The Influence of Transmission and Distribution Electricity Price Reform on Power Grid Enterprise Investment and Its Solution-Calculation Based on EVA Model

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Abstract. Transmission and distribution electricity price reform (TDEPR) is an important process of China's electricity price reform, which directly changes the profit model of the power grid enterprises (PGEs) by breaking the monopoly of them in "purchasing" and "selling" and liberalizing the sales side of electricity. These changes make an impact on the investment and operation model of "PGEs". This paper is talking about the results of the power grid reform. Based on the change of cost composition and accounting mode of the "PGEs" after the "TDEPR", this paper analyses the impact of the "TDEPR" on the investment of the "PGEs" from four perspectives: investment scale, investment structure, investment efficiency and the economic value added (EVA). It is found that the "PGEs" have problems such as too large investment scale, inaccurate cost control, failure to balance the proportion of long-term and short-term projects, low return but large pressure on short-term investment, sharp drop in return on assets (ROA), insufficient ability to respond to policy changes, and lack of asset management. In response to the above problems, this paper proposes the following measures. First, in terms of investment scale, it is recommended that the "PGEs" should strengthen investment cost control and improve investment precision. Second, in terms of investment projects, it is suggested that the "PGEs" take into account short-term investment benefits while ensuring long-term benefits, strengthen the evaluation of investment benefit, and promote effective investment. Third, in terms of investment benefits, it is suggested that the "PGEs" optimize investment processes, improve asset management, and strengthen investment controllability. This paper provides some practical references for the challenges that the "PGEs" encounter in promoting the "TDEPR".

Keywords: transmission and distribution price reform; power grid enterprise investment; economic value added; analysis of investment data

1 Introduction

Transmission and distribution electricity price reform (TDEPR) is an important process of China's electricity price reform. In October 2014, the National Development and Reform Commission (NDRC) and the National Energy Administration (NEA) formulated the guiding document for the first time. It guided the provincial-level power grids carry out the "TDEPR" in batches, by starting from the provincial power grid "TDEPR", through the reform method of "pilot first, then promotion",

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with "permission cost plus reasonable income" as the basic principle. At the end of 2017, after 32 provincial power grids completed the first regulatory cycle of the approval work of the transmission and distribution price (TDEP), the “NDRC” extended the “TDEPR” across provinces and regions by virtue of the extensive transmission characteristics of regional power grids. In March 2018, the “NDRC”, in order to achieve the target of an average 10% reduction in the general industrial and commercial electricity prices, decided to implement price reduction measures in two batches and directly cut electricity prices for general industrial and commercial industries. Therefore, the “TDEP” s cooled again. In May 2019, the “NDRC” and the “NEA” jointly revised and issued cost supervision measures for the “TDEPR” in order to promote the “TDEPR” through the management of transmission and distribution cost. This management method strengthens the restraint and incentive function of cost supervision and examination, refines the methods of cost supervision and examination and standardizes the requirements of cost supervision and examination procedures, and promotes the reform of transmission and distribution electricity price from a more detailed and more operational cost level. With the gradual advance of the “TDEPR”, the power grid company, as the transmission and distribution hub, has been affected by many aspects. These influences have promoted scholars to conduct in-depth studies on the “TDEPR” and the cost management of the power grid enterprises (PGEs) [1], asset management [2-3], investment benefits [4-5] and Economics activities [6]. Since the “TDEP” is directly related to the income of the power grid company, in order to ensure the sustainable development of the company, the precision and efficiency of the investment become the key [7-8]. Therefore, combining various existing assets, optimizing investment decisions is an important way for the “PGEs” to cope with and promote the “TDEPR” and ensure their own development during the period [9-10].

With the continuous introduction of the “TDEPR” policies, the “PGEs” to deal with the “TDEPR” of the way is gradually mature. According to the scholars' thinking and research, this paper reviews the investment status of the “PGEs” since the “TDEPR”. Based on the concrete influence of the “PGEs” in the process of the “TDEPR”, the change and significance of their investment measures are identified. More accurately finding out the problems when the “PGEs” to deal with the “TDEPR”, and give more practical solutions. Then, it can help China promote the “TDEPR” more effectively and promote the steady.

2 Influence of transmission and distribution price reform on power grid enterprise investment

2.1 Investment Scale

Before the “TDEPR”, the relevant business of electricity in China was taken care of by State Grid Corporation of China (SGCC), China Southern Power Grid (CSGP) and Mengxi Power Grid. The power grid business of 31 out of 34 provinces is in the charge of SGCC and CSPG. Therefore, these two enterprises are selected as the main research objects. From a macro perspective, based on the first year after the pilot of “TDEPR” of State-owned Assets Supervision and Administration Commission (SASAC) in 2015. Data collation and analysis were made on the overall investment scale of the two major the “PGEs”. According to the investment data disclosed by State Grid Corporation and China Southern Grid Corporation in their social responsibility reports (Fig. 1).

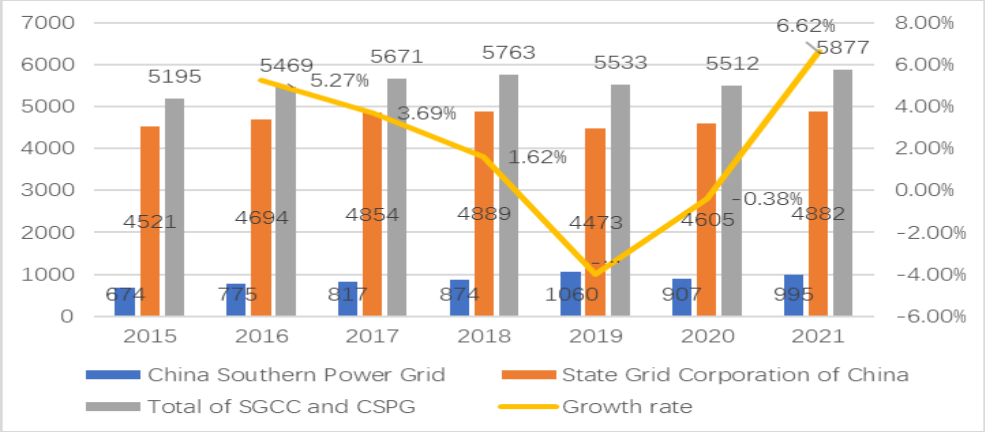


Fig. 1. Investment scale of SGCC and CSPG. (in hundred millions)

The collated data shows that until 2019, although the investment trend has been showing an upward trend, the growth rate has been declining. Even the SGCC significantly reduced its investment amount in 2019. In 2020, CSPG also reduced its own investment, and the total investment did not rise again until 2021.

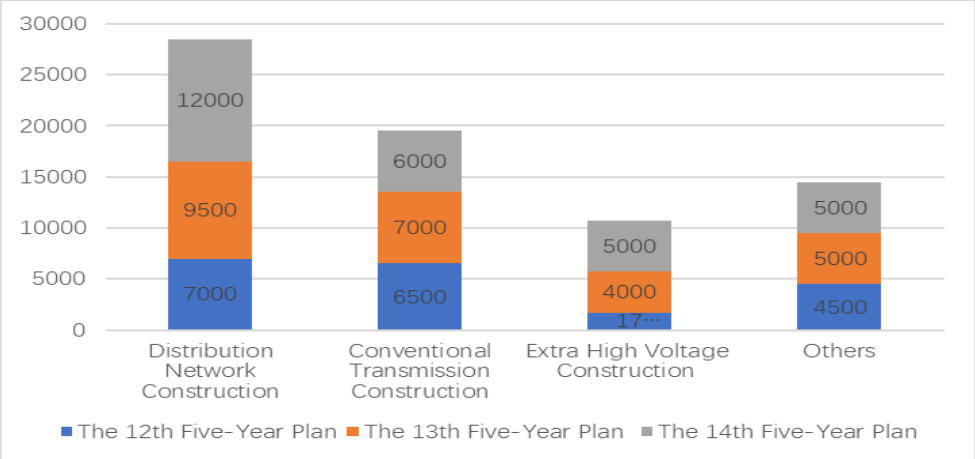
Based on the requirements of the “TDEPR” for the “PGEs”, that is, the price only consists of the cost and reasonable income allowed by the "price authority of The State Council". After that, the income structure of the “PGEs” changed from charging the price difference of purchasing and selling electricity to charging network fees according to the principle of permissible cost and reasonable income, resulting in a certain degree of compression of the profit of the “PGEs”. From the perspective of time, in the first four years before the “TDEPR” was fully implemented, although the reform reduced the income to some extent, the “PGEs” ensured their huge profit space and maintained their investment capacity by relying on their original high electricity market share. The gradual slowdown in the rate of investment growth also shows that the “PGEs” have realized the impact of the “TDEPR”. On the other hand, after the “TDEPR”, with the change of cost composition and accounting method of the “PGEs”, the transmission and distribution cost of the “PGEs” has squeezed out the power purchase cost, and its proportion in the total cost has gradually increased.

Therefore, in the case that the “TDEPR” has not been fully promoted, the “PGEs” are relatively little impact on investment, and the change of investment scale is also within a reasonable range. The beginning of the policy pilot has not had much impact on their investment scale. However, in 2018, SASAC directly lowered the general industrial and commercial electricity prices twice, which brought a shock to the “PGEs”. The result of the shock was directly reflected in the power grid investment scale in the following year, and the overall investment scale was lowered to mitigate the impact of the sudden decline in income. With the continuous progress of the “TDEPR”, the electricity sales market is gradually opened to social capital, and the “PGEs”' market share of electricity sales business is further compressed. Then in 2021, the rise of the new energy consumption market under the influence of the “carbon peaking and carbon neutrality goals” (“Double Carbon” goal) makes the investment scale of the “PGEs” increase again in the same year, making preparations for the future competition in the electricity sales market and the proportion of new energy transmission and distribution market.

To sum up, as the “TDEPR” has been promoted from pilot to firm, the investment scale of Chinese the “PGEs” has experienced a process of first slowing down and then cautiously declining. In order to strengthen the competitiveness of the “PGEs”, and promote new energy given under the "Double Carbon" goal market, the investment scale of rose again showed the credibility and determination of state-owned enterprises, but the huge investment scale changes still need further explanation and research, investment scale of volatility is the embodiment of the investment strategy is not comprehensive. In order to strengthen the competitiveness of the “PGEs”, and promote green energy market given under the “Double Carbon” goal, rising again of the investment scale showed the credibility and determination of state-owned enterprises. But the huge investment scale changes still need further explanation and research and the drastic fluctuation of investment scale is also the reflection of the incomplete investment strategy.

2.2 Investment structure

As the “TDEPR” directly affects the profit of the “PGEs”, it has largely changed the business management thinking and profit model of these the “PGEs”. In order to adapt to the “TDEPR”, the “PGEs” began to pay more attention to the economic benefits that investment projects can bring, and also show a cautious attitude in the power grid investment structure. After data integration from the micro perspective of each project share of power grid investment, the time period is divided into the 12th Five-Year Plan period (2011-2015), 13th Five-Year Plan period (2016-2020) and 14th Five-Year Plan (2021-2025) period. Through sorting out the subdivision structure of power grid investment of the “PGEs”, it is found that after the “TDEPR”, the proportion of distribution network construction in the power grid investment structure gradually increases, while the conventional transmission construction is stable and has a decreasing trend during the 14th Five-Year Plan period (Fig. 2).



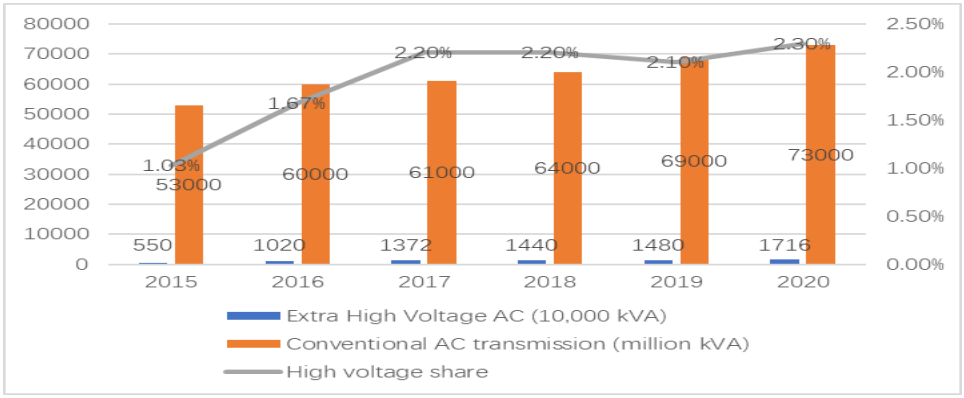
Data source. Cinda Securities R&D Center

Fig. 2. Graphical representation of the breakdown structure of power grid investments. (in hundred millions)

The distribution grid is a key link for energy production, conversion and consumption, and a support platform for renewable energy consumption. Increasing investment in it can improve power quality, enhance customer experience and meet more electricity demand. Under the background of the

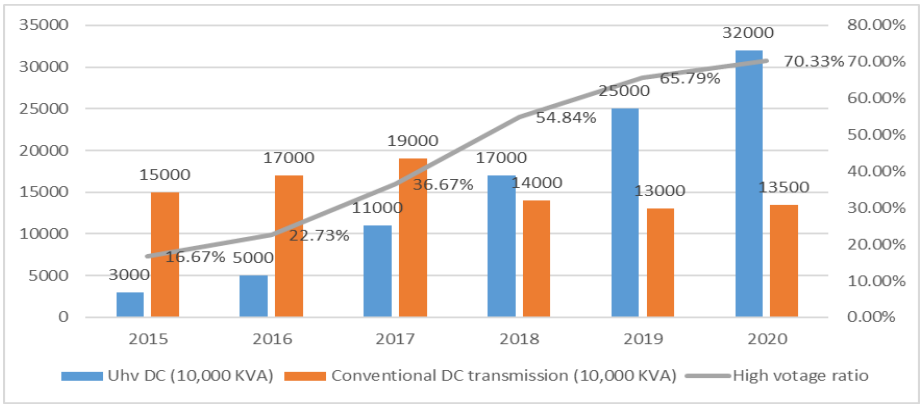
"TDEPR", investing in distribution grid construction can improve the ability of the "PGEs" to meet customers' electricity demand, thus increasing business income by increasing electricity supply.

At the same time, the proportion of investment in extra-high voltage construction is also gradually increasing. Although the proportion of extra-high voltage in alternating current (AC) power is not high and the change is small (Fig. 3), the proportion of extra-high voltage in direct current (DC) transmission is gradually increasing (Fig. 4).



Data source. CEC, Cinda Securities R&D Center

Fig. 3. Conventional AC substation capacity and extra high voltage AC substation capacity.



Data source. CEC, Cinda Securities R&D Center

Fig. 4. Conventional DC transformer capacity and UHV DC transformer capacity.

Ultra-high voltage (UHV) power grid has the advantages of long-distance, large capacity, low loss and low land occupation, etc. At the same time, UHV is the necessary support for the development of clean energy, and UHV power grid is the key to solve the large-scale consumption of clean energy generation. In the current situation, the rising coal price has led to a significant increase in the cost of thermal power generation, coupled with the guidance of the "Double Carbon" policy, clean energy power generation has become the main trend in the future, the "PGEs" to increase investment in the

construction of UHV is conducive to adapt to the trend of power generation enterprises to rely on clean energy generation, which helps to improve the “PGEs”' resource allocation capacity and economic operation efficiency. At the same time, the “PGEs” are investing more and more in grid intelligence (Table 1).

Table 1. Smart grid construction investment of SGCC ratio table. (in hundred millions)

	2009-2010		2011-2015		2016-2020	
	investment	proportion	investment	proportion	investment	proportion
Power generation	6.4	1.88%	28.1	1.61%	60	1.56%
Transmission	22.4	6.57%	91.2	5.21%	238.8	6.22%
Substation	17.2	5.04%	364.9	20.85%	748.1	19.48%
Distribution	56	16.41%	380.4	21.74%	892.1	23.22%
Used	100.8	29.54%	579	33.09%	1184.7	30.84%
Scheduling	32.8	9.61%	62	3.54%	146.4	3.81%
Communication information	105.6	30.95%	244.4	13.97%	571.2	14.87%
Total	341.2	100.00%	1750	100%	3841.3	100%

Data source. Company prospectus, "National Grid Intelligent Planning General Report", Western Securities R&D Center

The investment in the digital transformation of the grid can be seen as an important strategy to seize the future economic high ground under the “Double Carbon” goal and the "Internet+" wind, which is important to ensure the future profitability of the grid, so both SGCC and CSPG are actively engaged in digital transformation. For example, from 2009 to 2020, the total investment in smart grid construction is increasing. After the “TDEPR”, the investment in smart grid construction has increased 119.50% during the 13th Five-Year Plan compared to the 12th Five-Year Plan.

The “TDEPR” makes the “PGEs” need to consider more economic benefits and investment risks, while the increase of investment in extra high voltage construction, distribution network construction and smart grid construction is conducive to improving the profitability of the “PGEs”, helping them to speed up the adaptation to the changes of power generation side, while providing better electricity quality and services to customers.

2.3 Investment benefits

In addition to investment scale and investment structure, investment income is an important part of investment strategy. The investment income in the same period also reflects the attitude and strategy of the “PGEs” towards the “TDEPR”. According to the data disclosed by the SGCC and CSPG in the social responsibility report (Fig. 5), it can be found that the “TDEPR” does have a certain impact on corporate profits. After the introduction of the “TDEPR” policy in 2015, the overall return on equity of power grid showed a downward trend, and then the reform changed from "mechanism building" to "strong supervision". The investment income of the “PGEs” continued to decline, and the downward trend became more obvious in 2020. The return on equity of SGCC and CSPG directly dropped to 2.15% and 1.89%. Finally, the investment efficiency of the “PGEs” picked up in 2021.

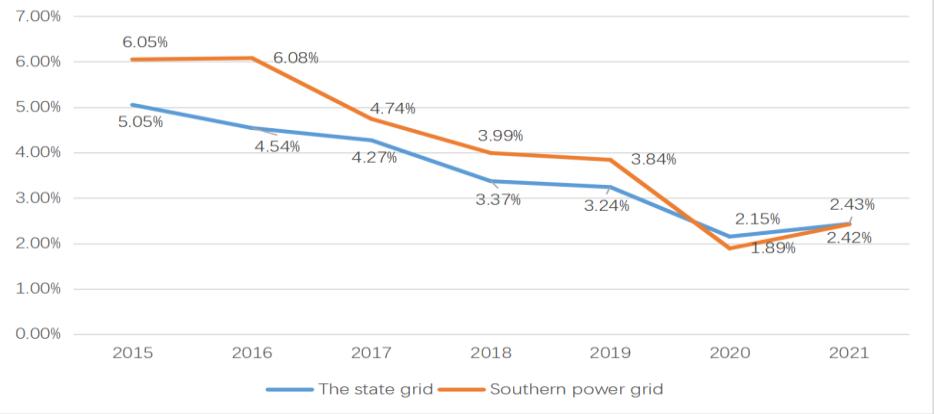


Fig. 5. Return on net assets of power grid.

Looking back at the whole reform period of electricity "TDEP", a new round of electricity price reform was officially launched in 2015, and the "TDEPR" was carried out nationwide in 2016. This round of power reform has a profound impact on the development of the "PGEs" in all aspects. Since the electricity price after the reform is changed to be measured by the income reviewed by the regulatory authorities, the estimated income of the "PGEs" is limited. Based on this, the business field and profit model of the "PGEs" have gradually changed, and the competition mechanism has been introduced into the power generation side and the power sales side. It can be seen that the profit source of enterprises has changed from the electricity sales revenue minus related costs of the power grid before the reform to the coexistence of earned electricity purchase and sale price difference and approved the "TDEP" after the reform. Therefore, with the gradual increase of reform intensity and the gradual improvement of supporting mechanism, the profit space of the "PGEs" is compressed, and then the investment benefit shows a gradual downward trend.

In 2019, the average electricity price of general industry and commerce was lowered, and the main electricity sales income of the "PGEs" came from general industry and commerce, which affected the income of enterprises again. In addition, under the impact of the epidemic, from the internal point of view, in order to actively respond to the national "call for phased reduction of enterprise electricity cost", the "PGEs" transfer profits to power enterprises; From the external perspective, the daily activities of urban and rural residents are limited, the overall social demand for electricity slows down, and then the electricity sales of enterprises decrease, resulting in the continuous expansion of the loss area of enterprises at all levels of the SGCC, and finally leading to a significant decline in the return on power grid investment in 2020.

2021 is the first year of the 14th Five-Year Plan. China has entered a new stage of development, and the investment efficiency of the "PGEs" has begun to pick up. On the one hand, the epidemic control in China has been gradually improved, the economy is in the recovery stage, and all industries in society are back in operation. Although the social electricity demand has not recovered to the pre-epidemic level, it has also begun to recover gradually. On the other hand, according to the national requirements, the "PGEs" take the initiative to adapt to the relevant policies of the "TDEPR", strictly control power grid investment, improve enterprise business performance, reduce inefficient and ineffective investment, so that the return on net assets of power grid begins to show a state of recovery.

To sum up, the “TDEPR” has a fundamental impact on the profit model and investment efficiency of the “PGEs”. It not only shows the increasingly perfect “TDEPR”, but also reflects the process of the “PGEs” gradually adapting to the reform. However, enterprises still need to optimize investment strategies, reduce costs and increase efficiency, and achieve more accurate and effective investment, so as to further cope with the new situation of compressed income.

2.4 Economic Value Added

In order to provide data support for the investment benefits of power grid companies from an overall perspective, according to the guidance of the “SASAC”, central enterprises are encouraged to use economic value added (EVA) for annual assessment. Based on the EVA business performance evaluation index system established by SGCC in 2008, the following calculation formula is set:

$$EVA = NOPAT – AC \times WACC \tag{1}$$

where

NOPAT- Net operating profit after tax;

AC- Adjusted capital;

WACC- Average cost of capital ratio;

The average cost of capital ratio of “PGEs” is calculated at 4.1% according to the standard of enterprises with poor asset versatility. As the guidance of the EVA business performance evaluation index system given, the NOPAT of the “PGEs” should be calculated as the formula below:

$$NOPAT = NP + (IE + RDEA) \times (1 – ITR) \tag{2}$$

where

NP- Net profit;

IE- Interest expense;

RDEA- Research and development expense adjustment;

ITR- Income tax rate;

According to the tax law, the income tax rate is temporarily calculated at 25%.

Due to the characteristics of central enterprises, the adjust capital has the characteristics of state-owned assets, so SGCC has made the guidance applicable to central enterprises, the formula is as follows:

$$AC = AOE + TAL – AIFCL - ACP \tag{3}$$

where

AOE- Average owner's equity;

TAL- Total average liabilities;

AIFCL- Average interest-free current liabilities;

ACP- Average construction in progress;

The calculation formula of AIFCL is set:

$$AIFCL = (IFCL1 + IFCL2) /2 \quad (4)$$

where

$IFCL_1$-Last year interest-free current liabilities;

$IFCL_2$-Current year interest-free current liabilities;

According to the index system, the Interest-free current liabilities (IFCL) includes notes payable, accounts payable, prepaid accounts, employee compensation payable, taxes payable, interest payable, dividends payable, special payable, other current liabilities and other payable payments.

Based on the audit reports of SGCC and CSPG, relevant data are sorted out. The following tables are sorted out for the parts related to IFCL (Table 2, Table 3):

Table 2. IFCL of SGCC (in hundred millions)

IFCL of SGCC	2014	2015	2016	2017	2018	2019	2020	2021
Notes payable	9.88	172.08	250.08	255.13	5353.64	558.78	932.02	744.18
Accounts payable	3856.08	3832.89	4202.09	4714.79	0	5043.81	4853.76	5383.86
Prepaid accounts	1175.46	1234.83	1728.67	2157.79	1960.86	1904.58	1521.13	14.67
Employee compensation payable	320.98	322.05	318.48	342.63	358.88	384.98	174.44	183.91
Taxes payable	48.44	25.47	189.3	256.79	265.93	257.49	366.28	329.62
Interest payable	102.29	109.87	104.71	108.36	0	0	0	0
Dividends payable	107.66	118.04	172.49	120.92	0	0	0	0
Special payable	2335.38	2775.42	3190.89	3191.6	3607.49	3782.64	3530.51	3195.84
Other current liabilities	9.51	18.94	25.21	22.18	17.71	15.95	97.81	307.97
Other payable payments	147.2	136.55	153.74	161.4	0	0	0	0
Sum of IFCL	8112.88	8746.15	10335.66	11331.59	11564.52	11948.23	11475.94	10160.06
AIFCL		8429.52	9540.9	10833.62	11448.05	11756.38	11712.09	10818

Table 3. IFCL of CSPG (in hundred millions)

IFCL of CSPG	2014	2015	2016	2017	2018	2019	2020	2021
Notes payable	1.74	14.3	13.28	12.63	42.3	71.89	85.05	102.2
Accounts payable	544.93	535.03	645.31	782.06	745.75	752.5	729.56	796.81
Prepaid accounts	105.51	114.13	127.48	135.69	140.8	135.82	15.52	43.42
Employee compensation payable	106.26	109.1	111.79	112.91	114.44	88.3	50.25	52.83
Taxes payable	-9.49	-6.25	49.23	61.94	47.4	84.93	31.84	44.53
Interest payable	21.97	21.18	19.92	18.63	0	0	0	0
Dividends payable	0.12	0.07	0.07	0.07	0	0	0.64	0.83
Special payable	28.92	32.07	30.13	35.19	0	0	0	0
Other current liabilities	200.65	100.36	51.18	175.37	345.77	300.68	232.42	324.66
Other payable payments	440.27	533.27	641.35	698.51	664.46	639.12	539.04	534.81
Sum of IFCL	1440.88	1453.26	1689.74	2033	2100.92	2073.24	1684.32	1900.09
AIFCL		1447.07	1571.5	1861.37	2066.96	2087.08	1878.78	1792.21

According to the formulas (1-4), the EVA calculation results of the two companies are shown as follows (Table 4, Table 5):

Table 4. EVA of SGCC (in hundred millions)

EVA of SGCC	2015	2016	2017	2018	2019	2020	2021
NP	671.56	660.05	671.56	565.10	579.31	420.21	502.69
IE	373.23	351.53	410.84	397.98	384.69	398.49	318.79
RDEA	0.00	0.00	90.32	98.55	140.99	167.04	163.30
AOE	13298.27	14463.29	15590.04	16620.93	17629.87	18717.50	19827.93
TAL	16707.20	18100.88	20482.86	22078.37	22895.72	23997.68	25286.12
AIFCL	8429.52	9540.90	10833.62	11448.05	11756.38	11712.09	10818.00
ACP	3813.04	4122.64	4068.27	3967.70	3933.59	4059.57	3983.86
WACC	4.10%	4.10%	4.10%	4.10%	4.10%	4.10%	4.10%
EVA	223.20	148.77	179.42	-17.13	-44.69	-260.33	-378.55

Table 5. EVA of CSPG (in hundred millions)

EVA of CSPG	2015	2016	2017	2018	2019	2020	2021
NP	194	160	137	126	138	81	100
IE	122.3	97.92	94.33	116.54	124.43	138.18	143.63
RDEA	0.1	0.2	0	1.9	20	25	8.6
AOE	2350.5	2589.5	1840.5	3069.5	2369.5	3927	2769.5
TAL	3934.5	4055.5	779.5	4715.5	763	5803.5	3356
AIFCL	1447.07	1571.5	1861.37	2066.96	2087.08	1878.78	1792.21
ACP	802	775	48	693.5	797.5	989.5	32.5
WACC	4.10%	4.10%	4.10%	4.10%	4.10%	4.10%	4.10%
EVA	120.33	57.35	178.61	8.82	236.16	-77.97	37.84

The EVA performance of “PGEs” shows a decrease until 2019 and a gradual recovery after 2020, which is consistent with the overall profit change and investment benefit of power grid enterprises. It can be seen from the profit status of power grid enterprises shown by EVA performance that it interacts with the change of investment strategy of enterprises. When dealing with the reform of electricity transmission and distribution price, the immaturity of investment strategy and method brings burden to the added value of enterprises. In the case of the fluctuation of added value, the investment also makes corresponding adjustment and gradually matures. Therefore, the EVA of power grid enterprises can be measured from a more comprehensive perspective, and the influence of the electricity transmission and distribution price reform on the investment and even the overall profit of power grid enterprises can be proved by data facts.

3 Problems in power grid enterprise investment under transmission and distribution price reform

According to the collation and summary of the above data, it can be found that in the period of the “TDEPR”, although the “PGEs” experienced a decline in benefits and a sharp reduction in investment scale in 2019, they still picked up again in 2021 and returned to the right track. Review the whole process of “TDEPR” so far. The problems and causes of power grid enterprise investment fluctuation can be explored from the time dimension.

First of all, in the early stage of the “TDEPR”, from 2015 to 2017, the reform has not been fully applied to the whole country. Although the growth rate of investment scale has slowed down, the “PGEs” still maintain the original operation status. However, in the “TDEPR”, through the updating of electricity price structure and cost accounting methods, as well as the more stringent requirements, the “PGEs” lack in cost control and investment accuracy, resulting in the failure to properly control the investment scale and ensure returns.

Secondly, in the middle period of the “TDEPR”, from 2018 to 2019, with the gradual improvement of the reform plan and requirements, the “PGEs” are also adapting to the new operating conditions and reducing the scale of investment to mitigate the income reduction caused by the change of electricity price structure. However, the continuous reduction of investment benefits shows that the “PGEs” have problems in their expected judgment of investment projects. The “PGEs” consumed a large amount of power grid investment in UHV construction and smart grid. In the long run, these investments are conducive to the “PGEs” to adapt to the changes in the power generation side, which is conducive to the sustainable development of the “PGEs”. However, in the short term, both UHV and smart grid construction are projects with long payback period and high initial input cost. In the case of the “PGEs”' profit space is compressed, the investment in UHV construction and smart grid has significantly increased the cost, which has a negative impact on their short-term profits.

Finally, in 2020-2021, the “TDEPR” has been relatively mature and complete. The investment scale，benefits and the EVA of the “PGEs” have a certain trend of recovery, but the return on assets has plummeted, which highlights the “PGEs”' insufficient ability to cope with policy changes and emergency capacity in asset management. Due to the impact of epidemic and the formulation of “Double Carbon” goal policies, the “PGEs”, as state-owned enterprises, have the obligation to maintain people's livelihood and respond to policies. Therefore, in order to implement policies and ensure people's livelihood, the “PGEs”, while sacrificing their own interests, should also consider optimizing asset management to reduce the impact of policy and public health changes.

To sum up, in the process of the “TDEPR”, the “PGEs”, due to the lack of detailed cost control, inaccurate project expectation judgment and unreliable policy response, eventually led to the fluctuation of investment scale, the allocation of investment projects and the decline of investment benefits during this period.

4 Solutions and recommendation for power grid enterprise investment under the reform of transmission and distribution price

In the process of “TDEPR”, the investment situation of the “PGEs” has been greatly affected. Some of the issues outlined above indicate that the “PGEs” still have room for improvement to provide a more solid foundation for future grid investment activities and stable operations, and to support further development of the “TDEPR”.

First of all, in terms of investment scale control, the “PGEs” should limit the investment scale, try to avoid blind investment without prior calculation, and reduce their own burdens and risks [11-12]. When considering investment timing, the “PGEs” need to focus on the overall balance, reasonable arrangement of investment opportunity, balance each regulation cycle of investment scale, avoid blind in the regulatory period gradually expand the scale of investment, which leads to the next cycle regulation distribution electricity price volatility, ultimately meet the demand of power grid security,

revenue expectations and long-term development of power grid [13]. For example, in view of the new requirements for the accounting of newly added effective assets put forward by the “TDEPR”, the “PGEs” should give priority to the projects with low investment in the years of capital shortage. This is also conducive to the next regulatory cycle, to maintain corporate efficiency, and to maintain business stability.

In terms of investment project prediction, the “PGEs” should take long-term consideration to ensure long-term investment benefits while reducing the negative impact of short-term investment benefits. First of all, the “PGEs” should make scientific planning in the timing of long-term and short-term investment projects, control the proportion of long-term investment projects and short-term investment projects, and promote effective investment in power grid. In terms of investment importance selection, the “PGEs” should fully understand the current situation of power grid development, prioritize power grid investment projects through overall consideration of the demands of relevant departments for power grid investment, so as to make limited investment funds tilt to key areas and important directions. At the same time, the “PGEs” should also consider the investment effect and construction cycle in a comprehensive way to avoid planning too much of the project with long payback period or large initial input cost, which will affect the short-term investment benefits of enterprises[14]. Secondly, the “PGEs” should carry out fine management in terms of investment project structure, effectively strengthen the overall evaluation and assessment of investment structure, and strengthen the evaluation of investment benefits. According to the diagnostic analysis of power grid development and the post-evaluation of power grid projects, the “PGEs” should analyze the power grid investment efficiency from multiple perspectives, provide quantitative support for scientific investment decisions, and balance the long-term and short-term investment benefits. In terms of investment expectation planning, the “PGEs” should also consider that the decrease of electricity price caused by the “TDEPR” will lead to the increase of electricity consumption. They should carry out investment plans according to the scale of the increase of electricity consumption, and pay attention to the short-term investment priorities while taking into account the long-term investment objectives [15].

In terms of asset and investment management, the “PGEs” should be prepared for the impact of policies and public health events such as the epidemic. In the process of the “TDEPR”, the profit model of the “PGEs” has changed fundamentally, and the profit has been compressed into a trend. Under such circumstances, enterprises need to optimize their own asset management, strengthen investment controllability, and pay attention to power grid investment benefits to cope with the impact of policy changes. In terms of asset management, enterprises should first improve the efficiency of using fixed assets, improve the fixed asset management system according to the current situation of fixed assets management and the actual production, realize scientific asset management, and maintain key indicators such as asset-liability ratio at a relatively stable level. Secondly, to improve the ability of asset preservation, the “PGEs” can ensure the scientific and fair depreciation policy and optimize the management and control strategy of asset obsolescence.

In terms of investment control, with the continuous strengthening of supervision by SASAC, the “PGEs” should, on the one hand, pay attention to the improvement of lean investment management system, that is, strengthen the supervision of departments with sufficient funds and concentrated power, and evaluate and evaluate the data of each link of power grid investment from the perspectives of timeliness, accuracy and so on, so as to gradually improve the controllability of investment. On the other hand, since the policy restricts the “PGEs” from entering the field of incremental distribution, the active participation of enterprises in such competitive businesses as incremental distribution

network can diversify the investment subjects [16]. The “PGEs” should also set up a supporting investment management mechanism to improve the current situation of long process and complicated approval procedures of investment control plan.

5 Conclusion

The paper reviews the investment situation of Chinese the “PGEs”, based on the changes of investment scale, investment structure, investment benefit and the EVA of the “PEGs” after the “TDEPR”, combined with the policy reform and social changes for research and analysis, to interpret the fundamental reasons for the change of the “PGEs” investment situation. In addition, it deeply considers the investment management of the “PGEs”, investment project prediction and policy response, and puts forward the relevant problems that the “PGEs” fail to consider completely or properly when dealing with the “TDEPR”, and gives corresponding solution. In 2021, the investment and the investment benefit of power grid enterprise has been gradually recovery, after the “TDEPR”, such as “Double Carbon” goal setting policy change and after the outbreak, the “PGEs” have gradually adapted to the “TDEPR” after the model, and actively promote “TDEPR” in all respects at the same time, provides support for stable social and livelihood of the people. Although the “PGEs” have experienced a decline in benefits and a contraction in investment scale from 2019 to 2020, their investment in UHV direct current and smart grid and other related projects will bring them quite positive returns in the future. Through such measures as seeking progress while maintaining stability and fine management, the “PGEs” can achieve better results in the process of realizing the "Double Carbon" goal, and steadily promote the “TDEPR” and the healthy development of society.

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