



ENERGY AUDIT

**Presented By,
Sri Basavaraju H B
DGM, Energy Audit,
Corporate Office, BESCOM**

BRIEF DESCRIPTION OF BESCOM



- In the year 1999, Karnataka embarked on a major Reform of the power sector. As a first step, Karnataka Electricity Board (KEB) was dissolved and in its place, the Karnataka Power Transmission Corporation Limited (KPTCL) was incorporated.
- This was followed by the constitution of Karnataka Electricity Regulatory Commission (KERC) in November 1999.
- In the next phase of the Reform Process, the transmission and distribution business managed by KPTCL were unbundled in June 2002. Five new distribution companies were formed to distribute power in Karnataka.
- BESCOM has taken over the responsibility from KPTCL for the distribution of electricity in 8 districts and commenced its operations from 1st June 2002.
- **BESCOM was incorporated in 30.04.2002 under the companies Act 1956, and commenced its operations with effect from 01.06.2002. BESCOM has successfully completed 22 years in “Distribution of Electricity”.**
- BESCOM is responsible for Power distribution in Eight districts of Karnataka (Bangalore Urban, Bangalore Rural, Chikkaballapura, Kolar, Davanagere, Tumkur, Chitradurga and Ramanagara). BESCOM covers an area of 41,092 Sq. Kms. with a population of over 207 lakhs.
- The company has 4 operating Zones – Bangalore Metropolitan Area Zone (North), Bangalore Metropolitan Area Zone (South), Bangalore Rural Area Zone and Chitradurga Zone, 9 Circles, 32 Divisions, 147 Sub-divisions and 534 Section Offices.
- BESCOM having its headquarters in Bangalore City.

BESCOM has 8 Districts further categorized into 4 zones, 9 Circles, 32 divisions and 147 Sub-divisions. The 8 Districts are shown below:

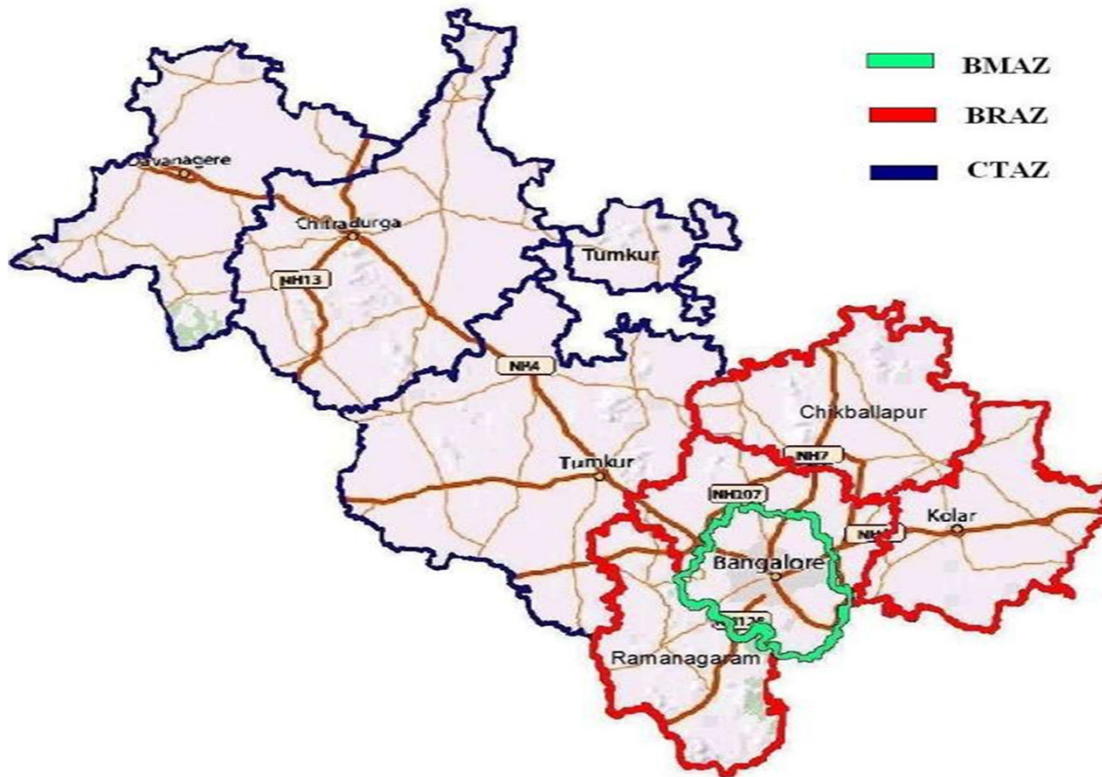


Vision: The Vision of BESCOM is to become number one in customer satisfaction in South Asia in Power distribution.

Mission:

- The Mission of BESCOM is to ensure absolute consumer satisfaction and continuous profit in business.
- By ensuring total employee satisfaction.
- By developing infrastructure commensurate with growth, thus ensuring reliable and quality power supply.
- By using best technology in communication and best practices in power sector.

BESCOM Jurisdiction



- The company has 4 operating Zones – Bangalore Metropolitan Area Zone (North), Bangalore Metropolitan Area Zone (South), Bangalore Rural Area Zone and Chitradurga Zone, 9 Circles, 32 Divisions, 147 Sub-divisions and 534 Section Offices.
- Zonal office is headed by an officer of the rank of a Chief Engineer (CE).
- Circle office is headed by an officer of the rank of a Superintending Engineer (SE).
- Division is headed by an officer of the rank of an Executive Engineer (EE).
- Subdivision is headed by an officer of the rank of an Assistant Executive Engineer (AEE).
- Section offices/ operation and maintenance units are headed by an Assistant engineer/ Junior engineer (AE/JE).

BRIEF DESCRIPTION OF ENERGY FLOW



Generation :

KARNATAKA POWER CORPORATION LIMITED (KPCL) ,entire state owned generation of power is maintained by KPCL, which includes Hydel, Thermal, solar and wind. Along with this many private Genco exists in the state.

Transmission :

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED (KPTCL), entire state Transmission of power is maintained by KPTCL.

Distribution (ESCOMs):

There are 5 ESCOMs and one Cooperative society (HUKKERI) are Distribution Licensee in the state, in which BESCOM is the leading Discoms in the state covering the state Capital Bangalore, IT hubs and Industrial hubs majorly.

Definition of Energy Audit

As per the Energy Conservation Act, 2001, Energy Audit is defined as

“The verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption”

Importance of Energy Auditing



Today Indian Power Sector are facing major challenges with the introduction of Reforms and Globalization. Energy and peak power shortages are not only continuing, but also further increasing. The quality of the power supply in respect of reliability, stability and security has to be ensured.

The reasons for energy crunch are due to population explosion and Elevation in living standards. Hence the only way is to use the available energy in a much planned and productive way than ever before. The need of hour is therefore **“Energy Auditing”**. This really means to reduce the load demand by applying well established principles and techniques through efficient Energy Auditing.

Electrical Energy is invisible; hence often it is wasted or made theft without being noticed except at the end of the month when energy is accounted or reviewed.

Energy Auditing



- Energy audit is an analysis of energy input with respect to sales.
- BESCOM is computing distribution loss by considering input energy for the previous month and sales of the current month. Eg: for April month's sales & March month's input is considered.

The main objectives of energy audit are:

- ✓ To know the inflow and outflow of energy in the system.
- ✓ To know the losses and wastages of energy occurring in the system.
- ✓ To assess the efficiency of the system.
- ✓ To identify the area of high T&D losses
- ✓ To assess the extent of theft & pilferage
- ✓ To take appropriate steps for making the system technically more efficient and financially sustainable.
- ✓ To prepare alternative plans for reduction of losses and to improve system efficiency.

Energy Auditing

- Energy audit is an analysis of how much energy is purchased and how much energy is sold and how much loss has occurred and also its an engineering technique used to establish the pattern of energy use and identification of how and where the losses are occurring. Electrical Energy is invisible; hence often it is wasted or made theft without being noticed except at the end of the month when energy is accounted or reviewed. Hence any savings in energy usage & losses directly leads to the profitability of the utility.
- Energy losses in the system are classified as Technical and Commercial losses.

Technical losses : 11 kV line losses

- Distribution transformer losses (Iron & Copper losses).
- L.T. Line losses
- Miscellaneous technical losses.

Commercial Losses : The commercial losses comprises of:

- Mistakes in the billing.
- Meters not recording (MNR)
- Meters by passed due to defects/ intentionally
- Meters not read & billed
- Theft and pilferage

KERC in their letter dt: 20.4.2015 have stated the maximum limits for the loss in the distribution system:

• **For Urban Feeder:**

- HT Loss – < 3.5%
- DTC Loss - <1.5%
- LT Loss - < 5%
- Commercial loss of LT distribution - <1%

For Rural Feeder:

- HT Loss – < 4%
- DTC Loss - <1.5%
- LT Loss - < 6.5%

Energy Audit: Formulae



- **Distribution Loss** is the difference between energy supplied at the Input Points and Energy Billed to Consumers (Sold) in percentage terms for a particular period:

$$\text{Distribution Loss} = \frac{(\text{Energy Input} - \text{Energy Billed})}{(\text{Energy Input})} \times 100$$

- ✓ The input energy is received from Power purchase section which in turn is being reconciled from TBC, KPTCL
 - Consumption from the reading taken from feeder meter at Substation
 - Energy imported from change-over feeders to be added
 - Energy exported from change-over feeders to be deducted
 - SRTPV input Energy to be added
- ✓ The metered & un-metered sales are taken from the DCB statement for computing energy audit

- **Aggregate Technical and Commercial Loss (AT&C Loss)** is the sum total of technical loss, commercial losses and shortage due to non-realization of total billed amount:

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

- ✓ **Collection Efficiency** is the ratio of revenue actually realized from consumers and energy amount billed to Consumers for a particular period, in percentage terms:

$$\frac{(\text{Collection} / \text{Demand}) \times 100}{}$$

- ✓ **Billing Efficiency (Business Efficiency)** is ratio of sales over input for a particular period.

$$\frac{(\text{Sales} / \text{Input Energy}) \times 100}{}$$

- **Bill issuing efficiency** is ratio of No. of bills issued over total No. of installation.

Energy Audit



For precise energy Auditing:

- All the consumers connected to respective DTCs to be tagged properly.
- All the DTCs of respective feeder to be tagged
- Boundary meters to be provided to sharing feeders
- Consumption of the feeder during change period over shall be considered
- SRTPV input to ESCOM grid to be accounted properly
- IF point readings at Bank level to be tallied with all feeders connected to that bank
- All the consumer installations are to be metered
- Electromechanical Meters (EM) provided to Domestic and Commercial installations are to be replaced With static meters.
- All the energy meters which are not recording (MNR) are to be replaced with the new ones
- All the Direct Connections without energy meter and tampered meters are to be regularized by providing meters.
- Vigilance activities shall be increased and patrolling of linemen or MR shall be insisted for DC connections

Energy Accounting is being done at Different level within ESCOMs i.e.,

- Sub division wise
- Division wise
- Circle wise
- Zone wise and
- ESCOM wise

Open Access/ Wheeled Energy/SRTPV Input Energy/Station Auxiliary

- **SRTPV Input Energy & Station Auxiliary** are considered for calculation of the distribution loss for BESCOM network as per the directions of Hon'ble KERC.

ZONEWISE STATIONS IN BESCOM AS ON 31.05.2024



STATIONS

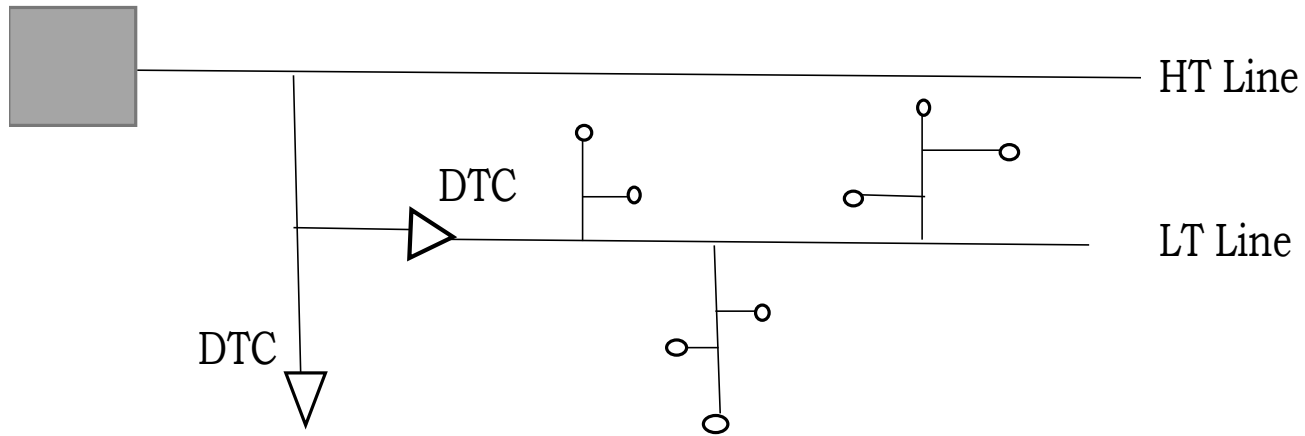
VOLTAGE CLASS	Bangalore - North Zone	Bangalore - South Zone	Bangalore Rural Zone	Chitradurga Zone	Total
220/66/11 kV	9	13	19	11	52
220/110/11 kV	0	0	0	2	2
220/66KV	3	1	4	4	12
110/11kV	0	0	0	32	32
66/11 kV	46	54	179	170	449
Total	58	68	202	219	547

FEEDERS

Feeder Category	Bangalore - North Zone	Bangalore - South Zone	Bangalore Rural Zone	Chitradurga Zone	Total
AGRI			973	1596	2569
NJY			476	566	1042
INDUSTRIAL	67	110	326	68	571
WATER WORKS	2	4	15	34	55
URBAN	768	865	357	151	2141
RURAL	3	0	57	23	83
Total	840	979	2204	2438	6461

SCHEMATIC DIAGRAM OF 11kV AND LT DISTRIBUTION LINES

Sub-Station



Feeder wise Energy Audit

Company

Zones

Circles

Divisions

Sub-division

11KV feeders

DTCs

Feeder wise Energy Accounting is being done at Different level within BESCOM i.e., Sub division wise/Division wise/Circle wise and Zone wise. In BESCOM, total **6461** nos of feeders emanating from KPTCL sub stations with DLMS featured meters (as on May-24).

For Feeder wise Energy Audit - (Feeder to consumer audit)

Total input of the feeder is calculated taking the feeder consumption $\{(FR-IR)*MC\}$, import, export and SRTPV Input. Total sales for the feeder is taken as the consumers billed consumption (Metered Sales) and unmetered Sales tagged to the feeder.

Energy Loss = $\{(\text{Net Input to feeder} - \text{Total sales}) / \text{Net Input to feeder}\} * 100$

Input Energy:

Feeder Consumption = $\{(\text{Final reading} - \text{Initial Reading}) * MC\}$

Net Input to Feeder = Feeder Consumption + Import energy - Export Energy + SRTPV Input

Sales: Consumers billed consumption (Metered Sales) + unmetered Sales tagged to the feeder

Consumer tagging is a constant process that will updated continuously, whenever new installations are added to the system.

DTC wise Energy Audit



Company

DTC wise Energy Accounting is being done at Different level within BESCOM i.e., Sub division wise/Division wise/Circle wise and Zone wise. In BESCOM, total **120356** DTCs are metered (as on May-24).

Zones

For DTC wise Energy Audit- (DTC to consumer audit)

Circles

DTC energy audit is done on monthly basis for DTCs that are having healthy meters by considering the total DTC input i.e. $\{(FR-IR)*MC\}$, import, export & SRTPV Input and total sales for the DTCs (Sales is taken as the consumers billed consumption tagged to the DTC).

Divisions

Sub-division

DTC energy audit is done for DTCs that are having healthy meters by considering the total DTC input and total sales is billed consumption of consumers tagged to the DTC

11KV feeders

DTCs

Energy Audit: Sub Division/ Division



For computing Sub Division loss:

Net Input Energy of all the feeders pertaining to sub division and total sales as per DCB are considered for computing sub division loss
Auxiliary Transformer consumption of all the sub stations in sub division jurisdiction to be considered for both input energy & sales

For computing Division loss:

Net Input Energy of all sub divisions and total sales as per DCB are considered for computing division loss

Similarly, Circle, Zone and ESCOM losses will be computed.

Distribution Loss of BESCOM - FY-24 (KERC Approved Loss: 10%)

Month	Net Input Energy in MUs	Sales to BESCOM in Mus		Total Sales in Mus	Energy Loss in MUs	% Distribution Loss
		Metered Sales	Unmetered Sales			
Apr-23	3553.66	2086.63	1096.98	3183.62	370.05	10.41%
May-23	3721.87	1922.07	1084.57	3006.63	715.24	19.22%
Jun-23	3150.11	2732.34	634.77	3367.12	-217.01	-6.89%
1st Quarter	10425.63	6741.04	2816.32	9557.36	868.27	8.33%
Jul-23	3150.16	2050.04	695.22	2745.27	404.89	12.85%
Aug-23	2746.57	2112.69	426.21	2538.89	207.68	7.56%
Sep-23	3442.21	2224.45	888.75	3113.20	329.01	9.56%
2nd Quarter	9338.93	6387.18	2010.18	8397.36	941.57	10.08%
Oct-23	2928.73	2126.21	588.61	2714.82	213.91	7.30%
Nov-23	3323.92	2184.81	825.67	3010.48	313.44	9.43%
Dec-23	3000.65	2085.55	660.81	2746.37	254.29	8.47%
3rd Quarter	9253.30	6396.57	2075.09	8471.66	781.64	8.45%
Jan-24	3436.27	2155.68	950.57	3106.24	330.03	9.60%
Feb-24	3643.46	2162.44	1140.47	3302.91	340.55	9.35%
Mar-24	3723.38	2120.62	1228.91	3349.54	373.84	10.04%
4th Quarter	10803.12	6438.74	3319.95	9758.69	1044.43	9.67%
FY-24	39820.99	25963.53	10221.54	36185.07	3635.91	9.13%

Procedure of IP assessment in Nsoft Portal.



- Feeder consumption is calculated by taking the initial reading and final reading multiplying with meter constant, then import or export energy are added or deducted to the feeder consumption if any.
- Further, for agriculture feeders 10%* of the loss is deducted and also metered sales if any are also deducted and the net consumption arrived is divided by total sanctioned load of IP sets on that feeders to arrive per HP of that particular feeder.
- For non-agricultural feeders the average of all the agri feeders of particular subdivision is considered to arrive at subdivision average per HP.
- This per HP value is multiplied with total sanctioned load of IP sets on that feeder to arrive the Unmetered sales.
- * As per the KERC directions vide letter 91, dt: 20.04.2015, the permissible technical allowable loss in Rural /agriculture feeders shall be less than 12% and in Urban feeders shall be less than 10%. Hence an average of 10% loss has been considered for agriculture feeders.
- Further, A check has been provided for all the agri feeders in the Nsoft portal, if the agri feeder units per HP crosses 200 then it automatically takes the subdivision average per HP consumption. Hence even after deducting 10% loss, due to the above check the IP sales doesn't vary abnormally. However the IP sale depends on the rain, water table and type of crops grown etc.

Key Notes

- $1\text{HP} = 0.746\text{KW}$
- Energy Consumed per month = Kw $\times$ No of hours power supply $\times$ no of days
- Multiplication Constant (MC)= CTR $\times$ PTR
- CT Ratio Calculation for HT installations:
- Power $P = \sqrt{3}VI$

Bureau of energy efficiency (BEE), Regulations for Conduct of Energy Auditing & Accounting



- Bureau of energy efficiency (BEE), Ministry of Power, Government of India had issued Regulations for conduct of energy audit in Electricity Distribution Companies under the purview of Energy Conservation Act 2001. As per the regulations, all electricity Distribution Companies are mandated to conduct annual energy audit and periodic energy accounting on quarterly basis.
- **Additional Director, PCKL** has been appointed as the State Designated Nodal Officer.
- Every quarterly, the periodic Energy Accounting shall be checked, verified and signed by Energy Manager and annual energy audit shall be checked, verified and signed by accredited Energy Auditor along with nodal officer. The timely reports to be submitted to BEE.

Thank You