v forecast	Shows depreciation increase/decrease versus allowance	Existing similarity and more reasonable index.
Actual tax	Shows tax increase/decrease versus allowance	The relevant data has been collected but is not set as an indicator.
Actual regulated asset value	Shows regulated asset value versus allowance	The relevant data has been collected but is not set as an indicator.
Actual revenue adjustment	Shows revenue adjustment versus forecast	The relevant data has been collected but is not set as an indicator.
Network charges		
Actual network charges	Shows the total actual network charges	The relevant data has been collected.
Ratio of actual revenue recovered from network charges	Shows the amount of revenue that is recovered from network charges	The relevant data has been collected.
Network charges for generation	Shows the network charges per MW of distributed or transmission generation	Not applicable in China.
Network charges for demand	Shows the network charges per MW of distributed or transmission demand	The relevant data has been collected.

D. Electricity Revenue

Performance measure	Description	Comment
Electricity sales		
Total forecast electricity sales	Shows increase/decrease	The relevant data has been collected but is not set as an indicator.

Performance measure	Description	Comment
Total actual electricity sales	Shows increase/decrease	The relevant data has been collected but is not set as an indicator.
Ratio of actual to forecast sales	Shows accuracy of forecast	Existing similarity and more reasonable index.
Electricity sales per unit of transformer capacity, by voltage	Shows split of sales by transformer capacity	Existing similarity and more reasonable index.
Electricity sales per unit of overhead lines, by voltage	Shows split of sales by overhead lines	Existing similarity and more reasonable index.
Electricity losses		
Ratio of technical losses	Measurement of losses attributed to each of transmission and distribution	Data has not been collected.
Ratio of non-technical losses	Measurement of losses attributed to metering errors, theft, etc.	Data has not been collected.

E. Service and outputs

Performance measure	Description	Comment
Reliability		
Number of customer interruptions (T&D)	The number of times an average customer will experience unplanned interruptions to supply	Data has not been collected.
Length of interruptions (T&D)	The time an average customer will experience unplanned interruptions to supply	Data has not been collected.
Energy not supplied (T)	The MWh of unsupplied energy to consumers	Data has not been collected.

Performance measure	Description	Comment
Number of unplanned outages (T)	Average number of outages, indicating reliability problems	Data has not been collected.
Duration of unplanned outages (T)	Average time of outage duration, indicating time that reliability is reduced	Data has not been collected.
Availability		
Guaranteed users (T&D)	The number and capacity of customers where supply is guaranteed	Data has not been collected.
Guaranteed users' power consumption (T&D) ¹	Energy supplied to guaranteed users	Data has not been collected.
Energy not supplied to guaranteed users (T&D)	The MWh of unsupplied energy to guaranteed users	Data has not been collected.
Customer service		
Number of complaints	The number of complaints together with an overview of actions taken to remedy complaints	Data has not been collected.
Customer surveys (T&D)	The overall response received from customer surveys in response to specific issues affecting them e.g. new connections, interruptions	Data has not been collected.
Connections		
Time to connect new demand customer (T&D)	The average time it takes to a) make offers, and b) connect new customers	Data has not been collected.
Time to connect new generator customer (T&D)	The average time it takes to a) make offers, and b) connect new customers	Data has not been collected.

Performance measure	Description	Comment
Safety		
Compliance with safety legislation	No of violations of safety legislation	Data has not been collected.
Environmental		
Compliance with environmental legislation	No of violations of environmental legislation	Data has not been collected.

F. System parameters

Performance measure	Description	Comment
Energy requirements		
Peak demand (MW)	Total and increase/decrease in peak demand, indicates capex requirements	Data has not been collected.
Energy delivered (MWh)	Total and increase/decrease in energy delivered indicating network utilisation	The relevant data has been collected but is not set as an indicator.
Distribution network loading	Average duration of network feeders operating at higher than planned utilisation factors	Data has not been collected.
Transmission network loading	Average duration of transmission network operating at higher than planned utilisation factors	Data has not been collected.
Distribution connected generation (MW)	Total and increase/decrease in distribution connected generation; split by renewables, and other fuel sources	The relevant data has been collected but is not set as an indicator.

Performance measure	Description	Comment
Transmission connected generation (MW)	Total and increase/decrease in transmission connected generation; split by renewables, and other fuel sources	Data has not been collected.
Capacity of non-grid connected distributed energy	Total and increase/decrease in non-grid connected distributed energy	Data has not been collected.
Ratio of grid connected distributed energy	Increase/decrease in non-grid energy	Data has not been collected.
Network characteristics (T&D)		
Overhead line length	Total and increase/decrease in length of overhead line; split by voltage level	The relevant data has been collected but is not set as an indicator.
Cable length	Total and increase/decrease in length of cables; split by voltage level	The relevant data has been collected but is not set as an indicator.
Transformer capacity	Total and increase/decrease in numbers and capacity of transformers; split by voltage level	The relevant data has been collected but is not set as an indicator.
Switchgear	Total and increase/decrease in numbers of switchgear; split by voltage level	Data has not been collected.
General information		
Geographic area	Area served by enterprise	Data has not been collected.
Total population	Allows population density to be calculated	Data has not been collected.
Number of customers	Allows customer density to be calculated	Data has not been collected.

4.3 Recommended improvement of data collection

Either the international data collection mechanism or the requirement of the database platform requires technical and financial information to be provided. But in the initial design, there is very little detail on the definition of what should be provided, and how consistency may be assured throughout. These include:

- 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 the 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.

According to the indicators suggested by the regulating database platform for transmission and distribution price, it is suggested to strengthen the data collection according to the following dimensions:

- **Energy Conservation** - Includes the power grid company's transmission equipment utilization rate and line loss reduction degree. The investment of power grid companies related to the energy - saving equipment will also be investigated with the purpose to Set up incentive programs. Relevant data was suggested to be collected from the power grid companies.
- **Load Side Response** - To investigate the business performance of load side response of grid companies, such as peak load reduction, short-term load side response, long-term load side response, and permanent load time shift, as well as the use of load side response to provide auxiliary services to the power market. Relevant data was suggested to be collected from the power grid companies and power market operators.

- **Proportion of Renewable Energy** – data related to the proportion of renewable energy as well as wind and light abandoning rate. Relevant data was suggested to be collected from the power producers.
- **Distributed Power Supplied** – data related to the distributed power generation and Local proportion of renewable energy available. Relevant data was suggested to be collected from the local government.
- **Energy Storage** - Total energy storage level, number of electric vehicles and number of energy storage contracts. Relevant data was suggested to be collected from the local government and the power grid companies.
- **Weather** - Extreme weather indicators can be measured in terms of social direct economic losses, and data should be collected from relevant government departments.
- **Social Security** - The indicator of a power smuggling event can be a quantity by electricity that is not measured except for line loss. Most of this electricity is due to electricity theft. Data should be collected from grid companies.
- **Risk Control** – Parameters related to the difficulty of power facility maintenance, health of power facilities and comprehensive quality of employees. Relevant data was suggested to be collected from the power grid companies.

5. Future work

The project team will continue to work on the improvement of transmission and distribution price regulation database preliminary design. Experts from government regulators, State Grid and China Southern Power Grid will be invited to provide further detailed suggestions related to the feasibility of the improved indicator system.