Performance Benchmarking for Electricity Distribution Utilities

Ashutosh Sharma,
11th Capacity Building Programme for Officers of Electricity Regulatory Commissions

13 November 2017
Ashutosh Sharma

- Presently - Principal Consultant and Head of Section (Asset Management and Power System Planning) ; Joined KEMA/DNV GL in 2007,
- Working in the power industry since 1985
- Maintenance manager with NTPC India till 1998
- Worked at ALBA in Bahrain till 2007 responsible for the High, Medium and Low Voltage electrical assets maintenance
- Area of Expertise:
  - Asset Management, Electrical Engineering, Asset Risk Management, Power Failure Investigation(asset / HSE)
- General Expertise:
  - Project Management, Training
DNV GL Company Introduction
2,500 energy experts help customers throughout the electrical power industry realize efficient, reliable and clean energy for today and the future.
About DNV GL

- Extensive experience in microgrid and storage technologies and applications
- DNV GL has advised on over 3000 solar projects, 150 GW of wind projects
- DNV GL is the world’s largest independent energy and renewables advisory firm
- We have over 2500 energy experts. More than 1000 are focused on renewables.

151 Year History

400 Offices
100 Countries
16,000 Employees
Our overall goal is to help governments, regulators, energy providers and other stakeholders manage the world’s growing demand for energy, while balancing costs, reliability and the environment... the so-called energy trilemma.
Energy Transition Outlook - Now available as a report here: [https://eto.dnvgl.com/2017/](https://eto.dnvgl.com/2017/)
Purpose, vision and values of DNV GL

Purpose
- To safeguard life, property and the environment

Values
- We build trust and confidence
- We never compromise on quality or integrity
- We are committed to teamwork and innovation
- We care for our customers and each other
- We embrace change and deliver results

Vision
- Global impact for a safe and sustainable future
Assisting companies in solving the energy trilemma
DNV GL service lines

Energy Advisory

- Asset Management (AM)
- Power System Planning (PSP)
- Market and Policy Development
- Project Management & Technical services
- Operational Excellence

Key deliverables:

- Business strategy across all markets
- Power system design and modelling
- Technology implementation services
- Operations and systems optimization

Key deliverables:

- Business strategy across all markets
- Power system design and modelling
- Technology implementation services
- Operations and systems optimization
...requires our comprehensive approach

We give clear answers and confidence

Strengthening the Grid
We enable customers to transform their grid and to comply with regulatory requirements and international standards using innovative solutions.

Balancing Supply & Demand
We deliver certainty about reliability and stability in diverse operational modes for the different generation scenarios with high RES in-feed.

Advanced Asset Management
We provide scenario’s to optimize the asset fleet performance and related risks and costs, resulting in sustainable world class asset management processes.

Offshore T&D Technology
We provide confidence in defined solutions and enable customers to demonstrate the value of investments in offshore and.

Integration of Renewables
We deliver innovative concepts to enable the integration of renewables in the grid, and to control the risks associated with large scale presence of distributed sources.
Strengthening the GRID

To enable grid extension in a changing environment while maintaining security of supply and compliance with regulatory requirements and international standards.

Associated DNV GL Services

- **Grid Development Planning**
  (e.g. grid reliability assessment, power system studies, NERC compliance)

- **Grid Technology Solutions**
  (e.g. basic design and specification for power lines, cables and substations, solutions for the integration of energy storage system integration)

- **Grid Projects Support**
  (e.g. Owner’s engineer, vendor selection, tender evaluation, project risk assessment, design verification & quality assurance)
Balancing Supply & Demand

To deliver certainty about reliability and stability in diverse operational modes for the different generation scenarios with high RES in-feed.

We provide transparency on system limits and give answers to all stakeholders including regulators and connected clients.

Associated DNV GL Services

- **Electricity Balancing**
  (e.g. advanced algorithms for Electricity Balancing, development of unit commitment and economic dispatch, storage facilities, incentives on operation flexibility)

- **Load Freq. Control & Reserve Management**
  (e.g. stability and controllability assessment, optimization of reserve management)

- **Congestion Management**
  (assessment of congestion management framework and developing of operational measures)
Advanced Asset Management

To deliver system optimization and improved reliability. We help to enhance the quality of the AM process and organization, optimize planning against aging assets but are also well-equipped to do power failure investigations.

Associated DNV GL Services

- **Process Review & Optimisation**
  (e.g. Auditing PAS55 / ISO55000, Integrated risk-based AM)

- **Asset Fleet Management**
  (e.g. Decision support & data utilization, CASCADE)

- **Condition and Remaining Life**
  (Cable & Substation diagnostics, Oil lab services, Smart Cable Guard)

- **Power Failure Investigations**
  (Independent root-cause analysis of power failures)

- **Competence Development**
  (DNV GL Academy training courses, Asset competence development)
## Asset Management
### Power Failure Investigations

#### Service description
- In depth analysis cause of failure
- Taking into account design, production, installation, service conditions
- With all possible laboratory services at hand
- With experts per component type
- Investigation at DNV GL or any other location

#### Customer benefits
- Independent report on the cause of failure
- Based on worldwide experience
- With recommendations to prevent future failures
- Often work can be done on short notice
B. Sustainable Energy Use

Advice, analysis and implementation assistance for energy efficiency programmes and measures

Service lines:

1. Policy advisory and research
2. Programme development and implementation
3. Sustainable buildings and communities
4. Industrial energy management

- Design and deliver turnkey energy efficiency programmes that produce verifiable savings and meet utility goals
- Develop innovative approaches for data collection and analysis that extract more value and support policy decisions
- Reduce building operating costs, increase property values, manage risks and meet expectations of investors and customers
Capacity Building

Date: 27th September 2017

Sub: Completion of “Capacity Building Programme on Integration of Renewable Energy Resources (RES) into the Grid” for Power Utilities operating in Southern Region against tender no. NIT 01/2017 floated by Southern Regional Power Committee (SRPC), Bangalore.

This letter is to confirm that between May 2017 and August 2017, Garrad Hassan India Pvt. Ltd. (a DNV GL Company) with support of the other DNV GL companies (KEMA-IEV GmbH & Garrad Hassan Iberica SL) completed the “Capacity Building Programme on Integration of Renewable Energy Resources (RES) into the Grid” for Power Utilities operating in Southern Region.

- Southern Regional Power Committee (SRPC)
- Central Electricity Authority (CEA)
- Ministry of Power (MoP)
- Central Electricity Regulatory Commission (CERC)
- Power System Operation Corporation Limited (POSOCO)
- Tamil Nadu Transmission Corporation Limited
- Power grid Corporation & India Ltd. (NGCIL)
- Karnataka Power Transmission Corporation Limited
- Transmission Corporation of Telangana Ltd
- Transmission Corporation of Andhra Pradesh Ltd
- National Thermal Power Corporation (NTPC)
- NLC India Ltd.
- Kerala State Electricity Board Ltd.
- Electricity Department (Govt. of Puducherry)

The programme was executed in India, Germany and Spain and contained visits to Power plant, Wind plant, SCADA system, Grid Lab besides class room and online training. The total contract price was INR 4,18,87,032/- as per agreed contract.

The focus of programme was on policy framework and regulatory aspects to promote integration of Renewable Energy Supply (RES) into the Grid. Participants were made familiar with challenges posed by RES for the grid and possible technological solution and following topics were emphasized during the training.

- Trends and Innovations in Green Power.
- Challenges posed by RES for the grid and technological solutions
- Policy Framework for Renewables energies in India and Renewable energy rich countries
- Regulatory Provisions for Renewable Energy in India and Renewable energy rich countries
- RE Management best practices in RE rich countries.
- Visits to Energy Self-sufficient Village Feldheim.
- Experience of flexing of Coal based generating stations to take care of variable RE generation including visit to such Coal based plant.
- Interactions with Transmission Operators dealing with large scale RES penetration.
- Assessment of balancing capacity and RE purchase
- Forecasting tools for wind and solar generation (plant wise and area wise).
- Technical solutions for integrating large scale RE capacity such as Low-Voltage – Ride-Through capability, Active Power Control, Dynamic Reactive power support.

The capacity building program was concluded within agreed timelines.

(S R BHAT)
Member Secretary
Southern Regional Power Committee
Bangalore
Importance of Benchmarking
What is your BMI?

Body Mass Index Calculator

Your BMI is 27.3
This means your weight is within the overweight range.
Your current BMI is greater than the recommended range of 18.5 to 24.9.

Being overweight is a chronic condition and therefore needs a long-term plan aimed at weight reduction. Your doctor or registered dietician is the ideal person to initiate and monitor an organized treatment plan for you. This treatment plan should center on behavior modification.

Important Note

Aim to keep within the healthy weight range by enjoying a healthy, well-balanced diet and exercising regularly. Most adults should get at least 30 minutes of moderate-intensity physical activity on most, if not all, days.

- Underweight = Less than 18.5
- Normal weight = 18.5–24.9
- Overweight = 25–29.9
- Obesity = BMI of 30 or greater
I know I need to benchmark but I am too busy.

Well if you don't benchmark now, and then implement improvements based on it, you will find yourself out of control. Then you'll have plenty of time to benchmark, but it won't matter.
A Question
Benchmarking

- Numbers
- What to do with numbers?
- Interpret the numbers
- What is behind the numbers?
- Find the gaps
- Bridge the gaps / Fill the gaps

- Benchmarking is a process
- Process of continually searching for the best methods, practices and processes
- To become the “best of the best.”
Types of Benchmarking

- Internal
- External

- Competitive Benchmarking
- Product Benchmarking
- Process Benchmarking
- Practices Benchmarking
- Strategic Benchmarking
- Parameter Benchmarking
Benchmarking – As a competitive process

- Improves Efficiency
- Improves Performance
- Improves >>>>>>>>>>

- Reduce Costs
Benchmarking

- Continuous process
- Investigation process
- Learning process
- Innovative process - a pragmatic search for ideas
- Requires discipline
- Resource - consuming
- A vital tool that provides useful information for improving virtually any business process
Benchmarking

• Specify Indices

Plan

• Quantify Indices

Do

• Interpret, assess actions

Act

• Measure

Check
Benchmarking
DBF – A Running Show Case of Distribution Utilities Benchmarking
VISION OF DBF

“To be a forum for participants to share experiences and learn from each other and improve performance through benchmarking”

OBJECTIVES

- IMPROVEMENT is part of business process
- MEASURE performance to improve
- BENCHMARK to identify gaps
- LEARN from peer group
DBF MEMBERS

شركت مسقط لتوزيع الكهرباء
Muscat Electricity Distribution Co.

Majan Electricity Co. (SAOC)

شركت طفار للطاقة
Dhofar Power Company S.A.O.G

Mazoon Electricity Company S.A.O.C

Rural Area Electricity Company S.A.O.C

Irbid Electricity
DBF ORGANISATION

- Steering Group
- Secretariat
- EHC (Observer)
  - Designated Observer
  - EHC
- Participating Member 1
- Participating Member 2
- Champ
- Working Group
- Participating Member N
  - Champ
  - Working Group
# DBF Benchmarking Areas

<table>
<thead>
<tr>
<th>1</th>
<th>NETWORK PERFORMANCE</th>
<th>What is the quality of the network system?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CUSTOMER SERVICE PERFORMANCE</td>
<td>How satisfied are customers?</td>
</tr>
<tr>
<td>3</td>
<td>FINANCIAL PERFORMANCE</td>
<td>How financially secure is the company?</td>
</tr>
<tr>
<td>4</td>
<td>HSE PERFORMANCE</td>
<td>How safe is the company’s environment?</td>
</tr>
<tr>
<td>5</td>
<td>HR PERFORMANCE</td>
<td>How satisfied are the employees?</td>
</tr>
</tbody>
</table>
CONFIDENTIALITY

- There shall be strict confidentiality in the treatment and disclosure of any data or information within the DBF.
- Participating Members can disclose benchmarking results of other Participating Members only in an anonymous manner.
- Each participating member shall enter into a confidentiality agreement with DNV as a secretariat for the duration of the participation. Confidentiality agreement format will be developed by DNV GL.
KPI’S OVERVIEW

3. FINANCIAL PERFORMANCE

3.1 Return on Capital (ROC) %
3.2 Cost Effectiveness (CE) RO/MWh
3.3 Days Sales Outstanding (DSO) days

4. HUMAN RESOURCES PERFORMANCE

4.1 Customer served per employee (CSPE) Number
4.2 Employee Satisfaction Index (ESI) Index

5. SAFETY HEALTH ENVIRONMENT PERFORMANCE

5.1 Lost Time Injury Frequency Rate (LTIFR) LTI/million hours
5.2 Near Miss Reported (NMR) Reports/staff
DBF – Tool
INTRODUCTION

- DNV GL has developed an online tool, to enter the Distribution Benchmarking data and instantly get benchmarking results.

- This tool allows users to either directly enter data online or to upload excel sheets with filled data.

- The tool is designed to ensure data security and all the company's are anonymised.
## FEATURES OF DBF TOOL

All data on one platform

<table>
<thead>
<tr>
<th>Compose</th>
<th>Get Format</th>
<th>Import</th>
<th>Export</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>2012</td>
<td>2012</td>
<td>2012</td>
</tr>
<tr>
<td>2013</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
</tr>
<tr>
<td>2015</td>
<td>2015</td>
<td>2015</td>
<td>2015</td>
</tr>
</tbody>
</table>

Performance Benchmark

**Sign In**

- Username
- Password

Log in

Powered By

DNV·GL
### FEATURES OF DBF TOOL

#### Benchmark Graphs

**Summary**
- 2012
- 2013
- 2014
- 2015

**Network & Operations**
- Energy Load
- Customers &
- Connections

**Completeness**
- Total Loss & NGL
- Indexes
- MV & LV Lines

---

**Fill in 2015 KPI(s)**

**Network Operations & Performance**

**Completion Rate** 86.11%

**NETWORK OPERATIONS RELATED INFORMATION**

<table>
<thead>
<tr>
<th>Key Indicator</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy served during the reporting period</td>
<td>MWh</td>
<td>216417.00</td>
</tr>
<tr>
<td>Peak load experienced during the reporting period</td>
<td>MW</td>
<td>51.70</td>
</tr>
<tr>
<td>Date and time of peak load</td>
<td>yyyy/mm/dd hh:mm</td>
<td>2015/07/24 14:00</td>
</tr>
<tr>
<td>Minimum load experienced during the reporting period</td>
<td>MW</td>
<td>19.60</td>
</tr>
<tr>
<td>Date and time of minimum load</td>
<td>yyyy/mm/dd hh:mm</td>
<td>2015/07/05 13:00</td>
</tr>
<tr>
<td>Total served area</td>
<td>Square kilometres</td>
<td>188446.07</td>
</tr>
<tr>
<td>Total Length of MV-Overhead lines (33kV)</td>
<td>kilometres</td>
<td>2000.73</td>
</tr>
<tr>
<td>Total Length of MV Cable service lines (33kV)</td>
<td>kilometres</td>
<td>261.73</td>
</tr>
<tr>
<td>Total Length of MV-Overhead lines (11kV)</td>
<td>kilometres</td>
<td>1297.12</td>
</tr>
</tbody>
</table>
Typical Show case of Network Operations KPIs
SAIDI Definition

- The System Average Interruption Duration Index (SAIDI) measures the average of the total long duration of interruptions affecting the average delivery point for a given year. Long interruptions are those that last longer than 5 minutes.

- This indicator is defined as the total time that customers were interrupted divided by the total number of customers.

\[
SAIDI = \frac{\sum_{i} (N_i \cdot d_i)}{CA}
\]

Where:

- \(i\): Index of interruptions for the year
- \(d_i\): Duration of interruption “\(i\)”, in minutes
- \(N_i\): Number of customers for which the supply was interrupted by interruption “\(i\)”
- \(CA\): Customer Accounts

* Interruption: An event where one or more customers experience loss of electricity supply for a period longer than 5 minutes.
**KPI Description:**

The System Average Interruption Duration Index (SAIDI) measures the average of the total long duration of interruptions affecting the average delivery point for a given year. Long interruptions are those that last longer than 5 minutes.

Participants should strive to **decrease** SAIDI.
NETWORK OPERATIONS KPIs: SAIDI

SAIDI Index
Unit in (Min./Customer)
INTERNATIONAL BEST-PRACTICE: SAIDI

SAIDI (Min./Customer)

Note: Unplanned HV and LV only
SAIFI Definition

- The System Average Interruption Frequency Index (SAIFI) measures the average number of long interruptions experienced per customer. The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period of time.
- Long interruptions are those that last longer than 5 minutes.
- This indicator is defined as the total number of customer interruptions divided by the total number of customers.

\[
SAIFI = \frac{\sum_{i} (N_i)}{CA}
\]

Where:

- \(i\): Index of interruptions for the year
- \(N_i\): Number of customers for which the supply was interrupted by interruption “i”
- \(CA\): Customer Accounts
KPI COMPARISON GRAPH: SAIFI

**KPI Description:**

The System Average Interruption Frequency Index (SAIFI) measures the average number of long interruptions experienced per customer.

Participants should strive to **decrease** SAIFI.
NETWORK OPERATIONS KPIs: SAIFI

SAIFI Index
Unit in (Interruptions / Customer)

- Planned LV
- Planned HV
- Unplanned LV
- Unplanned HV
- Generation
- Transmission
- Force Majeure
- Total SAIFI
CAIDI Definition

- The Customer Average Interruption Duration Index (CAIDI) measures the average time of long interruptions. This indicator is defined as the total time that customers were interrupted divided by the total number of customer interruptions.
- Alternatively this indicator can be defined as SAIDI divided by SAIFI.

\[
CAIDI = \frac{SAIDI}{SAIFI}
\]
KPI Description:

The Customer Average Interruption Duration Index (CAIDI) measures the average time of long interruptions. CAIDI is provided as a total CAIDI = total SAIDI/total SAIFI

Participants should strive to decrease CAIDI.
NETWORK OPERATIONS KPIs: CAIDI

CAIDI Index
Unit in (Min./Interruptions)
INTERNATIONAL BEST-PRACTICE: RELIABILITY

Note: Unplanned HV and LV only
KPI : LOSSES

KPI Description:

- Normally Technical Losses comprises energy losses caused by the physical transport of energy, e.g. line losses, transformer losses; and
- Technical Losses are normally determined using specific studies.

Best Practices have losses at around 4% - 5%.

Participants should strive to decrease total losses.
INTERNATIONAL BEST PRACTICE: TOTAL LOSSES

Losses (%)

Netherlands Japan Belgium Austria Slovenia Denmark Australia Poland United States European Union Sweden Luxembourg France Chile New Zealand Switzerland Italy DSO D United Kingdom Ireland DSO E DSO C Philippines Hungary Colombia DSO F Romania Hungary DSO B Panama Azerbaijan Mexico Iran, Islamic Rep. Tunisia
Typical Show case of Financial KPIs
RETURN ON CAPITAL

- The Return on Capital (ROC) is a measure of the return that the company is earning on its invested capital.

\[ ROC = \frac{PFO}{\text{Capital}} \times 100\% \]

Where:

- **PFO**: Profit from operations
- **Capital**: Average of the Net Regulatory Asset values on start date i.e. 1\textsuperscript{st} January and end date i.e. 31\textsuperscript{st} December of reporting period

- Additionally, please kindly check **DBF Manual** for further definitions.
COST EFFECTIVENESS

- The Cost Effectiveness (CE) is a measure of the cost level for the company relative to the number of units it distributes.

\[
CE = \frac{OC}{RUD}
\]

Where:

**OC**: Operating Costs during reporting period

**RUD**: Regulated Units Distributed during reporting period

- Additionally, please kindly check **DBF Manual** for further definitions.
Safety, Health and Environment KPIs
Lost Time Injury Frequency Rate

- Lost Time Injury Frequency Rate (LTIFR) measures how many Lost Time Injuries (LTI) occurred over a specified period per million staff working hours.

\[
LTIFR = \frac{LTI}{\text{Working Hours}} \times 1,000,000
\]

Where:

- **LTI**: Number of Loss Time Injuries occurred during the given period
- **Working Hours**: Total number of working hours for all staff in the given period including contractor staff

- Additionally, please kindly check **DBF Manual** for further definitions.
DBF Best Practices Workshop Presentation
Workshop of learning, sharing practices

1- Complaints Recovery Time

<table>
<thead>
<tr>
<th>Creation</th>
<th>No of Complaints</th>
<th>Solved in 10 Days</th>
<th>Solved in 40 Days</th>
<th>Not Solved</th>
<th>Solved in 10 Days %</th>
<th>Solved in 40 Days %</th>
<th>Not Solved</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1/2015</td>
<td>37</td>
<td>33</td>
<td>0</td>
<td>4</td>
<td>89.1861919</td>
<td>0</td>
<td>10.811</td>
</tr>
<tr>
<td>10/2/2015</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>10/3/2015</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>10/4/2015</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>33</td>
<td>0</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Management Daily Performance Monitoring through BI

Dedicated Technical Staff

Yes

(1) Initial Review

(2) Site Visit Required?

(3) Passing adjustments in billing system directly ‘if needed’

(4) Updates CRM & Send SMS to the customer

Registering Complaints in CRM by CC & branches

Monitoring Progress and Follow up the team & writing official response to the customers
ELECTRICITY DISTRIBUTION BENCHMARKING

Assessing and improving service performance for electricity distribution network operators

How can utilities meet the rapidly growing demand for electricity while managing ageing assets effectively and fulfilling regulatory requirements? The DNV GL-facilitated Distribution Benchmarking Forum helps you answer that question. Through annual in-depth benchmarking studies, it enables electricity distribution network operators (DNOs) to achieve and maintain world-class performance.

Electricity consumption in the Cooperation Council for the Arab States of the Gulf (GCC) region is growing fast. For example, in Oman both peak and average demand are predicted to approximately double between 2013 and 2020. For the region as a whole, demand is estimated to grow at around 5-10% per year over the coming five years. And demand per capita is increasing at around 2.5%—four times faster than in the USA.

In meeting this growth, DNOs must efficiently manage their ageing assets, increase efficiency and comply with all regulations. Benchmarking your operations against the peer group allows you to understand how well your company is performing and identify where and how you can improve effectiveness and efficiency even further.

The Distribution Benchmarking Forum gives you that opportunity—facilitated and supported by DNV GL, one of the most trusted and experienced independent consultant names in the energy industry.

The Distribution Benchmarking Forum

The Distribution Benchmarking Forum (DBF) was historically established in 2012 on the initiative of Electric Holding Company (EHC) owned by the Oman government with the goal of “measuring performance to improve”. To enable that goal, the EHC appointed DNV GL to act as the DBF’s independent benchmarking expert and secretary. DBF members can draw on DNV GL’s extensive global experience of benchmarking projects and analyses. The vision of the DBF is “to be a forum for participants to share experiences, learn from each other, and improve performance through benchmarking.”

Why to benchmark?

Benchmarking is essential for any electricity distribution network operator who has a desire to excel so needs to thoroughly review:

- Asset performance
- Planned and unplanned service interruptions
- Reliability indicators
- Customer satisfaction
- Financial performance
- Employee satisfaction

Benchmarking within the DBF

With the DBF, benchmarking focuses on five strategic themes:

- Network operation
- Customer services
- Financial performance
- Human resource management
- Health and safety

The forum uses standardized reporting practices and common metrics to simplify comparison with your peers, whilst accounting for specific differences between distribution companies. It promotes practical solutions that are easy to understand and easy to implement, helping to improve performance more quickly.

How it works

Each member DNO submits its yearly data on key indicators on standard templates released by DNV GL related to the five strategic themes. DNV GL checks the data from all members, and carries out detailed benchmarking calculations. The outcome of these calculations is shared via an annual report. This shows how your performance compares to other participating members and how the top performers achieve their results.

After the report is published, all DBF members are invited to an annual workshop to discuss the results and share best practices. The workshop is hosted by a workshop is hosted by one of the participating member and therefore can take place in various locations. This makes it possible to get an insight in the company of the host as well. All participating member DNOs sign the confidentiality agreement and make sure that the data and information is kept within their companies.

How to join

Membership of the DBF is open to all electricity distribution companies in the region and the globe. To take advantage of the benefits of membership, please contact:

Mr. Ashish Sharma
Tel: +971 4 357 6554
Fax: +971 4 862 3336
Email: dubai@dnvgi.com
Or go to www.dnvgi.com/dbf

Benefits of DBF membership

- Receive an annual overview of where your company stands
- Gain an understanding of where you can improve
- Learn best practices from the peer group leading performers

A TRUSTED AND EXPERIENCED PARTNER

DNV GL has a heritage stretching back 150 years. We unite the strengths, know-how and resources of respected brands including IEM, Garrad Hassan, DNV and GL.

As a leading business and technical consulting partner to the global energy industry, we have established a strong reputation for international benchmarking. We have been active in transmission benchmarking analyses since 1998 covering 106 countries, and have delivered distribution benchmarking studies for companies around the globe.
DBF Welcomes Utilities across the Globe to Join the Forum
DBF Welcomes Utilities across the Globe to Join the Forum

www.dnvgl.com/dbf

Contact at-

dbf@dnvgl.com

or at

Dubai@dnvgl.com
BENCHMARKING and PERFORMANCE ANALYTICS across the ENERGY VALUE CHAIN
# DNV GL Global Team of Experts in Benchmarking

## Name | Key Qualification and Experience
--- | ---
Tom McInally | Tom is a Senior Principal Consultant with DNV GL. Tom’s areas of expertise include Benchmarking, Electricity and Gas Market Design, Modelling and forecasting; Grid operations and codes; Micro grids; Governance and Operation; Electricity Trading; Retail pricing and billing. He has extensive work experience with utilities in Singapore, Switzerland, Germany, Austria, Australia, Czech Republic, Slovenia, Taiwan, Vietnam, Philippines, Malaysia, Thailand, and UK. Tom has recently been involved in benchmarking of SP Services, and separately on three occasions, in benchmarking of SPPG performance and cost to serve. In Malaysia (as part of IPP audits) Tom participated in benchmark of 8 IPPs in Malaysia.

Dr. Viren Ajodhia | Dr. Viren Ajodhia, was closely involved in the benchmarking projects previously conducted for SPPA as well as for SP Services. He has extensive international benchmarking project of network tariffs, end-user tariffs, and quality performance. In addition, as part of this project he developed proposals for quality incentive schemes and conducted the international benchmarking of network tariffs. Dr. Ajodhia is a benchmarking expert with a mixed engineering and economics background. He was previously regulatory economist with the Dutch Energy Regulator. As a consultant, he has advised on regulatory policy design, price and quality control implementation, and (DEA and econometric) benchmarking analysis in the areas of electricity, gas, and water. He is a part-time lecturer at Delft University of Technology. He is also an invited lecturer at the Florence School of Regulation where he teaches advanced courses in economic regulation to staff from various European energy regulators. He has published extensively on the issue of quality regulation and benchmarking.

Karthik Arunachalam | Karthik is a Consultant with DNV GL. In DNV GL he has worked on a range of projects including knowledge transfer assignments sponsored by international bodies such as the Asian Development Bank. He leads the center of excellence in benchmarking within D&V GL CTC Singapore and has led the development of a benchmarking portal. He has worked on and project managed a wide range of benchmarking projects with utilities in Asia Pacific. He has extensive experience in benchmarking, data analytics and data visualisation for utilities. He specialises in network regulation regimes, utility performance and retail operations. Karthik holds B.Eng (Hons.) and a MSc degree in Chemical Engineering from the National University of Singapore (NUS).
Benchmarking and Performance Analytics across the energy value chain

The Energy Value Chain

Policy, Strategy & Energy Trading

Energy Production

Transmission Management

Energy Distribution

Energy End Use

Power Plant Performance Audits

TSO/DSO Benchmarking
- Grid Reliability – SAIDI / SAIFI
- Grid Capex / Opex
- Power Quality

Retail Benchmarking
- Cost-to-serve
- End-user tariffs
- Customer Service Levels

Efficiency Analysis
T&D and Retail Benchmarking

Increasing cost pressure in utilities to keep electricity and gas at affordable and competitive tariffs.

Ageing T&D assets make high reliability a key focus of operation and maintenance regimes.

Limitation in capital and resources require new approaches to strategic and operational asset management and investment allocation.

In order to identify new approaches to business issues, many companies are turning to benchmarking against their peer groups to identify utilities with better practices and areas of improvement.
# Utility (T&D and Retail) Benchmarking

## Business drivers of Benchmarking

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Key business drivers</th>
</tr>
</thead>
</table>
| Regulators   | • Support efforts with electricity sector reforms and unbundling of utilities.  
               • Support efforts in development of incentive regulation and price-cap regulation policies.  
               • Measure financial and technical performance of the utilities.  
               • Develop energy sector performance database. |
| Utilities    | • Understand their relative cost position with reference to the others and identify opportunities for improvement.  
               • Enhance reliability and minimize operational downtime of ageing assets.  
               • Renewal of PPAs, subsidies, incentives from the regulator. |
| Retailers    | • Help determine the ideal cost to serve for future cost projection and planning.  
               • Help compare tariff levels and customer service levels to ensure reliability and quality of service to end users. |
Utility (T&D and Retail) Benchmarking

Methodology

Data Collection → Data Validation → Data Normalization → Data Analysis
Utility (T&D and Retail) Benchmarking

KPIs used for Utility Benchmarking

- **Operating Efficiency**
  - Unit operational costs per unit delivered
  - Substation OPEX
  - Lines OPEX per unit transported
  - Labor Costs / Operational costs

- **System Reliability**
  - System availability
  - Forced and Fault Outages,
  - SAIFI, SAIDI, CAIDI
  - System Average Restoration Index

- **Customer Service & Others**
  - Service Standards and Performances
  - Cost-to-serve per Customer
  - Unit Cost of Meter Reading
  - Metering cost per customer

- **Grid Charges and End-user tariffs**
  - Low tension – Small
  - Low tension – Large
  - High tension
  - Extra high tension

- **Power Quality**
  - Voltage and Frequency Deviation Indices
  - Volt-var optimisation practices
  - Comparison against industry stds such as SEMI F47 and ITIC for voltage sag

- **Cross-comparison:**
  - Cost-to-serve vs customer service standards
  - End-user tariffs vs customer service standards
  - Grid charges vs SAIDI
## DNV GL Benchmarking and Performance Analytics Services

### Comparison with Typical Benchmarking Approach

<table>
<thead>
<tr>
<th>Typical Benchmarking Approach</th>
<th>DNV GL’s Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>One off exercise</td>
<td>Performance benchmarking as the first step</td>
</tr>
<tr>
<td>Lack of in-depth industry exposure</td>
<td>Concrete follow-up actions items with an implementation roadmap</td>
</tr>
<tr>
<td>Generic Approach</td>
<td>Customized solution due to familiarity with global energy markets and regulations</td>
</tr>
</tbody>
</table>
# DNV GL experience in Energy Benchmarking

<table>
<thead>
<tr>
<th>S/No</th>
<th>Project Title</th>
<th>Customer</th>
<th>Country</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cost to Serve and Service Levels Benchmarking</td>
<td>SP Services</td>
<td>Singapore</td>
<td>Feb 2017 – June 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nuon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Carilec Multi-Dimensional Benchmarking</td>
<td>Carilec</td>
<td>the Caribbean</td>
<td>Nov 2005 – Apr 2006</td>
</tr>
</tbody>
</table>
BENCHMARKING and PERFORMANCE ANALYTICS

- A Quick Look
When looked from Benchmarking view?

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Distribution Company</th>
<th>Total No. of 11 K.V. Feeders</th>
<th>Metered 11 K. V. Feeders</th>
<th>Remaining Feeders</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jaipur VVNL</td>
<td>6642</td>
<td>6598</td>
<td>44</td>
</tr>
<tr>
<td>2</td>
<td>Ajmer VVNL</td>
<td>7442</td>
<td>7230</td>
<td>212</td>
</tr>
<tr>
<td>3</td>
<td>Jodhpur VVNL</td>
<td>8442</td>
<td>7623</td>
<td>819</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22526</td>
<td>21451</td>
<td>1075</td>
</tr>
</tbody>
</table>
When looked from Benchmarking view?

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Jaipur Discom</th>
<th>Ajmer Discom</th>
<th>Jodhpur Discom</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Area</td>
<td>72474 Sq. KM</td>
<td>87256 Sq. KM</td>
<td>182509 Sq. KM.</td>
<td>342239 Sq. KM.</td>
</tr>
<tr>
<td>3.</td>
<td>Population</td>
<td>256 Lakh</td>
<td>229 Lakh</td>
<td>203 Lakh</td>
<td>688 Lakh*</td>
</tr>
<tr>
<td>4.</td>
<td>Consumers</td>
<td>45.85 Lakh</td>
<td>43.27 Lakh</td>
<td>37.32 Lakh</td>
<td>126.44 Lakh</td>
</tr>
<tr>
<td>5.</td>
<td>Total Villages</td>
<td>15145</td>
<td>15279</td>
<td>14248</td>
<td>44672</td>
</tr>
<tr>
<td>6.</td>
<td>Electrified villages (as per old definition) (upto31.12.15)</td>
<td>14458 (95.46%)</td>
<td>14969 (97.97%)</td>
<td>13837 (97.11%)</td>
<td>43264 (96.84%)</td>
</tr>
<tr>
<td>7.</td>
<td>Electrified village, (as per new definition) (upto31.12.15)</td>
<td>14722 (97.20%)</td>
<td>15071 (98.63%)</td>
<td>13838 (97.12%)</td>
<td>43631 (97.67%)</td>
</tr>
<tr>
<td>S.No.</td>
<td>Name of Circle</td>
<td>Total number of consumers served</td>
<td>Total number of sustained interruptions to consumers</td>
<td>SAIFI = (2)/(1) (Number of Interruptions/consumer)</td>
<td>Target specified by the Commission</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------</td>
<td>----------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>JODHPUR, CC</td>
<td>265090</td>
<td>2688663</td>
<td>10.14</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>JODHPUR, DC</td>
<td>409820</td>
<td>7349972</td>
<td>17.93</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PALI</td>
<td>482355</td>
<td>4928119</td>
<td>10.22</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>SIROHI</td>
<td>206239</td>
<td>3521766</td>
<td>17.08</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BARMER</td>
<td>346844</td>
<td>14996350</td>
<td>43.24</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>JALORE</td>
<td>301231</td>
<td>9759209</td>
<td>32.40</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>JAISALMER</td>
<td>93039</td>
<td>2482177</td>
<td>26.68</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>BKESL(BIKANER CC)</td>
<td>148996</td>
<td>1549648</td>
<td>10.40</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>BIKANER, DC</td>
<td>213884</td>
<td>12091446</td>
<td>56.53</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>HANUMANGARH</td>
<td>341247</td>
<td>6577655</td>
<td>19.28</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>GANGANAGAR</td>
<td>355830</td>
<td>6387853</td>
<td>17.95</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>CHURU</td>
<td>348905</td>
<td>19261963</td>
<td>55.21</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>3513480</strong></td>
<td><strong>91594821</strong></td>
<td><strong>26.07</strong></td>
<td></td>
</tr>
</tbody>
</table>
When looked from Benchmarking view?

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Name of Circle</th>
<th>Total no of consumer served (1)</th>
<th>Total numbers of sustained interruptions to consumers (2)</th>
<th>SAIFI=(2)/(1) (No. of interruptions/Consumers)</th>
<th>Target specified by the commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JCC</td>
<td>805432</td>
<td>60375</td>
<td>0.0750</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>JPDC</td>
<td>685912</td>
<td>31569</td>
<td>0.0460</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DAUSA</td>
<td>286933</td>
<td>19413</td>
<td>0.0677</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ALWAR</td>
<td>639540</td>
<td>22462</td>
<td>0.0351</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TONK</td>
<td>219366</td>
<td>12131</td>
<td>0.0553</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BHARATPUR</td>
<td>277192</td>
<td>264788</td>
<td>0.9553</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>SAWAI MADHOPUR</td>
<td>195329</td>
<td>6735</td>
<td>0.0345</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DHOLPUR</td>
<td>107568</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>KARAULI</td>
<td>168368</td>
<td>44136</td>
<td>0.2621</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>KOTA</td>
<td>337521</td>
<td>35698</td>
<td>0.1058</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>BARAN</td>
<td>205131</td>
<td>5912</td>
<td>0.0288</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>BUNDI</td>
<td>170542</td>
<td>9870</td>
<td>0.0579</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>JHALAWAR</td>
<td>217586</td>
<td>2643</td>
<td>0.0121</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>4316420</td>
<td>515732</td>
<td>0.1195</td>
<td></td>
</tr>
</tbody>
</table>
When looked from Benchmarking view?
When looked from Benchmarking view?

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Name of Circle</th>
<th>Total no of consumer served (1)</th>
<th>Total minutes of sustained interruptions to consumers (2)</th>
<th>SAIDI=(2)/(1) (Minutes/Consumers)</th>
<th>Target specified by the commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JCC</td>
<td>805432</td>
<td>-½-226860</td>
<td>0.282</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>JPDC</td>
<td>685912</td>
<td>483954</td>
<td>0.706</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DAUSA</td>
<td>286933</td>
<td>324728</td>
<td>1.132</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ALWAR</td>
<td>639540</td>
<td>35560</td>
<td>0.056</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TONK</td>
<td>219366</td>
<td>108533</td>
<td>0.495</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BHARATPUR</td>
<td>277192</td>
<td>1325258</td>
<td>4.781</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>SAWAI MADHOPUR</td>
<td>195329</td>
<td>71219</td>
<td>0.365</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DHOLPUR</td>
<td>107568</td>
<td>0</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>KARAULI</td>
<td>168368</td>
<td>5479</td>
<td>0.033</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>KOTA</td>
<td>337521</td>
<td>71396</td>
<td>0.212</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>BARAN</td>
<td>205131</td>
<td>14300</td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>BUNDI</td>
<td>170542</td>
<td>23199</td>
<td>0.136</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>JHALAWAR</td>
<td>217586</td>
<td>11283</td>
<td>0.052</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>4316420</td>
<td>2701769</td>
<td>0.626</td>
<td></td>
</tr>
</tbody>
</table>
When looked from Benchmarking view?
Discussion