Annual Energy Audit Report

of

Adani Electricity Mumbai Ltd

for **FY 2021-22**

Devidas Lane, Off S.V. Road, Near MTNL Telephone Exchange, Borivali (West), Mumbai - 400103

June 2022

by

Prabodh Kala

(BEE Accredited Energy Auditor – AEA 0122)

M/s. Active Energy OPC Private Limited

Office: C-1010, Kailas Business Park, Vikhroli (W), Mumbai – 400 079

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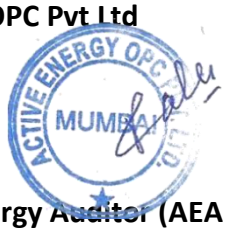
ACKNOWLEDGEMENT

Active Energy OPC Pvt Ltd would like to express sincere thanks to the management of **Adani Electricity Mumbai Ltd, Mumbai (AEML)** for giving us an opportunity to carry out Annual Energy Audit for FY 2021-22

We sincerely acknowledge the contribution of Shri. Sandeep Kumbhar (Additional VP) and the entire regulatory team and support staff during this audit exercise.

For Active Energy OPC Pvt Ltd



Prabodh Kala
BEE Accredited Energy Auditor (AEA 0122)

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LIST OF ABBREVIATIONS

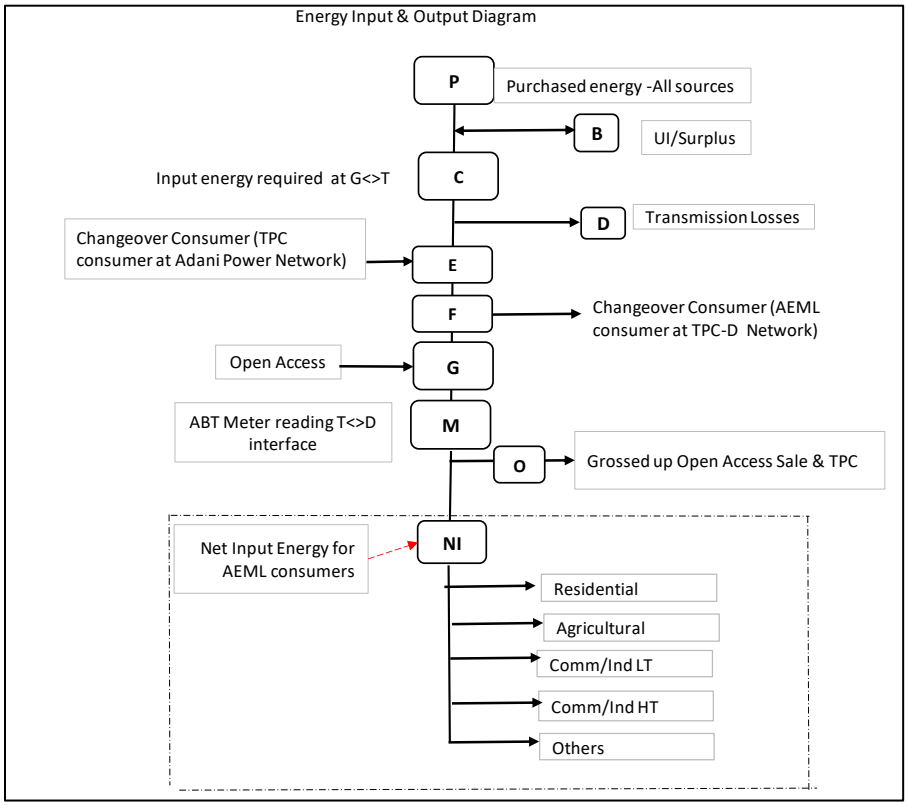
ABT	Availability Based Tariff
ACS	Average Cost of Supply
AEA	Accredited Energy Auditor
AEML	Adani Electricity Mumbai Ltd
ARR	Average Realisable Revenue
AT&C	Aggregate Technical & Commercial Loss
BEE	Bureau of Energy Efficiency
CE	Collection Efficiency
COC	Change Over Consumer
DC	Designated Consumer

DISCOM	Distribution Company
DSM	Deviation Settlement Mechanism
DSPPL	Dhursar Solar Power Pvt. Ltd
EA	Energy Auditor
EM	Energy Manager
HT	High Tension
KVA	Kilo Volt Ampere
KW	Kilo Watt
LT	Kilo Watt
MSLDC	Maharashtra State Load Despatch Centre
MU	Million Units
MVA	Meag Volt Ampere
MW	Mega Watt
OA	Open Access
RE	Renewable Energy
SLDC	State Load Despatch Centre
STU	State Transmission Unit
T&D/T<>D	Transmission & Distribution
TPC-D	Tata Power Company -Distribution
UI	Unscheduled Interchange

1. Executive Summary

Adani Electricity Mumbai Limited (AEML) is a 100% subsidiary of Adani Transmission Ltd formed post acquisition of Reliance Infrastructure Limited's integrated Generation, Transmission and Distribution utilities powering Mumbai city Adani distribution network covers over 400 Sq. kms catering to the electricity needs of over 2.9 million customers. The area in Suburban Mumbai served by AEML is from Bandra to Bhayander on the western side, and Sion to Mankhurd on the eastern Side. The area of distribution is divided in the western side, and Sion to Mankhurd on the eastern Side. The area of distribution is divided in 7 divisions- Andheri, Borivli, chembur, Malad, Mira Bhayender, Powai & Vandre.

1) The two major sources of power procurement of AEML are Adani Thermal Power station located at Dahanu, near Mumbai and Bilateral power purchases. AEML also fulfils is power requirements and RPO targets by purchasing power from Solar and wind power generators and traders.
2) AEML provides its distribution network for Open Access consumers and to changeover consumers to TPC-D. (Change over consumers - TPC consumers at AEML network)
3) Similarly AEML also purchases power to supply their consumers on TPC-D network (Change over consumers - AEML consumers at TPC network).
4) AEML distribution division receives power at 33KV or 22 KV at their Receiving substations. It is further stepped down to 11 KV and 0.433 KV for consumers. ABT meters are installed at these Receiving substations for recording of input energy.
5) The installed capacity of power transformers is 4365 MVA nad distribution transformers is 5295 MVA
6) AEML also maintains and energizes the street light poles. The charges are reimbursed by the respective area Municipal corporation.
7) The below diagram graphically indicated the various energy inputs and sales.



8) Infrastructure detail:

Number of divisions	7
Number of subdivisions	25
Number of feeders	1537
Number of DTs	7116
Number of consumers	3085523

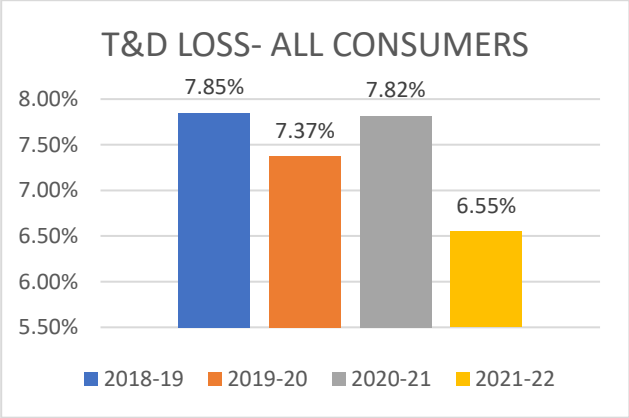
9) Energy metering and billing
   a) Energy meters are installed at each voltage level for energy consumption. The readings are taken manually and entered in SAP module which calculates the losses. Further action is taken based on loss determined. However energy consumption for at each voltage level could not be made available for the calculation of losses.
      - STU ABT meters -→ AMI . Down loaded by STU
      - HT/ AEML ABT meters → downloaded in mobile app & transferred to server
      - HT consumer - AMR → Server
      - LT consumer→ downloaded in mobile app & transferred to server
   b) The energy reading of commercial and Industrial consumers, Distribution transformer readings are downloaded by CMRI into the appropriate software for billing and analysis.
   c) There is 100% metering of consumers. Also AEML has claimed that there is 100% metering at 33/22/11 KV including the transformers.
   d) The energy consumed by AEML offices, receiving stations is also metered and accounted.
   e) The readings & billing of OA consumers is done by AEML and the settlement is through MSLDC. AEML receives only the wheeling charges from OA consumers through MSLDC.
   f) For CO consumers of TPC-D (TPC consumers on AEML network) energy is purchased by TPC & paid by TPC to supplier. Only wheeling charges paid by TPC to AEML

10) The various parameters for FY 2021-22 is tabulated below

Particulars	**Values**
Own Sales (With Self consumption) (MU)	7969.9
Input Energy at T-D (MU)	10404.806
CO HT sales + OA consumption (MU)	279.90
HT Loss	1.59%
HT grossed up energy at T-D boundary (MU)	284.42
CO LT sale (MU)	1,473.51
LT loss	6.43%
LT grossed up energy at T-D boundary (MU)	1,574.76
Total T-D energy attributable to CO sale & OA consumption (MU)	1,859.18
Net T-D energy attributable to AEML-D sale (MU)	8,545.6
T-D energy attributable to AEML-D C/O sale (MU)	1.7
Total T-D energy attributable to AEML-D sale (MU)	8,547.33
InSTS losses %	3.22%
Total requirement of AEML-D (MU) at G-T (MU)	**8,832**
T&D Losses (MU)	575.78
T&D Losses (%)	6.74%

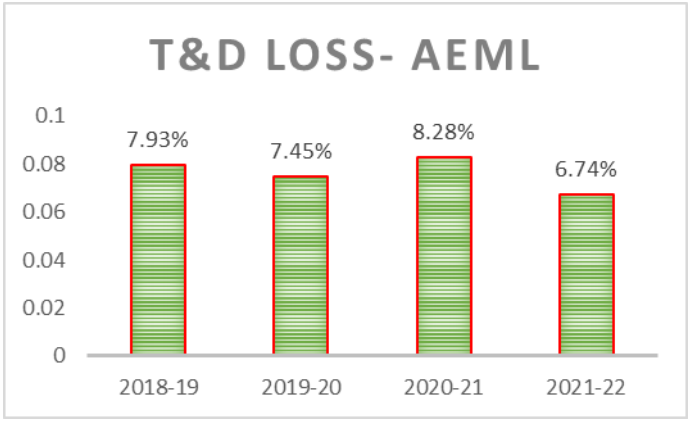
11) The below table shows the main parameters and distribution loss as calculated for all consumers (incl of CO and OA consumers) on AEML network.

Sr no	Particulars	2018-19	2019-20	2020-21	2021-22
1	Input Energy at T& D periphery	11,034.78	11,149.47	9642.78	10404.80
2	Energy sales at T& D periphery (incl, OA & C/O	10,168.73	10327.24	8889.13	9723.32
3	T& D loss MU	866.04	822.23	753.65	681.48
4	T&D %	7.85%	7.37%	7.82%	6.55%



12) The below table shows the main parameters and distribution loss as calculated for AEML consumers from FY 2018-19 to FY 2021-22

Sr no	Particulars	Unit	2018-19	2019-20	2020-21	2021-22
1	Net input energy at T<>D interface to AEML consumers	MU	9081.77	9131.98	7817.03	8,546,5
2	Sale	MU	8361.6	8452.09	7168.7	7969.9
3	T&D Losses	MU	720.17	679.89	647.58	575.78
4	T&D Losses	%	7.93%	7.45%	8.28%	6.74%



13) The divisionwise loss inclusive of OA and CO sales is given below

Division	**T & D loss**
Andheri	4.74%
Borivli	3.63%
Chembur	16.64%
Malad	5.69%
Mira Bhayandar	3.93%
Powai	6.88%
Vandre	5.16%

14) The AT&C loss is mentioned below

Particulars	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Collection efficiency	100.53	99.17	100.58	103.39
AT & C loss	7.93%	8.21%	8.28%	6.74%

Incase of >100% collection efficiency, AT&C Losses are calculated @ 100% collection efficiency.

2. Summary of Critical Analysis

2.1 Critical Analysis by Energy Auditor

As AEML has only provided the consolidated details of load, number of consumers (details include OA and CO consumers) the analysis is done for

a) Consolidated sales (Own sales + CO sales + OA sales)
b) AEML own sales

2.1.1 Consolidated sales (Own sales + CO sales + OA sales)

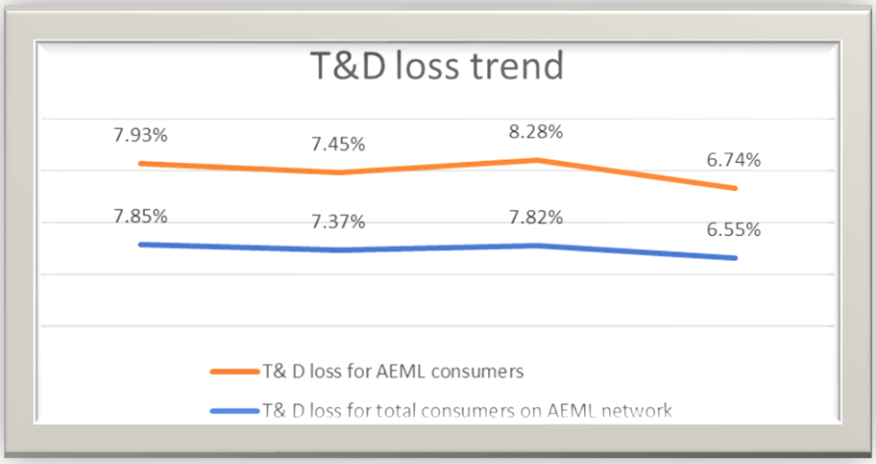
T&D losses have remained in the range of 7.85% from 2018-19 to 6.55% in 2021-22. It is observed that the losses have a downward trend but still on a higher side due to

- The HT consumption is less than 10% of the total consumption and HT consumers are approximately 0.014 %
- The residential consumers form a bulk of the consumers approx. 85% and a significant nos are located in slums. Here expansion of infrastructure for reducing losses is very difficult to constraints of space for substations and cables
- The Chembur division has a very high distribution loss of 16.64%. The major reason is the proliferation of highly congested residential slums where theft of energy is rampant and expansion of infrastructure very difficult due to their location, constraints of space and legal hurdles. However efforts are vigorously taken to reduce these loss the details given further in report.
- The growth of LT is higher than HT network. As observed the HT/LT ratio is approximately 0.24 which is very low to maintain low levels of loss for a DISCOM.
- The numbers of 11/0.415 KV transformers very high as compared to 33/22/11 KV transformers due to high LT load and LT consumers. This is one of the reasons for high T&D loss.
- Around 65% of AEML load is LT with LT consumers nearly 85%. To cater to the high LT load and consumer demand the number of LT and LT cables is high

2.1.2 Own Sales

1) T&D losses have remained in the range of 7.93% from 2018-19 to 6.74% in 2021-22. It is observed that the losses have a downward trend.
2) As the distribution loss trend of both consolidated consumers and AEML consumers follow the same trend the analysis of 2.1.1 applies to distribution losses of AEML consumers and network.
3) The loss for AEML consumers is higher due to all consumers in high loss division being of AEML.

A graphical representation is given below



4) The major loss sections are distribution Transformers. The number of distribution transformers is high, hence the no load losses of X'mers are a major contributor. But given the wide area of distribution system and predominantly LT load, and to install transformers near load centres.
5) Some of the transformers are old dating back to year 1955. The old transformers have more losses compared to modern transformers.
6) The length of LT cables is 5 times that of HT cables. The HT load is less than 10% with approx. 0.014% of HT consumers. These necessitates long lengths of LT cables to cater to demand which increase distribution loss.
7) The older PILC insulated cables have high losses compared to newer cables

2.2 Status and progress in compliance to pre-requisites to energy accounting

- Proforma of Q2, Q3 & Q4 of FY 21-22 has been submitted by AEML.
- Energy meters are installed at each voltage level for energy consumption. The readings are taken manually and entered in SAP module which calculates the losses. Further action is taken based on loss determined.
- The energy reading of commercial and Industrial consumers, Distribution transformer readings are downloaded by CMRI into the appropriate software for billing and analysis.
- There is 100% metering of consumers. Also AEML has claimed that there is 100% metering at 33/22/11 KV including the transformers.
- The energy consumed by AEML offices, receiving stations is also metered and accounted.

2.3 Important notes :

1) The input energy at T&D periphery is based on data received from MSLDC. However no documentation is available to verify the details. AEML is in process to obtain the documents. The ABT meter readings given in proforma are consumption shown by AEML meters.
2) There is difference of MU in input energy as recorded by AEML energy meters given in proforma and that received by AEML from MSLDC. As the consumption given by MSLDC have to be used for all purposes, it is considered for calculation of T&D loss.
3) AEML has provided consumer data divisionwise in proforma, SAP documents inclusive of OA and CO consumers. However the revenue billed and collected is from own sales. We have

analysed distribution loss on both own sales and consolidated sales based on monthly summary report provided by). AEML is presently unable to bifurcate own data with CO and OA data.

4) AEML has not included sales (1.7 MU after grossup) of its consumers on TPC-D network citing very low value of sales/consumers.
5) As per AEML the data of OA Purchase, COC & OA Credit is provisional as energy credit & finalisation is under process
6) Financial data related to power purchase cost, total income & total expenditure is not presently available from AEML
7) Where Collection efficiency is more than 100%, it is considered 100% for calculation of AT&C losses.

2.4 Management Analysis (Responses of DISCOM management on Comments by Auditor)

1. HT consumers are less as compared to nos. of LT consumers as most of the high connected load consumers opting for LT connections due to lack of space for the HT network in their premises.
2. We are coordinating with the local authorities for providing space for our substations in the slum areas, however some slum pockets are on forest land or on CRZ area hence getting permission and space for substations becomes difficult, resulting in high LT cable length.
3. We are in process of commissioning new 33/11kV substations in new developments which are already in our possession and asking for the space in upcoming developments for building new infrastructure.
4. Replacement of old PILC cables in planned and executed in a phased manner as the total length is very high.
5. We are in process of installing retrofits for existing feeder and DT meters for AMR, which will reduce manual (CMRI) reading work and online data will be available for loss calculation of HT network.
6. Some of data formats are new and we are in process of developing IT solutions to extract the data in the given format from our existing system.
7. Since OA and Change over consumers are feed from our own network, excluding their consumption from T&D loss calculations may give wrong loss data.
8. For FY 2020-21, vigilance activities were suspended (about 5 months) as per MERC guidelines due to COVID 19 pandemic, which resulted in increase in T& D loss.

3. BACKGROUND

3.1 Extant Regulations and role of BEE

In the provision of the Energy Conservation Act, 2001 the Bureau of Energy Efficiency has been set up with effect from day one of March 2002 by joining the earlier energy management center, which was the society under the ministry of powers. The initial aim of the Bureau of Energy Efficiency (BEE) is to decrease the energy intensity in the Indian economy through the taking up of a result-oriented approach. The broad aims of the Bureau of Energy Efficiency (BEE) are:

- To suppose leadership and give policy system and guide to national energy efficiency and conservation programs and efforts
- To direct the stakeholders about the policies and programs on using energy efficiently
- To set up a framework and procedures to monitor, verify and measure the efficient use of electricity in individual sectors as well as at the national stage
- To use multi-horizontal, bi-sidelong, and private segment support in the execution of the Energy Conservation Act and projects for effective utilization of energy and its preservation
- To show the delivery mechanisms of energy efficiency, by a public and private partnership
- To manage, implement, and plan energy conservation policies as given in the Energy Conservation Act.

In exercise of the powers conferred by clause (g) of sub-section (2) of section 58, read with clause (q) of sub-section (2) of section 13 of the Energy Conservation Act, 2001 (52 of 2001), the Bureau of Energy Efficiency, with the previous approval of the Central Government, has made a regulation regulations, (Manner and Intervals for Conduct of Energy Audit (Accounting) in Electricity Distribution Companies) vide No. 18/1/BEE/DISCOM/2021 dt 6th October 2021 and published it in the Gazette of India Part III section 4 on 7th October 2021. These regulations apply to all electricity distribution companies specified as designated consumer.

3.2 Purpose of audit and accounting Report

A healthy distribution sector is considered as the key to a financially viable power sector. One of the major challenges affecting the health of Indian distribution sector is the high aggregate technical and commercial (AT&C) losses. AT&C loss is the sum of technical loss and commercial loss. The technical loss occurs due to flow of energy into transmission and distribution network. Technological advancements could help in reduction of technical loss to an optimum level. As per international norms, the technical loss in a distribution system should be in the range of 4-5%. On the other hand, the commercial loss is mostly man-made and occurs due to inefficient billing and collection of the energy supplied, illegal connections, theft, meter tampering, and pilferage, etc. The commercial loss is occurring mostly due to managerial issues and could be brought down to zero with efficient administrative practices. National aggregate technical and commercial losses stood at 22%. As long as AT&C losses continues to be in such a high range, it is difficult for the DISCOMs to be commercially viable. In order to improve the energy efficiencies in the power system, the Ministry of Power, Government of India issued notification S.O. 3445 (E) dated 28th September, 2020 to cover all the Electricity Distribution Companies (DISCOMs) under the preview of the EC Act. As per the notification, which was formulated in consultation with Bureau of Energy Efficiency (BEE) "**All entities having issued distribution license by State/Joint Electricity Regulatory Commission under the Electricity Act, 2003 (36 of 2003)" are notified as Designated Consumers (DCs)**."

T&D losses is considered as performance matrix of electricity distribution companies under PAT. Now, each DISCOM will be governed under the various provisions of EC Act, such as Appointment of Energy Manager, Energy Accounting & Auditing, identification of Energy Losses Category wise, Implementation of energy conservation & efficiency measures etc.

3.3 Period of Energy Auditing and Accounting

Periodic Energy Accounting:

After the commencement of BEE regulations dated 6th October 2021, every electricity distribution company should conduct its first periodic energy accounting, for the last quarter of the financial year immediately preceding the date of such commencement (ie from 2nd quarter of the FY 21-22);

and

conduct its subsequent periodic energy accounting for each quarter of the financial year for a period of two financial years from the date of such commencement, and submit the periodic energy accounting report within sixty days from the date of periodic energy accounting.

An electricity distribution company should submit the periodic energy accounting report to

- Bureau of Energy Efficiency
- State Designated Agency **(MEDA)**
- the periodic energy accounting report should be made available on the website of electricity distribution company within forty-five days from the date of the periodic energy accounting.

Annual energy audit.: Every electricity distribution company should conduct an annual energy audit for every financial year and submit the annual energy audit report to the Bureau and respective State Designated Agency and also made available on the website of the electricity distribution company within a period of four months from the expiry of the relevant financial year. ***The first annual energy audit of should be conducted within six months from the date of such commencement, by taking into account the energy accounting of electricity distribution company for the financial year immediately preceding the date of the commencement of these regulations (ie for FY 20-21).***
A new electricity distribution company is established after the commencement of these regulations, such electricity distribution company shall conduct its first annual energy audit on completion of the first financial year from the date of being notified as designated consumer.

4. INTRODUCTION OF ADANI ELECTRICITY MUMBAI LTD.

Introduction :

Adani Electricity Mumbai Ltd (hereinafter referred to as "**AEML")** is a100% subsidiary of Adani Transmission Ltd formed post acquisition of Reliance Infrastructure Limited's integrated Generation, Transmission and Distribution utilities powering the Mumbai city. Their distribution network spans over 400 Sq. kms catering to the electricity needs of over 2.9 million customers today. The area in Suburban Mumbai served by AEML is from Bandra to Bhayendar on the Western side, and Sion to Mankhurd on the Eastern Side. The area of distribution is divided in 7 divisions- Andheri, Borivli, chembur, Malad, Mira Bhayender, Powai & Vandre.

Distribution area map:

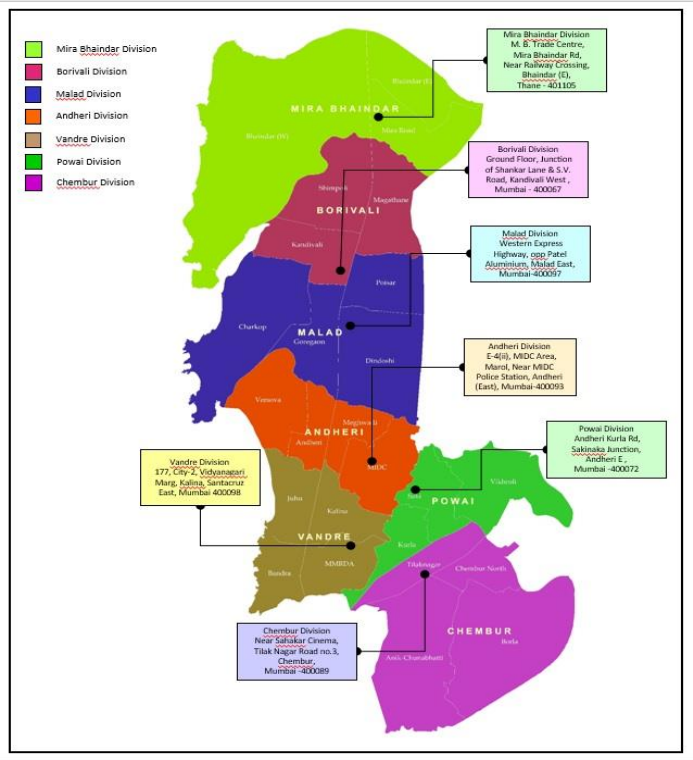


Fig 1: Disrtribution area map

4.1 Name and Address of Designated Consumer

Name : Adani Electricity Mumbai Ltd

Address: Devidas Lane, Off S.V.P. Road, Near Mtnl Telephone Exchange,

Borivali (West), Mumbai – 400103, Maharashtra

4.2 Name and Contact Details of Energy Manager and Authorized Signatory of DC (Nodal Officer)

Energy Manager Details

Name : Mr. Sandeep Kumbhar

Email : sandeep.kumbhar@adani.com

Contact No **: 9323647671**

Authorized Signatory of DC (Nodal Officer)

Name : Mr. Mr. Ashish Khedkar

Designation : VP

Contact No **:** 022-50548760

4.3 Summary profile of DCs (Assets, Energy Flow, Consumer base, salient features etc.)

4.3.1 Assets

Data as in March 2022

PARAMETERS	UOM	VANDRE	ANDHERI	MALAD	BORIWALI	MIRABHAINDER	POWAI	CHEMBUR	OVERALL
HT CABLE									
33/22 kV Feeders	Kms	116.294	269.074	181.082	93.052	93.54	168.968	120.073	1042.083
11 kV Feeders	Kms	588.207	675.153	786.257	489.109	473.809	425.164	435.323	3873.022
Others_HT	Kms	0	8.049	3.736	18.607	8.696	3.724	15.42	58.232
TOTAL HT LENGTH	**Kms**	**704.501**	**952.276**	**971.075**	**600.768**	**576.045**	**597.856**	**570.816**	**4973.337**
DISCONNECTED HT CABLE									
33/22 kV Feeders	Kms	7.368	3.371	0.666	0.71	0	0	0	12.115
11 kV Feeders	Kms	8.103	2.683	6.508	0.018	0.049	0	0.962	18.323
Others_HT	Kms	0	0	0	0	0	0	0	0
TOTAL DISCONNECTED HT LENGTH	**Kms**	**15.471**	**6.054**	**7.174**	**0.728**	**0.049**	**0**	**0.962**	**30.438**
LT CABLE									
LT Main Line Cable	Kms	907.482	1000.8	1354.396	861.481	811.119	709.185	851.581	6496.044
LT Service Cable	Kms	1578.021	1914.262	3085.123	1639.062	1301.84	999.39	1150.173	11667.871
St. Lt. Cable Length	Kms	330.602	267.349	381.1	284.018	293.591	257.168	326.461	2140.289
Others_LT	Kms	0	0	0	0	0	0	0	0
TOTAL LT LENGTH	**Kms**	**2816.105**	**3182.411**	**4820.619**	**2784.561**	**2406.55**	**1965.743**	**2328.215**	**20304.204**
SUB-STATIONS	**Nos**	**1018**	**1284**	**1185**	**884**	**729**	**670**	**740**	**6510**
REC-STATIONS	**Nos**	**17**	**15**	**23**	**11**	**8**	**12**	**13**	**99**
PILLARS									
24 Way	Nos	0	0	2	0	1	0	0	3
16 Way	Nos	7	12	13	4	0	10	4	50
12 Way	Nos	10	8	0	2	0	0	2	22
10 Way	Nos	299	444	290	237	206	217	189	1882
8 Way	Nos	696	1226	1198	822	554	781	851	6128
6 Way	Nos	1791	1727	1487	1051	987	775	1085	8903
5 Way	Nos	0	1	0	0	0	0	0	1
4 Way	Nos	1957	1706	1933	1369	1216	1292	1277	10750
2 Way	Nos	148	31	156	156	65	48	52	656
MP	Nos	4280	4730	8386	5628	5610	4517	4783	37934
FUMP	Nos	40	4	24	0	9	17	19	113
SLMP	Nos	518	434	619	589	407	464	592	3623
HTP	Nos	1	0	1	4	0	2	1	9
THEFT	Nos	14	64	101	18	1	45	697	940
FUSESTRIP	Nos	271	199	244	219	147	60	158	1298
OTHER_PILLARS	Nos	76	125	167	61	46	24	15	514
TOTAL PILLAR COUNT	**Nos**	**10108**	**10711**	**14621**	**10160**	**9249**	**8252**	**9725**	**72826**
ST. LIGHT POLES	**Nos**	**15716**	**13623**	**16574**	**13026**	**13260**	**11923**	**13422**	**97544**
CONNECTION OBJECTS									
Connected	Nos	63205	63678	97109	51261	45152	52524	60731	433660
Disconnected	Nos	476	75	240	1062	1007	264	701	3825
POWER TRANSFORMERS	**Nos**	**39**	**41**	**54**	**25**	**19**	**31**	**30**	**239**
DISTRIBUTION TRANSFORMERS	**Nos**	**1083**	**1411**	**1397**	**941**	**749**	**749**	**786**	**7116**

Table 1: Asset details

4.3.2 Consumer Base

The below table gives the consumer breakup categorywise of OA and CO consumers. It is observed that the residential consumers form the largest base of 83.37%

Category	Nos	% of consumers
Residential	2603409	84.37%
Agricultural	33	0.001%
Commercial / Industrial LT	472156	15.30%
Commercial / Industrial HT	442	0.01%
Others	9483	0.31%
Total	3085523	

Table 2: Consumer numbers categorywise

The below table gives the consumer breakup categorywise in each division inclusive of OA and CO consumers.

Division	Residential	Agricultural	Commercial / Industrial LT	Commercial / Industrial HT	Others
Andheri	14.76%	9.09%	15.92%	27.15%	15.11%
Borivili	14.50%	0.00%	12.04%	5.43%	15.36%
Chembur	14.80%	9.09%	11.64%	9.95%	16.66%
Malad	20.26%	27.27%	22.36%	17.19%	15.51%
Mira Bhayander	10.99%	54.55%	10.88%	4.07%	8.82%
Powai	12.22%	0.00%	13.98%	14.25%	11.87%
Vandre	12.47%	0.00%	13.17%	21.95%	16.66%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

Table 3: Consumer percentage in each division categorywise

4.3.3 Energy input and Output

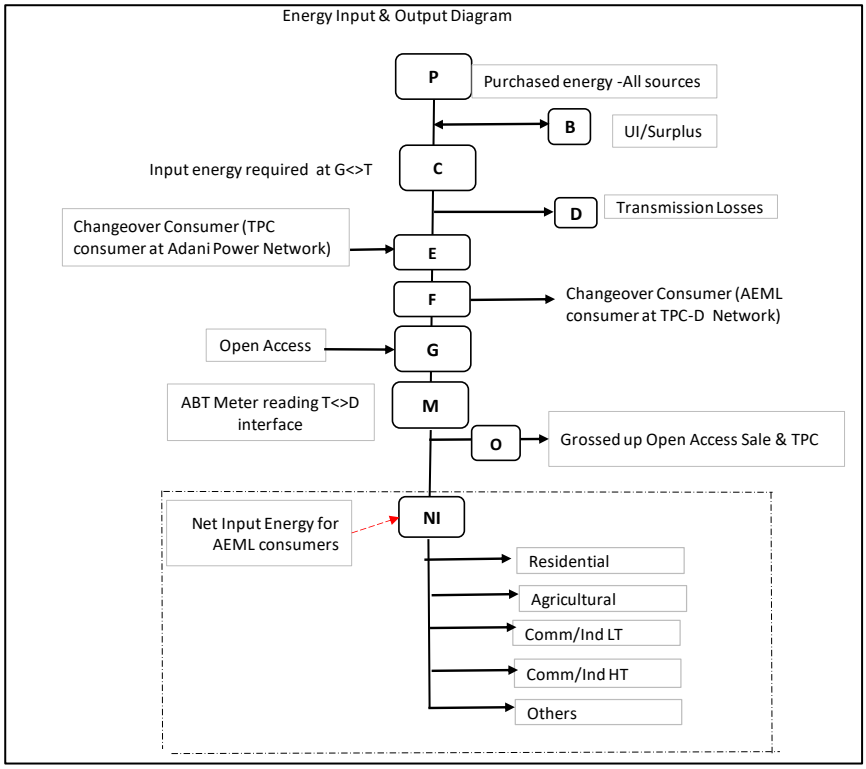


Fig.2: Energy input and output diagram

Meter	Description
P	Scheduled Energy
B	UI/Surplus
C	Input energy required at G<>T
D	Transmission losses
E	CO Consumer (TPC consumer at AEML Network)
F	CO Consumer (AEML consumer at TPC-D Network)
M	ABT Meter reading T<>D interface
NI	Net input for AEML consumers on its network
O	Grossed up OA and CO sales

Table 4: Legend of energy input and output diagram

- **Single line diagram**

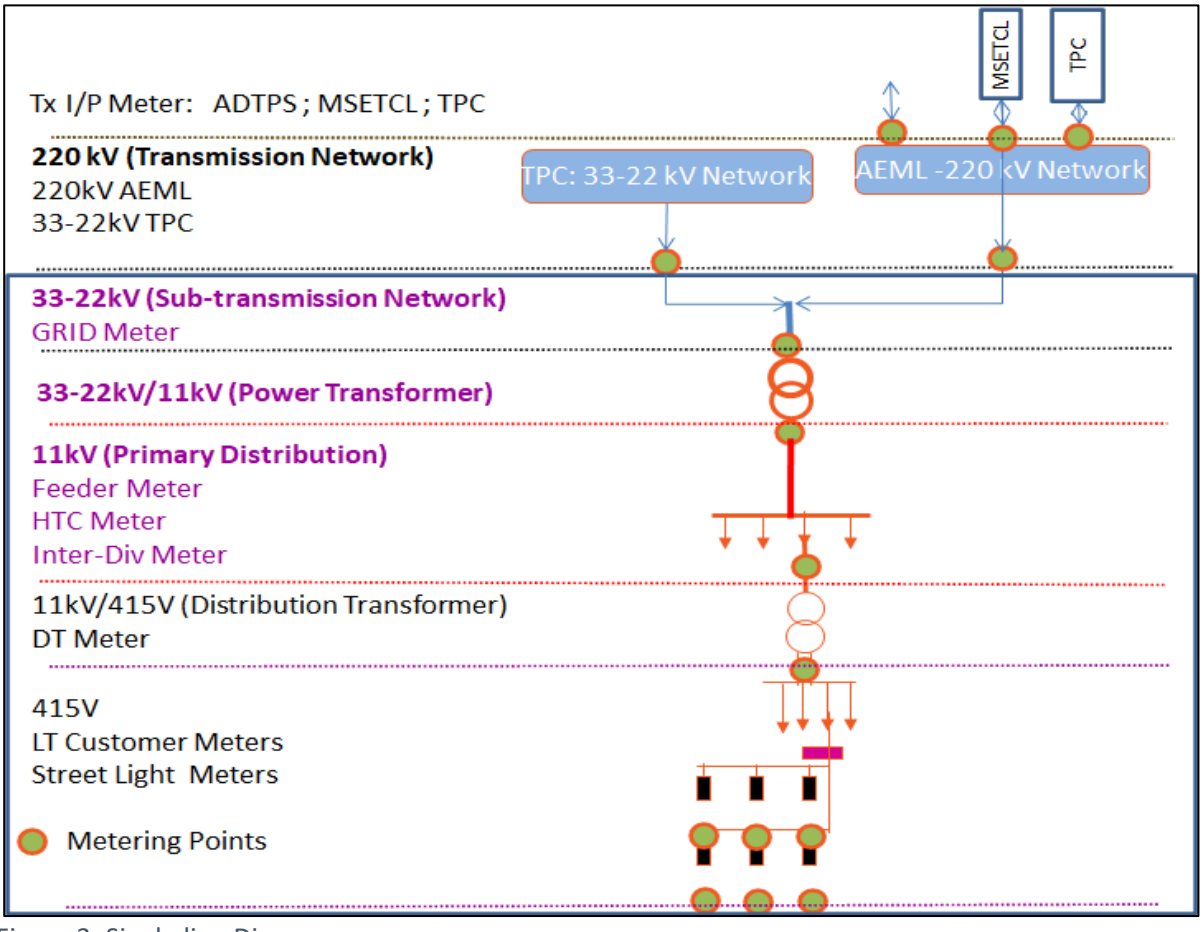


Figure 3: Single line Diagram

5. DISCUSSION & ANALYSIS

5.1.Energy accounts of previous years (18-19,19-20 & 20-21)

5.1.1 Consolidated sales (Own sales + CO sales + OA sales)

Particulars	Unit	2018-19	2019-20	2020-21
Input Energy at T& D periphery	MU	11,034.78	11,149.47	9642.78
Energy sales at T& D periphery (incl, OA & C/O	MU	10,168.73	10327.24	8889.13
T& D loss MU	MU	866.04	822.23	753.65
T&D %	%	7.85%	7.37%	7.82%

Table 5: Input energy, Sales and loss of consolidated consumers

5.1.2 Own sales

Particulars	Unit	2018-19	2019-20	2020-21
Total Energy Input at T<>D interface of AEML-D system	MU	11034.31	11149.47	9642.69
Total T<>D energy attributable to TPC-D sale & OA consumption + AEML CO consumers	MU	1952.54	2017.49	1827.16
Net T<>D energy attributable to AEML-D sale	MU	9081.77	9131.98	7815.53
Own Sale	MU	8361.6	8452.09	7168.7
T&D Losses	MU	720.17	679.89	646.83
T&D Losses	%	7.93%	7.45%	8.28%

Table 6: Input energy, Sales and loss of AEML consumers

From the above tables it can be observed that the T&D loss has increased in FY 2020-21 due to less sales and also the vigilance activities were suspended due to Covid-19.

5.2 Energy account of fy 2021-22

5.2.1 Details of computation of Input energy

- Energy purchase details from all sources was taken from monthly energy summary report. Details of Actual Energy purchased (Scheduled energy, Over/Under drawl) were taken from MIS report.
- Transmission loss in % is based on the Maharashtra State Load Despatch Centre (MSLDC)'s Grid Transmission Loss statements.
- **Energy purchased for CO consumers of AEML at TPC network is deducted to arrive Input energy required at T<>D**.
- Input energy at T<>D interface **(including OA & CO consumers)** is computed by compilation of ABT meter readings. The energy drawn by AEML at T<>D interface is based on ABT meters installed at their RSS / TPC RSS and check meters.

Net Input Energy at T<>D periphery for AEML consumers =

Metered energy at T<>D periphery
-(minus) grossed up Open Access Sale
-(minus) grossed up Changeover consumer sale(TPC-D consumers of AEML network)

Purchased Energy for AEML consumers =

Net Input Energy at T<>D periphery for AEML consumers
+(plus) Gross up input energy for AEML consumers on TPC-D network
+(plus) transmission loss

- The OA sales and C/O sales are grossed up (Wheeling loss as percentage of metered energy is added to metered energy—(% as per MERC order, metered data provided by TPC-D & OA consumers.)
- The grossed up sales are then deducted with energy recorded at T<>D periphery (ABT meters) to arrive at Net input energy at T<>D to AEML consumers.

a) The various parameters for computation of T&D loss for AEML consumers for FY 2021-22 mentioned above is tabulated below

Particulars	Values
Own Sales (With Self consumption) (MU)	7969.9
Metered Energy at T-D periphery (MU)	10404.81
CO HT sales + OA consumption (MU)	279.90
HT Loss	1.59%
HT grossed up energy at T-D boundary (MU)	284.42
CO LT sale (MU)	1,473.51
LT loss	6.43%
LT grossed up energy at T-D boundary (MU)	1,574.76
Total T-D energy attributable to CO sale & OA consumption (MU)	1,857.48
Net T-D energy attributable to AEML-D sale (MU)	8,545.6
T-D energy attributable to AEML-D C/O sale (MU)	1.7
Total T-D energy attributable to AEML-D sale (MU)	8,547.33
InSTS losses %	3.22%
Total requirement of AEML-D (MU) at G-T (MU)	**8,832**
T&D Losses for AEML consumers(MU)	575.78
T&D Losses for AEML consumers (%)	6.74%

Table 7: Parameters for computation of loss of AEML consumers

Note: The sales of AEML consumers on TPC-D network is not included in own sales and calculation of distribution loss by DISCOM citing low sales/negligible consumers and not on AEML network

b) Computation of T&D loss for all consumers on AEML network

Particulars	2021-22
Metered Energy at T-D periphery (MU)	10404.80
Energy sales at T& D periphery (incl, OA & C/O)	9723.32
T& D loss MU	681.48
T&D %	6.55%

Table 8: Parameters for computation of loss of consolidated consumers

5.2.2 Aggregate Technical & Commercial losses

Particulars	Value
Net input Energy for AEML consumers MU	8545.6
Own Sales MU	7970
Collection effciency	1
Energy realised MU	7970
AT& C loss	6.74%

Table 9: AT& C loss of FY 2021-22

Note: Though the details such as load, consumers & energy sales in proforma includes OA & CO consumers the billed and collected revenue pertains to own sales

5.2.3 Comparison of loss of AEML consumers from 2018 to 2022.

Sr no	Particulars	Unit	2018-19	2019-20	2020-21	2021-22
1	Total Energy Input at T<>D interface of AEML-D system	MU	11034.31	11149.47	9642.69	10404.861
2	Total T<>D energy attributable to TPC-D sale & OA consumption + AEML CO consumers	MU	1952.54	2017.49	1827.16	1859.18
3	Net T<>D energy attributable to AEML-D sale	MU	9081.77	9131.98	7816.28	8545.68
4	Own Sale	MU	8361.6	8452.09	7168.7	7969.9
5	T&D Losses	MU	720.17	679.89	647.58	575.78
6	T&D Losses	%	7.93%	7.45%	8.28%	6.74%

Table 10: Comparison of loss of AEML consumers from 2018 to 2022.

Comparing the loss levels from 2018-19 onwards it is observed that after falling the loss has increased in FY 2020-21. The reason for increase is reduction in consumption (due to COVID-19) & increase in LT consumer sales. The loss has reduced considerably in 2021-22 due to resumption of vigilance activities and other measures which were impacted by the pandemic

5.2.4 Voltage-wise losses

Voltage-wise consumption data not available DISCOM.

5.2.5 Division-wise losses

The Division wise data is consolidated (includes both CO & OA consumers) and hence the divisionwise distribution loss includes all the consumers in AEML network

Division	Sales MU	Input Energy	TD loss MU	T & D loss
Andheri	1765.43	1853.35	87.91	4.74%
Borivli	1196.15	1241.21	45.06	3.63%
Chembur	1067.54	1280.58	213.04	16.64%
Malad	1869.93	1982.82	112.90	5.69%
Mira Bhayandar	888.49	924.80	36.32	3.93%
Powai	1364.02	1464.74	100.72	6.88%
Vandre	1571.76	1657.30	85.54	5.16%

Table 11: Divisionwise input energy, sales & T&D loss of consolidated consumers

5.2.6 Feeder-wise losses

Feeder-wise losses are not available due to the system being in Ring. The input and Output points are dynamic and are changed as per the load conditions and maintenance and repair requirements.

5.3 Energy conservation adopted and proposed for future

AEML has presently subdivided areas based on LT loss intensity in following subgroups for focused enforcement action. Following table depicts the subgroups and their loss intensity for corresponding financial year.

Sub_Groups	FY19 LT Loss MU	FY20 LT Loss MU	FY21 LT Loss MU*	FY22 LT Loss MU
A (> 5 MUs Annual LT loss)	227	184	206	190
B (>2.5 <= 5 MUs LT loss)	101	77	90	77
C (>1.5 <=2.5 MUs LT loss)	92	61	69	70
Others	485	192	195	122
Total	**905**	**513**	**559**	**458**

** Covid Related Lookdown Impact on field operations*

Table 12: Loss intensity yearwise FY2018=19 t0 FY 2021-22

AEML also planned varied field actions and track the performance of the said actions to ensure sustainable loss reduction initiatives. Following table depicts key loss reductions initiatives undertaken in corresponding financial years.

Enforcement Activities	FY19	FY20	FY21*	FY22
Cases Booked (Nos.)	4,018	3,248	1,583	7,262
Assessment (MUs)	9	7	4	16
Mass Raids Conducted (Nos.)	2825	3,035	1,880	12,299
Wires Recovered (Mass Raids) Kgs.	41340	48,072	39,557	57,384
FIRs (Nos.)	186	221	152	386
** Covid Related Lockdown Impact on field operations*				

Table 13: Theft cases yearwise FY2018-19 to FY 2021-22

AEML has also planned major advanced initiatives for enhancing productivity and efficiency

1) Implementation of Advanced Distribution Management System (ADMS) to study:
   - Network connectivity/reconfiguration
   - Load flow
   - Fault isolation/restoration
   - Loading optimization for reducing loss
2) Replacement of all 33 kV and 11 kV PILC cable network with XLPE cables of higher sizes
3) Replacement of Oil Type Ring Main Units (RMUs) with Maintenance-free dry type RMUs (SF6, vacuum)
4) Implementation of Smart Metering
5) Implementation of Substation Equipment Parameters Monitoring System
6) Installation of Theft Aversion Boxes (TAB) at Service Positions and Theft Proof LT Pillars (TPP) in theft-prone areas

To ensure sustainability throughout the organisation, AEML has undertaken the following initiatives:

- Use of environment-friendly dry and ester oil transformers
- Replaced oil-type switch gears with dry-type maintenance-free switch gears
- Reduced carbon footprint by using LED lamps for streetlights
  New investments for
- Ensuring asset hardening and modernization
- Investing in modern O&M practices, ensuring lower SAIDI and SAIFI
- Protecting against outages due to adverse events

5.4 Unitwise Performance

The area of distribution is divided in 7 divisions. Divisionwise data of COC and OAC is not available and hence the below given division wise performance includes all the consumers on AEML network.

Division	% of total input energy	% of total sales	T & D loss
Andheri	17.81%	18.16%	4.74%
Borivili	11.93%	12.30%	3.63%
Chembur	12.31%	10.98%	16.64%
Malad	19.06%	19.23%	5.69%
Mira Bhayander	8.89%	9.14%	3.93%
Powai	14.08%	14.03%	6.88%
Vandre	15.93%	16.16%	5.16%
Total	**100.00%**	**100.00%**	

Table 14: Percentage Input, sales and Loss division wise for consolidated consumers

Division	% LT consumers of total LT consumers	% HT consumers of total HT consumers	T & D loss
Andheri	14.94%	27.15%	4.74%
Borivili	14.13%	5.43%	3.63%
Chembur	14.32%	9.95%	16.64%
Malad	20.56%	17.19%	5.69%
Mira Bhayander	10.96%	4.07%	3.93%
Powai	12.49%	14.25%	6.88%
Vandre	12.59%	21.95%	5.16%
Total	100.00%	100.00%	

Table 14: Percentage LT, HT consumers and Loss division wise for consolidated consumers

The above table shows that

- Chembur division has a low percentage of input energy and sales but the loss are the abnormally high. This is due to higher percentage of congested residential slums giving rise to pilferage of energy and lack of space for facilitating and improving distribution infrastructure
- Malad division has the highest consumption but a satisfactory distribution loss
- Borivli division has the lowest loss but also a low percentage of consumption

5.4.1 Power Purchase Details

The major sources of power are Adani Dahanu thermal power Station and bilateral purchases. The other sources are Renewable Energy generators and traders. The details of power procurement are given in the following table

Source	Total
ADTPS	2,975
DSPPL	52
Reliance Innoventure	61
AAA Sons Enterprise	2
Vector Green Energy Pvt Ltd	33
Vector Green Energy Pvt Ltd	11
Tembhu Power Pvt. Ltd.	3
Reliance Power Ltd.	68
RE Hybrid (Solar)	227
RE Hybrid (Non-Solar)	66
Short Term RE Solar	159
Short Term RE Non Solar	35
Bilateral Purchase	5,007
Bilateral Sale	-2
OA purchase Solar	1
OA purchase Non Solar	4
Pool Imbalance	115
Total	**8,832 MU**

Table 15: Power purchase details for AEML consumers

Note: The financial details of power procurement was not available from AEML

5.4.2 Consumer base and consumption

The below table gives the consumer breakup categorywise of OA and CO consumers. It is observed that the residential consumers form the largest base of 83.37% with a major sales of 58.41%

Category	Sales MU	Nos	% of consumers	% sales
Residential	5679.641	2603409	84.37%	58.41%
Agricultural	0.211	33	0.001%	0.002%
Commercial / IndustrialLT	2782.448	472156	15.30%	28.62%
Commercial / IndustrialHT	921.877	442	0.01%	9.48%
Others	339.143	9483	0.31%	3.49%
Total	9723.320	3085523		

Table 16: Categorywise sales and consumer base of consolidated consumers

5.5 Critical analysis by energy auditor

1) AEML distribution network also includes the changeover consumers and Open access consumers. AEML presently has provided the consolidated details of load, number of consumers, category wise consumption (all the consumers in network) in the proforma and the net input energy and total sales for AEML consumers in their monthly summary report consumption, the T&D loss was calculated on total consumers (consolidated) as well as AEML consumers.
    - Consolidated T&D losses have remained in the range of 7.85% from 2018-19 to 6.55% in 2021-22. It is observed that the losses have a downward trend
    - For AEML consumers T&D losses have remained in the range of 7.93% from 2018-19 to 6.74% in 2021-22. It is observed that the losses have a downward trend

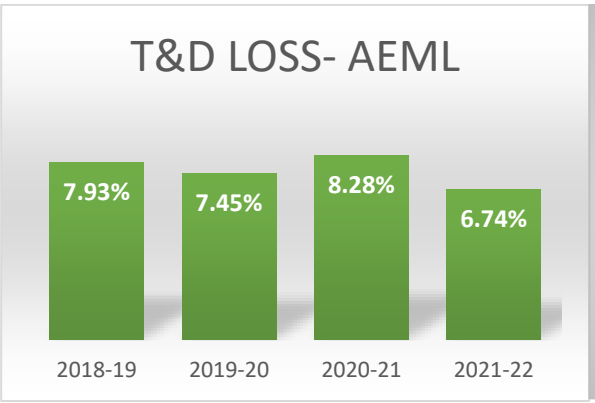


Fig 4: T & D loss of AEML consumers from FY 2018-19 to FY 2021-22

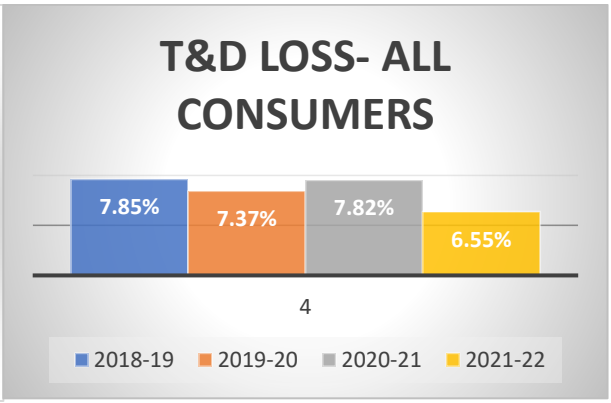


Fig 5: T & D loss of consolidated consumers from FY 2018-19 to FY 2021-22

2) As the distribution loss trend of both consolidated consumers and AEML consumers follow the same trend the analysis for the loss applies to distribution losses of AEML consumers and network

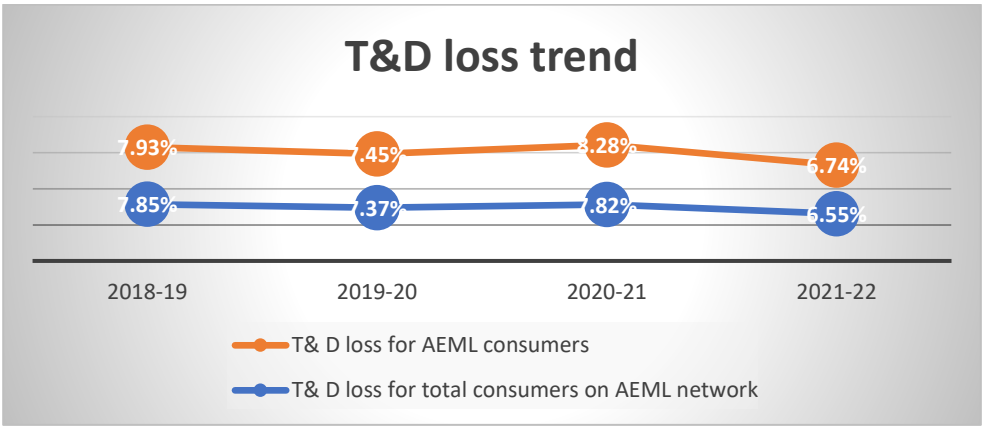


Fig 6: T& D loss trend of consolidated and AEML consumers from FY 2018-19 to FY 2021-22

3) Analysis

- The HT consumption is less than 10% of the total consumption and HT consumers are approximately 0.014 %
- The residential consumers form a bulk of the consumers approx. 85% and a significant nos are located in slums. Here expansion of infrastructure for reducing losses is very difficult to constraints of space for substations and cables
- The Chembur division has a very high distribution loss of 16.64%. The major reason is the proliferation of highly congested residential slums where theft of energy is rampant and expansion of infrastructure very difficult due to their location, constraints of space and legal hurdles .

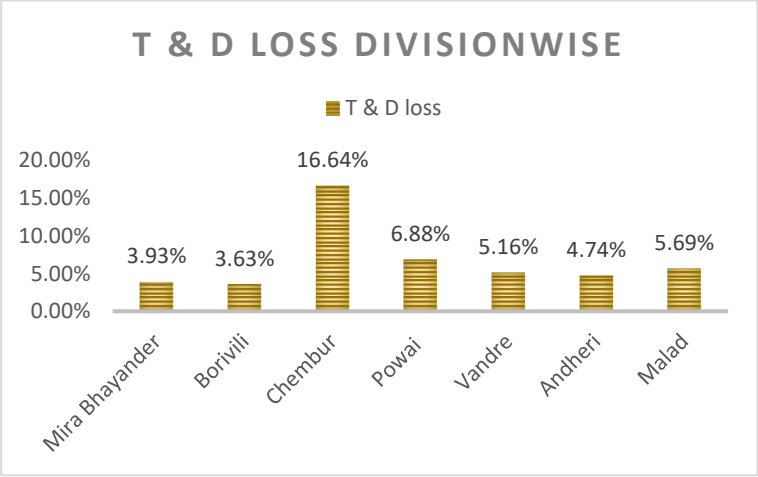


Fig: 7: Divisionwise T&D loss for consolidated consumers

- The growth of LT is higher than HT network. As observed the HT/LT ratio is approximately 0.24 which is very low to maintain low levels of loss for a DISCOM.
- The numbers of 11/0.415 KV transformers very high as compared to 33/22/11 KV transformers due to high LT load and LT consumers. This is one of the reasons for high T&D loss.
- Around 65% of AEML load is LT with LT consumers nearly 85%. To cater to the high LT load and consumer demand the number of LT and LT cables is high

.

4) The AT&C loss for AEML consumers is given below. It is observed as the collection and recovery of billed energy is robust the AT& C loss is equal to the T& D loss.

Particulars	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Collection efficiency	100.53	99.17	100.58	103.39
AT & C loss	7.93%	8.21%	8.28%	6.74%

Table 17: Collection efficiency and AT&C loss of AEML consumers from FY 2018-19 to FY 2021-22

Incase of >100% collection efficiency, AT&C Losses are calculated @ 100% collection efficiency

5) AEML has constituted special vigilance squads to recover revenue lost to theft. It is also upgrading its infrastructure to reduce equipment/cable loss

5.6 Inclusion and exclusions

The input and sales of AEML COC (AEML on TPC-D) network excluded from loss calculations

6. NOTES OF THE EA/EM ALONG WITH QUERIES AND REPLIES TO DATA GAPS.

1) The consumer data (nos & load and other details) mentioned in report are consolidated (inclusive of OA & CO consumers). Need AEML specific details.
   Due to switching to changeover consumers and Open Access, the number of own consumers (AEML), load and consumption for each category of consumers could not be given. Consumer number, load and consumption for each category includes all consumers at AEML network (including OA & C/over TPC consumers).
   Similarly data given in proforma for division-wise, feeder I/O data, transformer data, Detailed consumer billing, etc are inclusive of OA & C/O consumers.
2) Voltage wise loss details required
3) The verification documents for metered input energy is required.
4) Consumption of AEML consumers in TPC network is not taken in sales (In this report) as they do not contribute to loss and is of very low value
5) Where Collection efficiency is more than 100%, it is considered 100% for calculation of AT&C losses.
6) Detailed Power purchase cost, Total expenditure and Revenue earned is required.
7) Detailed write up measures adopted for loss reduction (not like consumer DSM measures) is needed along with quantified expenditure and savings.

7. ANNEXURES

- Annexure 1: Introduction of verification firm
- Annexure 2: Checklist prepared for verification of data
- Annexure 3: Brief Approach, Scope & Methodology for audit
- Annexure 4: Infrastructure details
- Annexure 5: Electrical distribution System
- Annexure 6: Power purchase details
- Annexure 7: Single Line Diagram
- Annexure 8: Category of service details
- Annexure 9: List of documents verified with each parameter
    - 9.1: Input Energy
    - 9.2: Screen shot of Transmission loss for year 2018-2019, 2019- 2020, 2020-21 & 2021-22
    - 9.3: Consumer sales for 2017-18, 2018-19, 2019-20 & 2020-21
- Annexure 10: List of Parameters arrived through calculation or formulae with list of documents as source of data