



ANALYSIS OF AT&C LOSSES IN THE POWER SECTOR: A COMPARATIVE CASE STUDY OF PUNJAB AND HARYANA

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ABSTRACT

DOI No: 10.36713/epra31731

Article DOI: <https://doi.org/10.36713/epra31731>

The paper compares the AT&C losses of the power sector of Punjab and Haryana, following the adoption of UDAY scheme. The analysis is done by employing various statistical tools such as CAGR, growth rate, exponential growth rate and regression. The data for this study is extracted from reports published by the PFC for the years 2012-13 to 2023-24. It was concluded that Haryana's power sector had improved significantly as compared to Punjab's. However, Punjab already was in a much better state. It is suggested to further reduce the losses by adopting GIS mapping, feeder metering etc.

KEY-WORDS: Power Sector, AT&C Losses, UDAY Scheme, Haryana, Punjab, Regression Analysis

INTRODUCTION

Electricity is the heart for both economic and non-economic growth of a nation. For a developing nation, like India, the power sector's efficiency highly impacts the nation's production and overall socioeconomic-economic progress. The country's power sector has gone through radical structural reforms especially after the World Bank's report "More Power to India". The report emphasised on the need for power sector reforms for better management and a strong fight against theft to ascertain economic growth and long term stability. (Pargal & Banarjee, 2014). Following the Electricity Reforms Act Orissa became the first state to implement power sector reforms succeeded by Haryana and Punjab. (Kumar, 2004).

The power sector of Punjab has two corporations responsible for power generation, transmission and the other responsible for distribution, namely — Punjab State Power Corporation Limited and Punjab State Transmission Corporation Limited

respectively. (Bhargava & Gupta, 2006). Further, Haryana's power sector is unbundled into four corporations one responsible for generation, one for transmission and the other two responsible for distribution in the state's northern and southern circles of the state, namely — Haryana Power Generation Corporation Limited, Haryana Vidyut Prasaran Nigam Limited, Uttar Haryana Bijli Vitran Nigam Limited and Dakshin Haryana Bijli Vitran Nigam Limited. (Centre of Energy Regulation, IIT Kanpur).

The power sector's financial and operational efficiency's one of the key components is AT&C losses. Lower the losses more is the efficiency. AT&C losses i.e. Aggregate Technical and Commercial Losses is the energy lost during transmission process and includes loss in energy due to various reasons such as power theft, collection and billing efficiency, payment evasion from the customers served etc. (Government of India, Ministry of Power, 2016).

$$\text{AT\&C Losses} = [1 - (\text{Billing Efficiency} \times \text{Collection Efficiency})] \times 100$$

To reduce these losses to 14 percent for Punjab MoU was signed by the state on 4-March-2016, (Press Information Bureau, 2016), and 15 percent for Haryana the MoU was signed by Haryana on 11-March-2016. (Press Information Bureau, 2016). This reduction was the target to be achieved by 2018-19. (Ministry of Power, Government of India, 2015).

LITERATURE REVIEW

Mishra, (2019) provides an extensive overview on the power sector of India. The study reports the poor financial health of power DISCOMs despite UDAY reforms, thereby converting thermal power plants, the dominant source of the nation's power sector, into NPA. It notices underutilisation of capacities and insolvency concerns. The improved electrification numbers are followed by questionable quality of power supply. The author

concludes the nation requires tariff rationalisation along with better coordination and stronger compliances.

Nirula, (2019) assesses the financial and operational sustainability of India's power DISCOMs in reference to the UDAY scheme. The weakest link in the power sector of the country. It was observed that about 50 DISCOMs had an overdue of more than 60 days to power generation amounting to ₹267.56 billion. The targeted AT & C losses reduced 15 percent or below for March 2019 were achieved by merely 14 DISCOMs. However, Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, Rajasthan failed to achieve this target. The ACS-ARR gap widened post tariff revisions. Billing efficiency improved by mere 1 percent in the year 2019. The author recommends the installation of smart meters, IT backed, meter-billing-collection-audit cycle and a revised UDAY 2.0.

Singh and Vashishth, (2019) explored the operational parameters and analysed the financial performance of the power sector DISCOMs in the state of Haryana. The study is based on secondary data collected from the UDAY portal from 11-March-2016 to 31-March-2019. It was observed that DHBVNL was working efficiently to achieve the reduced target of AT&C losses but UHBVNL was far away from the anticipated goal. Where the financial performance of the power sector was fragile its operational progress was mixed with power theft and weak smart metering being a concern. The author recommends revised tariffs for eliminating the ACS-ARR gap and to achieve UDAY set targets so as to avail priority funding through other centre schemes.

Kaur, (2026) evaluated the operational efficiency of Haryana's power DISCOMs by using secondary data. The study employed various statistical tools such as CAGR, growth rate, exponential growth rate and correlation. The variables analysed were customers served, billing and collection efficiency and AT&C losses. It was found that there was significant improvement in the operational and financial efficiency with a steady consumer growth.

GAP & SIGNIFICANCE OF THE STUDY

Out of the studies reviewed none has compared the AT&C losses of the power sectors of Punjab and Haryana. As on 1st November 1966, Punjab's geographical boundaries were restructured into two states — Punjab and Haryana, with a

common union territory — Chandigarh. (Government of India, 1966). Since, historically both the states before 1966 had shared the same geographical jurisdiction. It is logical to compare the AT&C losses of both the states and understand their operational performances.

OBJECTIVES

The objectives of this study are —

- To analyse AT&C losses in the power sector of Haryana
- To analyse AT&C losses in the power sector of Punjab
- To do a comparative analysis of AT&C losses between the power sectors of Punjab and Haryana

HYPOTHESES

Ho1: $\beta=0$, i.e. There is no improvement in the AT&C losses in the power sector of Haryana.

Ho2: $\beta=0$, i.e. There is no improvement in the AT&C losses in the power sector of Punjab.

RESEARCH METHODOLOGY

To achieve the objectives of the study data is drawn from the official website of Power Finance Corporations from 2013-2024. To examine the operational efficiency the analytical tools used are:

- **Growth Rate** - It is the percentage change expressed with respect to the previous year. It is the change of rate on year-on-previous-year. (United Nations Economic and Social Commission for Western Asia)
- **Compounded Annual Growth Rate (CAGR)** - Similar to the concept of compound interest. It is the growth over the study period with the compound effect. (Chan, 2009).
- **Exponential Growth Rate** - Overcoming the CAGR's limitation of ignoring the intermediate values between the extreme values of the time series. Exponential growth rate acknowledges the growth rate of intermediate values and therefore represents growth of all observations over the study period. (United Nations Economic and Social Commission for Asia and the Pacific, 2015)
- **Regression** - It shows the relation between dependent variables and the independent variables. (Freund et al., 2006)

TABLE-1 Multiple R values and their interpretation

Correlation Value	Interpretation
0.00-0.10	Negligible Correlation
0.10-0.39	Weak Correlation
0.40-0.69	Moderate Correlation
0.70-0.89	Strong Correlation
0.90-1.00	Very Strong Correlation

Source: Schober et al., 2018

KEY FINDINGS AND INTERPRETATIONS**TABLE-2 Aggregate Technical and Commercial Losses of Punjab and Haryana. (Values in percentage)**

YEARS	HARYANA		PUNJAB	
	LOSSES	GROWTH	LOSSES	GROWTH
2013-14	34.33	-	17.87	-
2014-15	32.52	-5.27	17.56	-1.73
2015-16	32.35	-0.52	15.88	-9.57
2016-17	26.42	-18.33	14.46	-8.94
2017-18	21.78	-17.56	17.31	19.71
2018-19	18.08	-16.99	11.28	-34.84
2019-20	18.26	1	14.35	27.22
2020-21	17.05	-6.63	18.54	29.2
2021-22	13.72	-19.53	11.67	-37.06
2022-23	12.01	-12.46	11.26	-3.51
2023-24	11.3	-5.91	10.96	-2.66
CAGR (value in %)	-10.52	-	-4.77	-
EXPONENTIAL GROWTH RATE (value in %)	-11.12	-	-4.89	-

Source: Power Finance Corporation Ltd. (2016, 2020, 2022, 2023, 2025)

(Table-2) The CAGR of AT&C losses of Haryana's power sector (-10.52 percent) is much more than the CAGR of AT&C losses of Punjab's power sector (-4.77 percent). This means the AT&C losses of the power sector of Haryana have shown a tremendous improvement as compared to that of Punjab's power sector. The exponential growth of negative 11.12 percent for Haryana's power sector and negative 4.89 percent for Punjab's power sector further proves the better efficiency of Haryana. From Table-2, it is evident that Haryana started with a larger AT&C losses of 34.33 percent in the year 2013-14 as compared to Punjab's much lesser AT&C losses of 17.87 percent. However, the power sector of Haryana managed to

drop to 11.3 percent by 2023-24, matching Punjab's AT&C losses of 10.96 percent. The major improvement year for Haryana was 2021-22. Both the states have shown a sudden rise in the losses in the year 2019-20 as a consequence of the infamous COVID-19 pandemic. This year in general came with a global setback and economic disruption. (Elavarasan et al., 2020). On comparing the growth rate of both the states, it is evident Haryana had led over Punjab's coping with the situation. From both the states Haryana stood tall whereas Punjab fell behind with a high growth rates of 27.22 percent and 29.2 percent in the years 2019-20 and 2020-21 respectively. However, it came out much stronger in the year 2021-22.

TABLE-2.1A Regression Statistics of AT&C Losses of Haryana's Power Sector

Multiple R	0.967215849
R Square	0.935506499
Adjusted R Square	0.927444811
Standard Error	2.099602307
Observations	10

Source: Author's calculation based on secondary data

Multiple R represents the correlation between dependent and independent variables. Here, (Table-2.1A) 0.967 of Multiple R exhibits a very strong correlation between the AT&C losses and the years. R Square and Adjusted R Square represent the explanatory power of the variables. 93.55 percent and 92.74 percent of R Square and Adjusted R Square means there is a very strong explanation of AT&C losses variation with respect to change in the years.

The correlation between AT&C losses and the years shows a robust relation in the power sector of Haryana as compared to the power sector of Punjab. Also, from Table-2.1A and Table-2.1B, variations in AT&C losses of Haryana's power sector are strongly explained as compared to a weak explanation by the AT&C losses of Punjab's power sector.

TABLE-2.1B Regression Statistics of AT&C Losses of Punjab's Power Sector

Multiple R	0.622169102
R Square	0.387094391
Adjusted R Square	0.31048119
Standard Error	2.422782366
Observations	10

Source: Author's calculation based on secondary data

Multiple R represents the correlation between dependent and independent variables. Here, (Table-2.1B) 0.622 of Multiple R exhibits a moderate correlation between the AT&C losses and the years. R Square and Adjusted R Square represent the explanatory power of the variables. 38.71 percent and 31.05

percent of R Square and Adjusted R Square means there is a weak explanation of AT&C losses variation with respect to change in the years.

TABLE-2.2A ANOVA-test of AT&C Losses of Haryana's Power Sector

	df	SS	MS	F	Significance F
Regression	1	511.558051	511.558051	116.043506	0.00000486
Residual	8	35.266639	4.408330		
Total	9	546.82469			

Source: Author's calculation based on secondary data

F-value represents the statistical significance of the model. Since, the F-value is more than 1 (Table-2.2A) it means the model is statistically significant. Significance F value represents the probability that the outcome occurred purely by chance. Significance F greater than 0.05 means the model is insignificant and null hypothesis gets accepted. Since, significance F value from Table-2.2A is much lower than 0.05, hence, null hypothesis (Ho1) should be rejected. Therefore,

there are improvements in the AT&C losses in the power sector of Haryana.

Table-2.2A and Table-2.2B, signifies the models are statistically significant for both Punjab and Haryana. Representing, there are improvements in the AT&C losses in the power sector of both Punjab and Haryana.

TABLE-2.2B ANOVA-test of AT&C Losses of Punjab's Power Sector

	df	SS	MS	F	Significance F
Regression	1	29.658015	29.658015	5.052581	0.054755
Residual	8	46.958995	5.869874		
Total	9	76.61701			

Source: Author's calculation based on secondary data

F-value represents the statistical significance of the model. Since, the F-value is more than 1 (Table-2.2B) it means the model is statistically significant. Significance F value represents the probability that the outcome occurred purely by chance. Significance F greater than 0.05 means the model is

insignificant and null hypothesis gets accepted. Since, significance F value from Table-2.2B is equal to 0.05, hence, null hypothesis (Ho2) should be rejected. Therefore, there are improvements in the AT&C losses in the power sector of Punjab.

TABLE-2.3A Significance of Regression Coefficients of AT&C Losses of Haryana's Power Sector

	Coefficients	Standard Error	t Stat	P-value
Intercept	36.5348	1.6427	22.2408	0.0000000177
1	-2.4901	0.2312	-10.7723	0.00000486

Source: Author's calculation based on secondary data

From Table-2.3A, it can be stated that for the power sector of Haryana AT&C losses = 36.5348 - 2.4901(Years). T-value measures the strength of the outcome. From Table-2.3A, t-value represents a strong strength of the outcome. P-value measures the reliability of the outcome. If P-value is less than

0.05 the null hypothesis gets rejected. Since, P-value is less than 0.05, Ho1 gets rejected, indicating a robust reliance of AT&C losses over the years. Therefore, there are improvements in the AT&C losses in the power sector of Haryana.

TABLE-2.3B Significance of Regression Coefficients of AT&C Losses of Punjab's Power Sector

	Coefficients	Standard Error	t Stat	P-value
Intercept	18.2242	1.8955	9.6143	0.00001377
1	-0.5996	0.2667	-2.2478	0.054755414

Source: Author's calculation based on secondary data

From Table-2.3B, it can be stated that for the power sector of Punjab AT&C losses = 18.2242 - 0.5996(Years). T-value measures the strength of the outcome. From Table-2.3B, t-value represents a moderate strength of the outcome. P-value measures the reliability of the outcome. If P-value is less than 0.05 the null hypothesis gets rejected. Since, P-value is less than 0.05, Ho2 gets rejected, indicating a robust reliance of AT&C losses over the years. Therefore, there are improvements in the AT&C losses in the power sector of Punjab.

T-values from Table-2.3A and Table-2.3B implies the outcomes of the model for Haryana are substantial while for Punjab it is moderate. However, P-values for both the states are less than 0.05, indicating improvements in the AT&C losses in the power sector of both the states.

CONCLUSION

It can be established from the above analysis that the power sector of Punjab was able to achieve the target of UDAY scheme of deducing the AT&C losses by 2018-19. However, it followed the upward trend thereafter till the year 2020-21 and by the end of the study period i.e. 2023-24, reduced to 10.96 percent. Whereas, Haryana was able to execute the target to reduce these losses only by the year 2021-22. To not overlook that Punjab was already witnessing much lower AT&C losses as compared to Haryana. Hence, the efficiency to reduce the AT&C losses was high for the power sector of Haryana as compared to the power sector of Punjab.

It is suggested that both the states should focus on meter auditing, compulsory installation of smart prepaid electricity meters, feeder metering, GIS mapping of losses, consumer indexing etc to reduce the aggregate technical and commercial losses at a much larger scale.

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