1 Introduction

Indian electricity sector has undergone various reforms since independence in 1947. Prior to 1947, the electricity sector was disaggregated with multiple private players mandated with electricity generation and transmission. There was a lack of any coordination at regional and national level to electricity production and consumption. This was addressed through the Electricity Supply Act (1948) mandating formation of State Electricity Boards (SEBs) to spread the supply from cities to the villages. However, the electricity transmission was still operated by the generators and thus widespread transmission of electricity was neglected due to poor revenue realisation by power generators. This, along with state-wise power generation hindered widespread adoption of electricity networks, which was addressed through rapid development of centralised power generation stations from 1975 onwards, and separation of TSO from power generators in 1991.

The next stage of reforms allowed for private power generation in 1991 and the introduction of power trading of up to 15% of new generation capacity via the Electricity Act (2003) which transformed the sector by allowing increasing competition and in turn reliable service to consumers. With the introduction of power trading, increasing imbalances to the grid frequency due to unrequisitioned surplus (URS) were being managed with a lot of difficulty by the system operator, necessitating the introduction of Deviation Settlement Mechanism (DSM, 2014) and Ancillary Services Mechanism (ASM, 2015) with the ancillary services provided for by dedicated power plants administered by the National Load Dispatch Centre (NLDC). But with increasing renewable energy generation capacity being added to the Indian electricity grid, currently at 200 GW in 2024, and a target of 500 GW by 2030, there was a need to manage sudden ramp and variation in supply closer to real-time. In this background, the Real-time market mechanism was introduced in 2020.[8] A visual representation of the evolution of the indian electricity market is shown below.

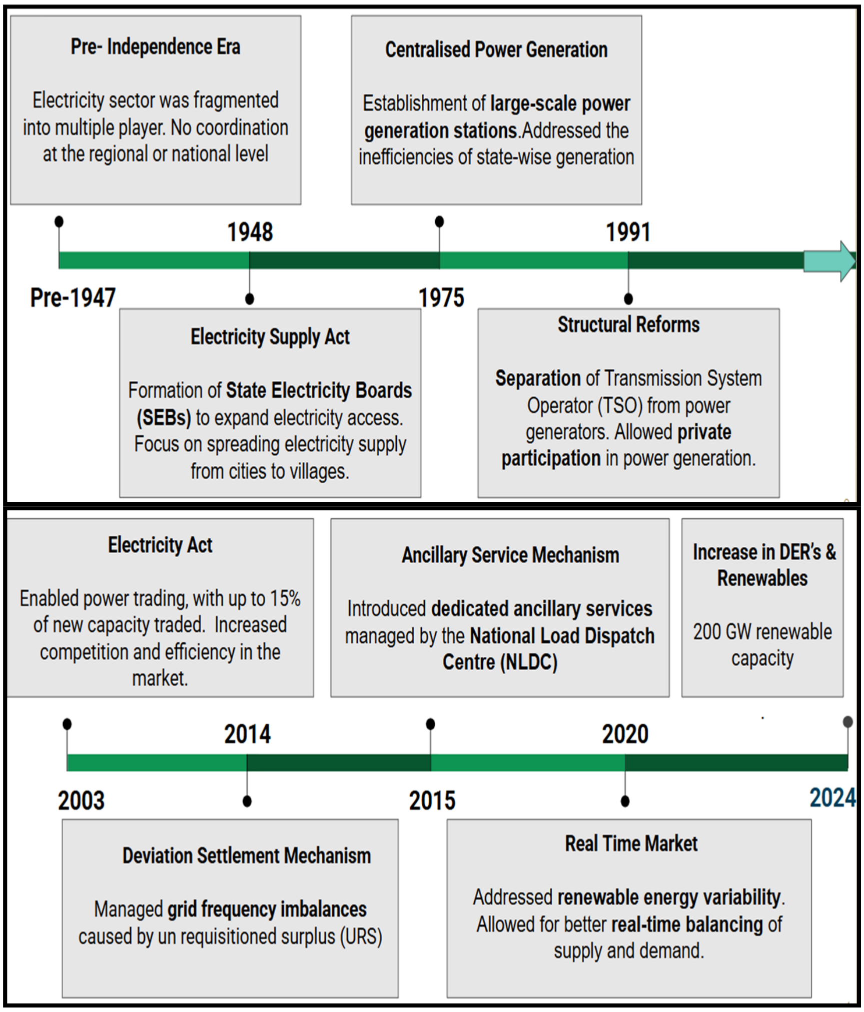

Fig. 1. Evolution of the Electricity System

2 Current Problem : the distribution sector

The distribution sector, handled by the Discoms (Distribution Companies), remains the most fragile link in India's power supply chain. These companies face numerous challenges that undermine their financial and operational stability. One of the most critical issues is the high level of Aggregate Technical and Commercial (ATC) losses, which result from outdated infrastructure, power theft, and inefficiencies in billing and revenue collection. Many Discoms struggle with poor billing efficiency and delays in tariff collection, making it difficult to recover costs. This inefficiency has contributed to mounting financial losses—by the end of FY 2021, total losses reached approximately €9.53 billion. Additionally, the monopoly structure of most Discoms has stifled competition, leaving little incentive to improve services or performance. Their inability to make timely payments to power generators further disrupts the electricity value chain, affecting overall energy security and reliability. The cumulative impact of these issues has left Discoms burdened with debt and in urgent need of structural reforms.

2.1 Case Study: Gujarat Discoms

Gujarat stands out as a strong example in India's power distribution landscape. The state has consistently maintained the lowest ATC losses, reflecting a high level of operational efficiency and effective infrastructure management. Its power supply is reliable, ensuring consistent electricity access across both urban and rural areas. Unlike many other states, Gujarat's distribution companies have a net positive worth, indicating sound financial health. In fact, the discoms in Gujarat have been ranked among the top five for nine consecutive years by the Power Finance Corporation in its Annual Integrated Rating Exercise. Gujarat has also been a frontrunner in adopting renewable energy and integrating real-time market (RTM) adjustments into its power management strategy. What truly sets the state apart is its strong political will and effective implementation of reforms. This combination has enabled Gujarat to maintain financial stability in its power sector while achieving widespread rural electrification.

3 Case Study Results

The following KPI as mentioned in the subsection where taken to measure the performance of discoms

3.1 ATC Losses, Billing Collection

To assess the performance and overall health of an electricity system, key metrics such as TD losses, ATC losses, and the ACS-ARR gap are commonly used. It is necessary to introduce these variable as we talk more about them in this section. In any electricity system, the total power generated is never fully utilized by consumers due to inherent losses. A portion of the electricity is lost during transmission and distribution, which is measured as Transmission and Distribution (TD) losses.

$$\%\text{age T\&D losses} = \left(1 - \frac{\text{Total energy Billed}}{\text{Total energy Input in the system}}\right) \times 100$$

India's TD losses average around 15% currently, nearly double the global average. However, there has been a significant improvement from 31.25% in 2004-05 [1]. These losses can be classified into:

- **Technical losses:** Losses due to energy dissipation in electrical components like transformers, lines, and conductors.
- **Non-Technical Losses (Commercial Losses):** Losses resulting from power theft, metering errors, or inefficiencies in billing and revenue collection.

While TD losses account for energy lost in the system, Aggregate Technical and Commercial (ATC) losses also talk about revenue collection efficiency.

$$\%\text{age AT\&C Loss} = (1 - (\text{Billing Efficiency} \times \text{Collection Efficiency})) \times 100$$

Where,

$$\text{Billing Efficiency} = \frac{\text{Total unit billed}}{\text{Total Input unit}}$$

$$\text{Collection Efficiency} = \frac{\text{Revenue Collected}}{\text{Amount Billed}}$$

With the challenges in the distribution sector, the Government of India has introduced various performance-linked schemes to ensure financial stability and operational efficiency of DISCOMs. One of the major reforms was the **Ujwal DISCOM Assurance Yojana (UDAY)**, launched to improve the financial health of state-owned distribution companies. Under UDAY, states assumed **75% of DISCOMs' outstanding debt as of September 30, 2015**, issuing **State Development Loan (SDL) Bonds** to restructure liabilities. This initiative, along with other efficiency measures, led to significant improvements:

- ATC losses declined from 23.70% in 2015-16 to 15.37% in 2023.
- The ACS-ARR gap (difference between the Average Cost of Supply and Average Revenue Realized) reduced from 0.54/kWh in 2015-16 to 0.45/kWh in 2023.[2][4]

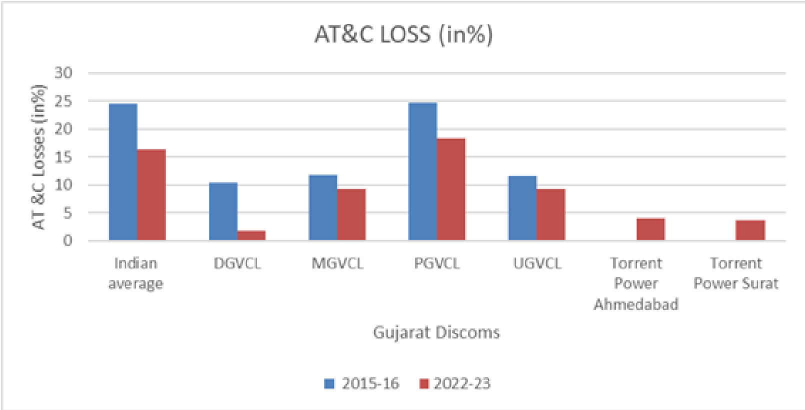

Fig. 2. AT&C Losses

ACS-ARR is also a critical parameter here which can be interesting to study for us. It measures the limit to which the average cost of supply which:

$$\text{(ACS-ARR) gap} = \text{Average Cost of Supply} - \text{Average Revenue Realized}$$

Where Average Cost of Supply is the total cost incurred by a DISCOM to procure, transmit, and distribute electricity, including generation costs, transmission charges, and operational expenses, divided by the total electricity supplied.

ARR (Average Revenue Realized) is the revenue earned per unit of electricity from consumers, including tariffs, subsidies, and other charges, divided by the total electricity sold.

Table 1. ACS-ARR Gap for Gujarat Discoms

States/DISCOMs	2015-16	2022-23	Remark
DGVCL	0.04	0.02	
MGVCL	0.01	0.05	Government
PGVCL	0.01	0.01	
UGVCL	0.04	0.02	
Torrent Power Ahmedabad		0.58	Private
Torrent Power Surat		0.30	
Average Gujarat	0.02	0.02	

3.2 Private player involvement

The Involvement of private players like Torrent Power at Ahmedabad and Surat location in Gujarat led to a very positive enhancement in the overall performances of the Discoms for the state, primarily due to following reasons:

- Huge reductions in AT&C losses, as seen in Figure 2, show that private sector companies have very low losses compared to their contemporary DISCOMs due to better management and a profit-driven approach.
- Their use of smart meters and SCADA systems helps them towards accurate data collection and enhanced billing efficiency, as per the 2022 audit report of the Bureau of Energy Efficiency.
- Highly efficient revenue collection and billing efficiency because of prepaid meters and digital payment systems.
- Strict enforcement against electricity theft through regular routine inspections, heavy fines, and active legal remedies against offenders.

4 Renewable Integration policies

As per the Electricity Act 2003 in conjunction with the National Electricity Policy of 2005 which envisioned that 85% of new generation capacity would be tied in long-term PPAs necessary for accessing debt for power producers and enabling their financial obligations by providing stable cash flow and the remaining 15% of the generation capacity will be available for trading through the electricity markets. At present, three power exchanges in India allow for short-term electricity transactions in various market segments, namely DAM and RTM. The success of the short-term transactions through the power exchanges can be illustrated by the rapid growth in the volume of electricity traded through these markets from 7.19 BU (2009-10) to 121.49 BU (2023-24) at a CAGR of 22.4%.[3] At the same time, the total volume of short-term electricity transactions DSM has consistently risen from 65.90 BU in 2009-10 to 218.22 BU in 2023-24 at a CAGR of 8.9% as can be seen in the figure 3 below, higher than the increase in total electricity generation at 6% reflecting the rapid growth of short-term power markets in India.[3]

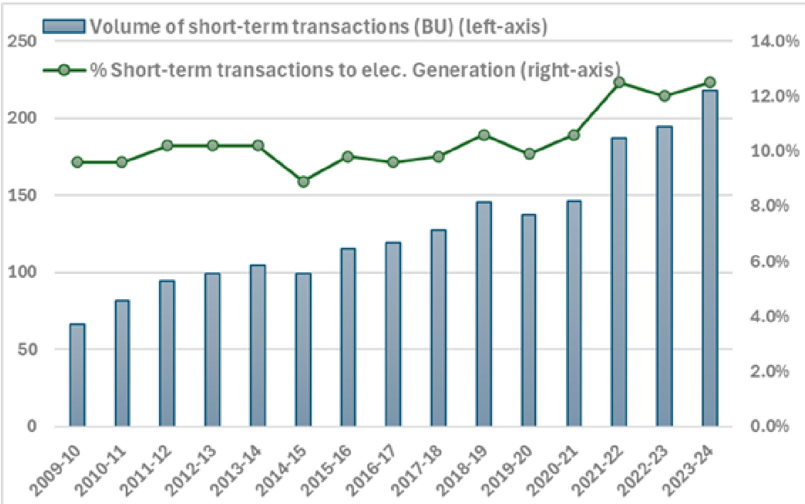

Fig. 3. Growth of short-term transactions

The success of RTM for short-term electricity transactions and the balancing of energy portfolios by participants in the electricity market can be gauged from the % of DSM volume of total short-term electricity volume, declining from 39.2% (2009-10) to 12.3% (2023-24) as can be seen in figure below.[3] A low volume of DSM % is beneficial for the market as DSM is not a market mechanism, and it means that market participants are utilizing RTM to settle their power balance schedules.

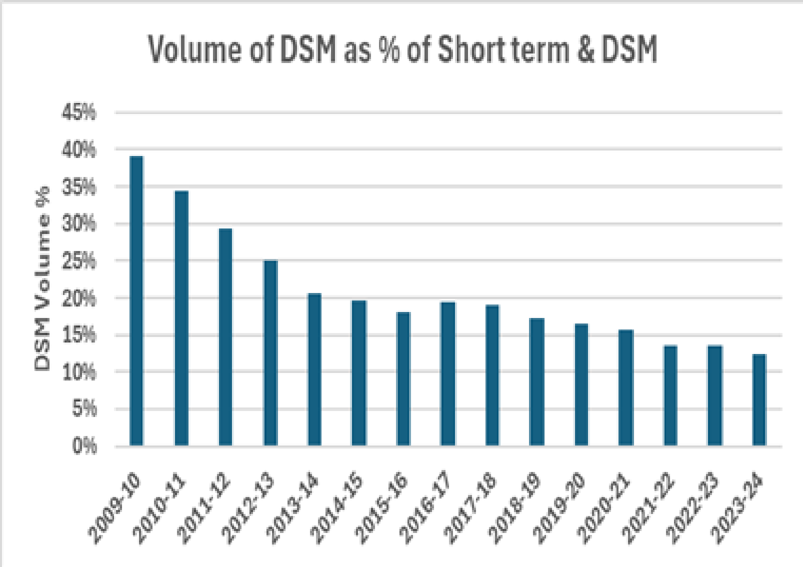

Fig. 4. Volume of DSM as % of short-term+DSM transactions

This rapid evolution of the power market in India over the last 15 years has not only enabled more dynamic and efficient portfolio management, but also laid the groundwork for renewable energy integration into the electricity mix. Gujarat, a province in western India is the leading contributor to the installed renewable energy capacity in India, having consistently risen from 9.4 GW (2017) to 27.5 GW (2023) at a CAGR of 20% as can be seen in figure 5 below.[5]

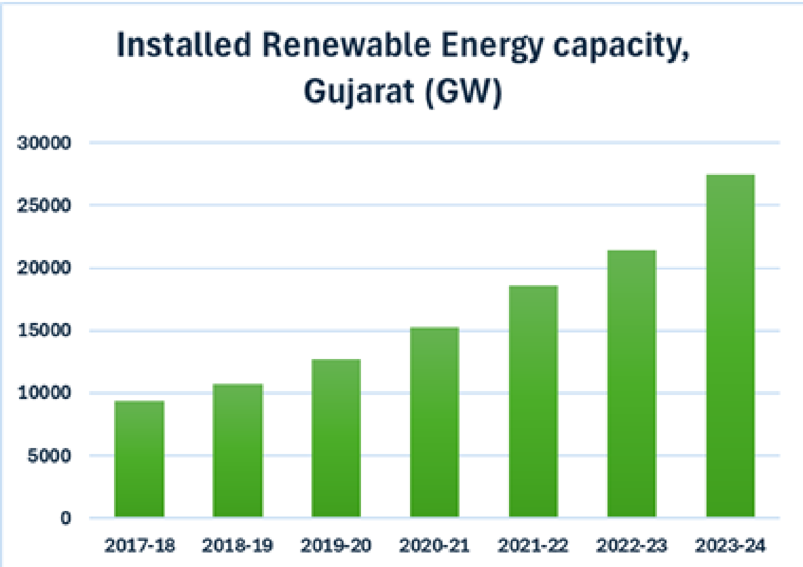

Fig. 5. Growth of renewable energy in gujarat

In this context, Gujarat has introduced specific measures to attract renewable energy investments. Some of them are worth mentioning here:

- **Wind-Solar Hybrid Power Policy (2018)**:[6]
  - **50% reduction in wheeling charges for hybrid energy projects:** Wheeling charges are the fees levied for utilizing the transmission and distribution infrastructure from the point of injection to consumption. A significant reduction in the wheeling charges has been aimed at incentivizing hybrid projects, which are significantly better at stable power generation. It also incentivizes renewable energy adoption as it reduces the cost to power consumers.

- **Green energy open access regulations (2024):**[7]
  - **Technical only losses for wheeling losses:**Wheeling losses typically consist of the following components;
    - Technical losses
    - Commercial losses
    - Wheeling ARR

    Applying only technical losses for wheeling charges incentivizes renewable energy for consumers and producers.
  - **Cap on Cross-subsidy charges:** Before 2003, DISCOMs subsidized residential/commercial consumers by charging industries higher tariffs. The Electricity Act 2003 allowed consumers with >1 MW load to bypass DISCOMs via Open Access, letting them buy cheaper market power.To offset lost cross-subsidy revenue from departing industries, DISCOMs levy Cross Subsidy Surcharge (CSS) on Open Access consumers. This charge compensates for the gap between subsidized tariffs for smaller consumers and the DISCOM's average supply cost. In this context, the CSS has been capped at 20% for green energy open access consumers to promote green energy consumption. Furthermore, a complete waiver is provided if the green energy is consumed for green hydrogen and ammonia production.

These state-specific policy initiatives by Gujarat have enabled the rapid integration of renewable energy into the power mix. But at the same time, to avoid the grid instability inherent in the variable production of renewable sources, Gujarat has also adopted the tightest deviation bands for DSM at 7% for solar power and 8-12% for wind power, which are more aggressive than the 10% limit defined by the CERC.

5 Why good policies are needed for better performance of Discoms?

A critical aspect of maintaining a stable grid lies in the accurate demand forecasting by DISCOMs. When demand forecasts deviate significantly from actual consumption, the resulting imbalance affects grid frequency, potentially leading to instability. To address this, incentive or disincentive frameworks encourage DISCOMs to align their forecasts more closely with actual demand. One prominent government policy in this context is the Deviation Settlement Mechanism (DSM), which serves as a key performance indicator (KPI) for frequency imbalances. By penalizing or rewarding market participants based on their adherence to scheduled drawal or generation, the DSM helps ensure more accurate forecasting and, ultimately, contributes to the overall stability of the power grid.

Deviation settlement Mechanism (DSM) regulations seek to ensure, through a commercial mechanism, that grid users do not deviate from and adhere to their schedule of drawl and injection of electricity in the interest of security and stability of the grid. However, starting from its inception, DSM has been revised as per the Central Energy Regulation Commission expert committee.

5.1 Introduction of Deviation Settlement Mechanism Regulation (2014-2016):

The Central Electricity Regulatory Commission (CERC) notified the Deviation Settlement Mechanism (DSM) Regulations in 2014 (DSM Regulations 2014) followed by an amendment in 2016 with the objective of ensuring grid discipline for the grid connected entities. In 2022, an amendment to the DSM Regulations came into effect with the key features of amending Deviation computation by delinking deviation charges from grid frequency and introducing a categorization system for different types of entities (general sellers/ wind-solar sellers).

Fig. 6. Timeline of DSM regulations

We discuss the evolution of the policy from 2014 to 2024 and see how CREC has been amending and suggesting improvements to the policy since its conception.

The DSM was introduced by CERC in 2014 to enhance grid discipline, frequency control, and scheduling accuracy among grid connected entities. The objective was to regulate power injection and withdrawals from the grid by imposing financial penalties for deviations from scheduled values. Through these objectives, it was expected to:

- Link deviation charges to frequency by formulating a pricing mechanism linked to frequency deviation.
- Encourage accurate forecasting and scheduling by incentivizing to improve forecasting methodologies to minimize deviations.
- Promote a market-based grid balancing approach to encourage integration with power markets and ancillary services to manage real-time grid imbalances efficiently.
- Although primarily focused on conventional power plants, DSM regulations sought to manage the growing share of renewable energy which posed forecasting challenges.

The regulation has set 2 pricing mechanisms; one for frequency deviation (called as schedule price) and the other for further deviations depending on the grid operating frequency and the operator.

The frequency deviation is charged for all the time-blocks for over drawl by the buyer and under-injection by the seller and receivable for under drawl by the buyer and over injection by the seller, **except for wind and solar generators which are regional entities which are to be worked out on the average frequency of a time-block which offer some flexibility to renewable generators**.

These charges, depending on the deviation level led to reduction in compensation for the producer or the buyer as summarized in the table 2 below:

Table 2. Penalty Charges Based on Frequency Deviation

Scenario	Applicable To	Penalty Applied
Over drawl when frequency $\geq 50.05\,\mathrm{Hz}$	Buyers	No penalty.
Over drawl when $49.70\,\mathrm{Hz} \leq$ frequency $< 50.10\,\mathrm{Hz}$	Buyers	DSM charge based on frequency.
Over drawl when frequency $< 49.70\,\mathrm{Hz}$	Buyers	Strictly prohibited, charged $824.04\,\mathrm{Paise/kWh}$.
Under drawl when frequency $> 50.10\,\mathrm{Hz}$	Buyers	Penalized at charge for $50.0\,\mathrm{Hz}$ deviation.
Under-injection when frequency $\geq 50.05\,\mathrm{Hz}$	Sellers	No penalty.
Under-injection when $49.70\,\mathrm{Hz} \leq$ frequency $< 50.10\,\mathrm{Hz}$	Sellers	DSM charge based on frequency.
Under-injection when frequency $< 49.70\,\mathrm{Hz}$	Sellers	Strictly penalized, charged $824.04\,\mathrm{Paise/kWh}$.
Over-injection when frequency $> 50.10\,\mathrm{Hz}$	Sellers	Penalized at charge for $50.0\,\mathrm{Hz}$ deviation.

5.2 DSM calculation for a fictitious example

One key feature of this regulation is the deviation pricing for renewables is not based on the scheduled price as discussed above but on the Power Purchase Agreement (PPA). Using an example, we can demonstrate how it is calculated:

If a renewable producer is deviating (under/over injecting), following penalties would be applicable:

- **Under-injection** Penalty applied based on the Absolute Error (%) (PPA rate × multipliers)
- **Over-injection**Compensation received based on Absolute Error (%) (reduced payment beyond 15%).

If the deviation exceeds the limit (L) then additional penalties are applied:

$$D_u = \text{The first L MW deviation, which is charged at normal deviation rates.}$$
$$D_L = \text{The excess deviation beyond L MW, which is penalized.}$$
$$D = D_L - L$$
$$\text{Scheduled Generation (SG)} = 500\,\text{MW}$$
$$\text{Actual Generation (AG)} = 420\,\text{MW}$$
$$\text{Grid Frequency} = 49.80\,\text{Hz}$$

Allowed Deviation = ±12% of SG or 150 MW, whichever is lower (12% of 500 MW = 60 MW → This is the limit.)

$$\text{Actual Deviation (D)} = 420\,\text{MW} - 500\,\text{MW} = -80\,\text{MW (under-injection)}$$
$$\text{Excess Deviation} = -80\,\text{MW} - (-60\,\text{MW}) = -20\,\text{MW beyond limit}$$

Table 3. Additional Charge Calculation

Category	Additional Charge Calculation
D is between 12% (60 MW) and 15% (75 MW)	50 x (Deviation - 12% of SG) x Normal Deviation Charge
D is between 15% (75 MW) and 20% (100 MW)	100 x (Deviation - 15% of SG) + 1.50 x SG x Normal Charge

From table 2, for 49.80 Hz, rate = 573.96 Paise/kWh = INR 5.7396/kWh

$$\text{Energy deviated} = 60\,\text{MW} \times (15/60)\,\text{hours} = 15\,\text{MWh}$$
$$\text{Charge} = 15 \times 5.7396 = €86{,}094$$
$$\text{Excess deviation in this range} = 75\,\text{MW} - 60\,\text{MW} = 15\,\text{MW}$$

Formula from Table 3:

$$\begin{aligned} &50 \times (15\,\text{MW} * 15/60) \times \text{Nominal deviation charge} \\ &= 50 \times 3.75\,\text{MW} \times 5.7396\,\frac{\text{INR}}{\text{MWh}} \\ &= \text{INR}10{,}769 \end{aligned}$$

Additional Charge (for deviation between 15% and 20% i.e., 75 to 80 MW)

$$\text{Excess deviation in this range} = 80\,\text{MW} - 75\,\text{MW} = 5\,\text{MW}$$
$$\text{Formula from Table3:} \quad 100 \times (5 * 15/60) \times 5.7396 = 7{,}179$$

Post implementation of the amendment, it was observed that while the number of frequency excursions decreased, frequency fluctuations outside the operative band increased by almost 20%.It was also noted that there was tendency to over-inject to avoid the payment of deviation charge for over-drawal/under-injection (OD/UI). In wake of this operational experience which jeopardizes the grid frequency, an intervention was put in place. Based on the feedback from Grid-India and other stakeholders post 26 December 2022, Grid-India noted that the frequency did improve but still continued to be of concern along with deployment of ancillary services. Another amendment to the DSM regulation was issued to remove difficulties in the implementation of DSM Regulations 2022 on 06 February 2023.

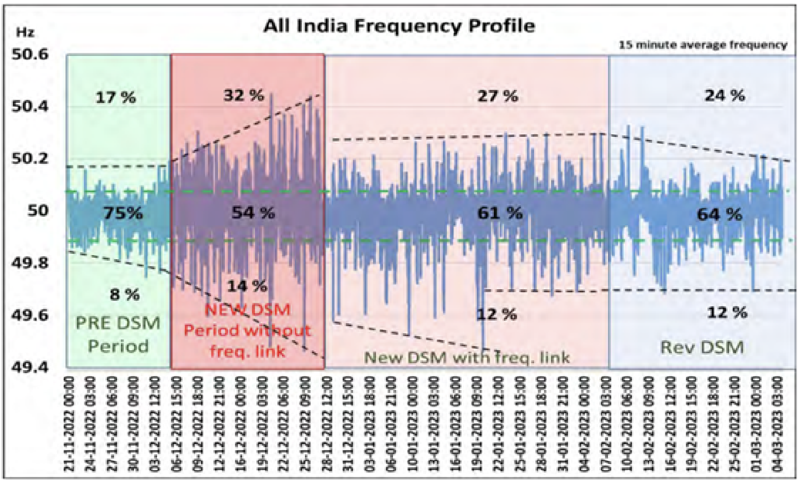

Fig. 7. All-India frequency profile

The previous DSM pricing structure hurts the participation and stability of renewable energy sources in the grid. The DSM expert committee in January 2024 argues that:

- Wind and Solar sellers tend to over schedule and under-inject (i.e., there is a mismatch in forecast and actual production) which leads to frequency fluctuations. This behaviour is exacerbated by the asymmetry in pricing between over-scheduling and under-injection for renewable energy sources. An incentive is created for renewable energy producers to avoid high penalties for under-injection while still potentially benefiting from high DSM charges if they over-schedule their generation.
- When frequency was delinked, DSM became volume based instead of frequency-response, so there was no direct financial penalty for causing frequency instability. Prioritizing market pricing over grid stability causes generators to over inject power during peak demand.

Based on the recommendations, further amendments were proposed in 2024 with notable changes as follows:

- The exponential increase in implementation of renewables and as a way to incentivize states with high green energy penetration, the CERC introduced a "Renewable super-rich states" with >= 5000 MW of installed capacity. This has allowed for a higher deviation limit for renewable sellers (up to 350MW given the frequency remains around 50Hz) from the previous limit of 250MW.
- With relaxation of limits, a measure was taken to tighten the deviation limit (in terms of absolute percentages) for the graded penalties as follows in table 4:

Instead of a flat price as seen from 2014-2016, there was a mechanism introduced to have a dynamic penalty scaling which is symmetric and prevents gaming.However, an implementation of tighter tolerance bands for sellers is suggested by the DSM

Table 4. DSM Regulation Comparison

Aspect	DSM 2024
General Deviation Limits	Lowered to 10% or 100 MW (whichever is lower) for general sellers.
Penalty slabs for excessive deviations	10-15% deviation $\rightarrow$ 30% extra charge.
	15-20% deviation $\rightarrow$ 60% extra charge.
	>20% deviation $\rightarrow$ 200% extra charge.

expert committee. By reducing the tolerance band to ±5%, the report aims to encourage more accurate forecasting by renewable generators. However, this could hurt renewables because the variability in renewable energy generation (due to weather or other factors) makes it harder to predict accurately. Consequently, renewables may face more frequent penalties for minor deviations.

To conclude:

- There are Primary and Secondary Response Gaps with generators
  - Many generating units failed to provide the expected frequency response due to delayed response from thermal power plants due to boiler lag. Manual intervention in automatic controls, causing time lags in response, this is a persistent issue with generators.Manual interventions were noted in certain instances to achieve an ideal response. These interventions could introduce delays and uncertainty in restoring grid frequency.
- Impact of Delinking DSM from Frequency
  - The March 2022 DSM Regulations removed frequency-based DSM penalties.
  - This encouraged market players to optimize for cost rather than frequency stability, leading to increased deviations.
  - RTM (Real-Time Market) participation did not fully replace DSM as expected, leading to higher reliance on deviations for imbalance settlement.
- Asymmetric DSM Pricing Encouraged Strategic Deviations
  - Generators manipulated over-injection and under-injection to maximize incentives.
  - Buyers under-drew power to take advantage of pricing gaps.
  - Over-injection during high frequency and under-drawal during low frequency worsened grid instability.

The policy itself is amended as per the feedback from buyers and sellers, but not everyone is happy. Tighter bands for deviation has led to producers worry about their profitability and the intent for renewable producers to better their forecast is not always possible, privilege for renewable energy is appreciated but this could lead to additional burden on the grid if better forecasting is not implemented for a better schedule management.

6 Conclusion

The current situation of Discoms in India highlights the significant financial challenges they face. Due to persistent operational inefficiencies and collection issues, these companies are burdened with enormous debts. The inefficient processes not only hamper day-to-day operations but also affect the long-term financial stability of the power distribution sector.

In contrast, Gujarat discoms have demonstrated higher performance levels. This success can largely be attributed to the strong political will in the state, coupled with the strict and effective implementation of policies. Such proactive measures have allowed Gujarat discoms to mitigate some of the systemic issues that plague other regions.

However, regulatory measures such as the cap on cross-subsidy surcharge, introduced to promote renewable energy, have a potential downside. While intended to support the growth of renewable energy sources, this cap may inadvertently reduce revenue for the discoms, thereby increasing their indebtedness. The loss of this critical revenue stream poses a significant challenge to the financial health of these entities.

Furthermore, the Demand Side Management (DSM) policy remains in a state of flux, with constant amendments and updates. Being relatively new, DSM has left many discoms still trying to fully understand and integrate its provisions into their operational frameworks. The continuous evolution of this policy adds an additional layer of complexity to an already challenging environment.

Overall, while there are examples of effective policy implementation and promising improvements in certain regions, the widespread financial and operational challenges faced by Discoms in India call for sustained and comprehensive reform efforts. These efforts must address both the structural inefficiencies and the unintended consequences of regulatory measures to secure a more stable and efficient power distribution network in the long term.

7 Limitations

Although this study offers insights into the performance and policies of various Discoms, there are several important limitations that must be acknowledged:

Financial KPIs: A more comprehensive comparison among Discoms would benefit from analyzing specific financial Key Performance Indicators (KPIs), such as the debt-equity ratio. These metrics provide a clearer picture of the overall financial health of each Discom. However, due to time constraints and limited data availability, a deeper examination of these indicators was not feasible.

Recent Renewable Energy Policies in Gujarat: Gujarat has introduced new renewable energy policies in the period of 2022–2024. Since these policies are relatively recent, there is insufficient research to conclusively measure their impact or effectiveness. Consequently, drawing definitive conclusions on their long-term outcomes remains challenging.

DSM and Frequency Stabilization Data: Demand Side Management (DSM) and other policies aimed at stabilizing frequency suffer from a lack of robust and comprehensive data. This shortfall makes it difficult to assess the full impact of these initiatives or to establish clear best practices. As a result, more extensive data collection and analysis are required to determine the efficacy and scalability of DSM and related frequency stabilization measures.

References

[1] Transmission and distribution losses by cea. URL https://beeindia.gov.in/sites/default/files/Transmission%20and%20Distribution%20Losses%20by%20CEA.pdf.

[2] Report title. URL https://powermin.gov.in/sites/default/files/uploads/RS25112024_Eng.pdf.

[3] Central Electricity Regulatory Commission (CERC). Report on short-term power market in india, 2023-24, 2024.

[4] V. Garg and K. Shah. The curious case of india's discoms: How renewable energy could reduce their financial distress, 2020. URL https://ieefa.org/wp-content/uploads/2020/08/The-Curious-Case-of-Indias-Discoms_August-2020.pdf.

[5] GERC. 24th annual report financial year - 2022-23. *Name of Journal/Report*.

[6] Gujarat Electricity Regulatory Commission (GERC). Forecasting, scheduling, deviation settlement and related matters of solar and wind generation sources) regulations, 2019, 2019.

[7] Gujarat Electricity Regulatory Commission (GERC). Gujarat electricity regulatory commission (terms and conditions for green energy open access) regulations, 2024, 2024.

[8] S.K. Jain and P.K. Agarwal. Challenges faced and lessons learnt in development of indian electricity markets and regulations. In *2019 CIGRE Canada Conference*, Place of Conference, 2019.