



DELHI METRO RAIL  
CORPORATION LIMITED  
(DMRC)

**BLUE LINE 3 & 4 - CASE STUDY**

**April 2019**



# In 2018, DMRC became the first PEER certified transit system in the world.

*“DMRC, being a life line of the Delhi transport system, ensures that all the systems are being provided with redundancy to provide reliability and resiliency. PEER provides a rating system, to benchmark and evaluate these efforts and motivate the participants to strive for improvement. We are proud to be part of this rating system and wish all success to GBCI in their endeavors.” — Dr. Mangu Singh, Managing Director of Delhi Metro Rail Corporation, India.*



DMRC operates an urban rail-based mass rapid transit system on nine lines in Delhi-NCR region with nineteen hours of operational service per day serving nearly 2.8 million people on average per day. DMRC’s astounding commitment towards sustainability sets the standard among leading metros of the world to provide quality service to its customers. To date, DMRC earned LEED v4 O+M: Transit certification for five stations achieving Gold.

With a huge energy infrastructure spread across 343 kilometers with 250 stations in 2018, the energy expenses are around 37% of total O&M expenditure. With the past trend of increases in the electricity tariff, the necessity for energy conservation becomes the need of the hour. Considering these aspects and to improve their performance **DMRC earned PEER Gold certification for its Blue line (51 stations)** after undergoing a rigorous certification and review

## KEY HIGHLIGHTS OF DMRC BLUE LINE

The project has achieved significant benefits from renewable energy generation and energy efficiency measures – such as installation of regenerative braking mechanisms and Demand Side Management (DSM) programs. Through these programs the cumulative numbers achieved per annum are –

 Energy saved 110 million units

 90756 tons of CO<sub>2</sub> emission mitigated

 Cost savings of INR 800 million

process. Thus, demonstrating its leadership in sustainable power and transformation.

### FOCUS ON SUSTAINABILITY

The DMRC system has a mix of underground, at-grade, and elevated stations using both broad-gauge and standard-gauge railways. The power output is supplied by 25-kilovolt, 50 hertz alternating currents through an overhead catenary. To cater to the increasing energy consumption and to support the environment, DMRC has developed a solar policy. They are the first metro in India to sign a power purchase agreement (PPA) to procure 345 million units from the 750 MWp REWA Solar plant at Madhya Pradesh for the entire DMRC network. Locally (on-site) DMRC have installed a 5.72 MW rooftop solar PV system across their blue line.

PEER certification validates DMRC’s accomplishments to date and demonstrates their commitment to sustainable power and continuous improvement.

### RELIABLE AND RESILIENT NETWORK SYSTEM

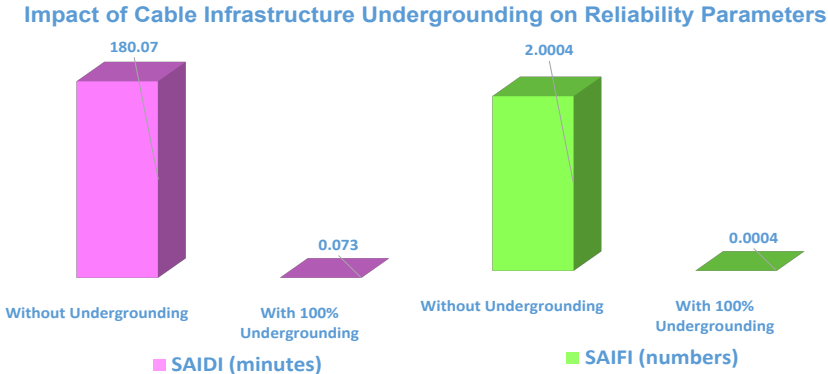
DMRC’s operational performance can be projected through their reliability metrics. The project has a System Average Interruption Duration Index (SAIDI) of 0.07 minutes, which means the project very little downtime in operations. A System Average Interruption Frequency Index (SAIFI) of 0.0004 means the frequency of downtime is also very low, highlighting their reliable transit system operation. Here, SAIDI denotes the number of trips affected/cancelled due to power interruption for a time in a year (2016-17) and SAIFI denotes the frequency on number of trips affected/cancelled due to power interruptions in the year.



DMRC’s SCADA system tracks and monitors all interruptions, including seconds of voltage fluctuation causing momentary interruptions. The entire energy infrastructure is designed to prevent flooding of underground stations, sub stations and diesel generation systems. Strategies and design considerations were implemented to prevent damage from wind storms and seismic activities.

All traction and non-traction loads are distribution redundant, being supplied with power from three different utilities that includes Tata Power - Delhi Distribution Ltd., BSES Rajdhani and BSES Yamuna. This means even when there is a power supply issue from one utility to the metro, the

power is rerouted and restored seamlessly by the alternate utility. The entire network's cables are 100 % undergrounded, thereby improving their overall reliability and resiliency, assuring a seamless travel experience for their commuters. The graph below illustrates reliability parameters (SAIDI, SAIFI) based on the cable infrastructure with and without undergrounding. This means due to 100 percentage of undergrounding DMRC has avoided SAIDI of 180.07 minutes of outage and similarly SAIFI of 2.0004 every year, showing their performance improvement.



### ENERGY EFFICIENCY & LOAD MANAGEMENT

DMRC is the first metro system in India to install regenerative braking mechanisms in their cars. This has resulted in an energy savings of roughly 110 million units per annum on their traction energy consumption for the blue line. PEER emphasizes energy conservation through the Demand Side Management (DSM) credit. To achieve this DMRC installed a VRV (Variable Refrigerant Volume) system for controlling the cooling demand, thus achieving a reduction of close to 116 MWh per year for their blue line. All lifts and escalators are VVVF (Variable Voltage Variable Frequency) driven to match power requirements with actual load and have motion sensors to operate efficiently.

### VERIFIED PERFORMANCE:

PEER is a certification that measures and improves power system performance and electricity delivery systems. The PEER rating system includes evaluates four main categories. Projects are also rewarded for innovation and addressing regional priorities.

PEER Certification for Transit Projects	
Certified 28 March 2018	
<b>Total Points Achieved</b>	<b>64</b>
Reliability and Resiliency	22
Energy Efficiency & Environment	11
Operations, Management & Safety	18
Grid Services	07
Innovations & Regional Priority	06
<b>Total Possible Points</b>	<b>110</b>

- ▶ Reliability and Resiliency (RR)
- ▶ Energy Efficiency and Environment (EE)
- ▶ Operations, Management and Safety (OP)
- ▶ Grid Services (GS)

Out of a possible 110 points, DMRC (Blue line 3 & 4) earned 64, comfortably above the 60 points minimum required for PEER v2 **Gold** certification. As part of the process, DMRC identified opportunities for sustained improvement, including load duration curve optimization, and improving their generation mix through solar power procurement. These strategies have the potential to help DMRC further reduce their energy cost in long-term.

### SUMMARY:

DMRC's sustainability practices and electrical system performance have been rigorously reviewed and benchmarked with global standards. Using PEER, DMRC improved their power system performance and achieved savings in blue line by installation of rooftop solar PV, DSM program and regenerative braking mechanism contributing to cumulative *energy savings of 110 MUs/year*, equivalent *financial savings of \$12 million/year* and *mitigating 90.5 kilotons of CO<sub>2</sub>/year*. Achieving PEER GOLD certification showcases organizations commitment towards environment, safety and reliability.



### About PEER

Performance Excellence in Electricity Renewal (PEER) is a rating system and certification for defining, assessing and verifying the overall sustainable performance of electricity delivery system design & operations. PEER is designed to deliver sustainable, resilient and reliable energy around the globe. Learn more: [peer.gbci.org](http://peer.gbci.org)