



# Adani Transmission Limited

## O&M Excellence Showcase

Oct - 2021



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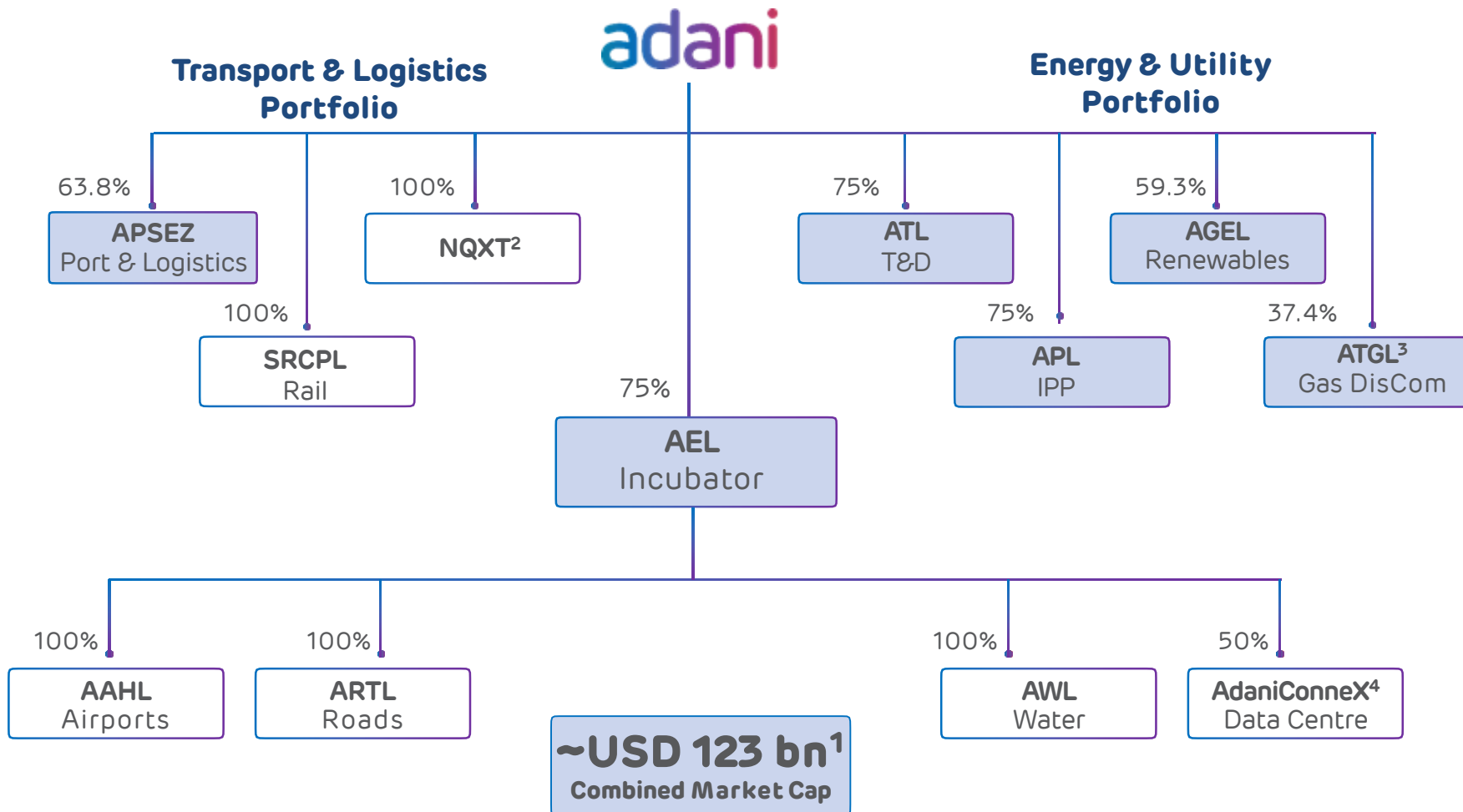
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# Adani Group and Adani Transmission



# Adani Group: A world class infrastructure & utility portfolio



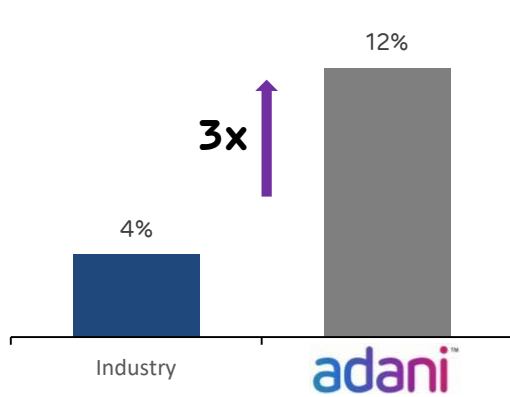
## Adani

- **Marked shift from B2B to B2C businesses –**
- **ATGL** – Gas distribution network to serve key geographies across India
- **AEML** – Electricity distribution network that powers the financial capital of India
- **Adani Airports** – To operate, manage and develop eight airports in the country
- **Locked in Growth –**
  - Transport & Logistics - Airports and Roads
  - Energy & Utility – Water and Data Centre

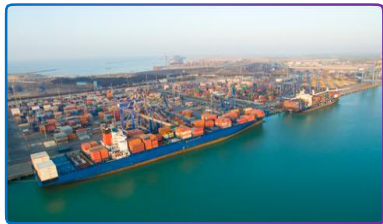
Opportunity identification, development and beneficiation is intrinsic to diversification and growth of the group.

# Adani Group: Decades long track record of industry best growth rates across sectors

Port Cargo Throughput (MMT)



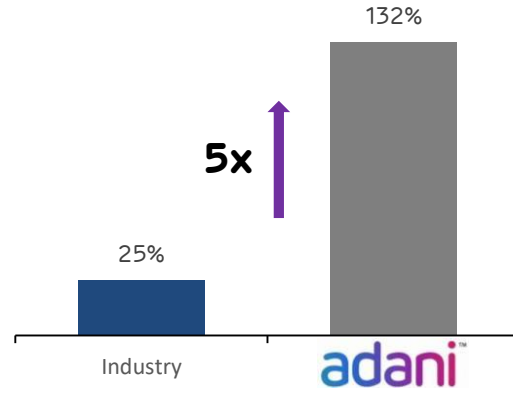
2014	972 MMT	113 MMT
2021	1,246 MMT	247 MMT



## APSEZ

Highest Margin among Peers globally  
EBITDA margin: 70%<sup>1,2</sup>  
Next best peer margin: 55%

Renewable Capacity (GW)



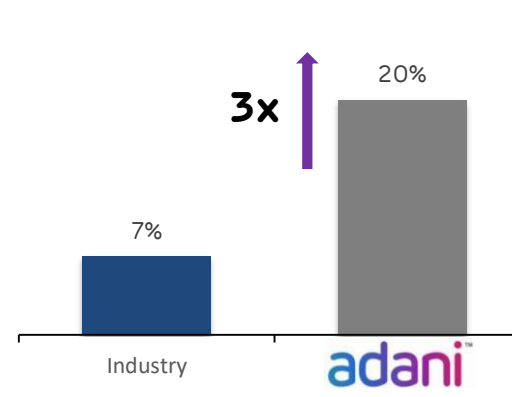
2016	46 GW	0.3 GW
2021	140 GW <sup>9</sup>	19.3 GW <sup>6</sup>



## AGEL

World's largest developer  
EBITDA margin: 91%<sup>1,4</sup>  
Among the best in Industry

Transmission Network (ckm)



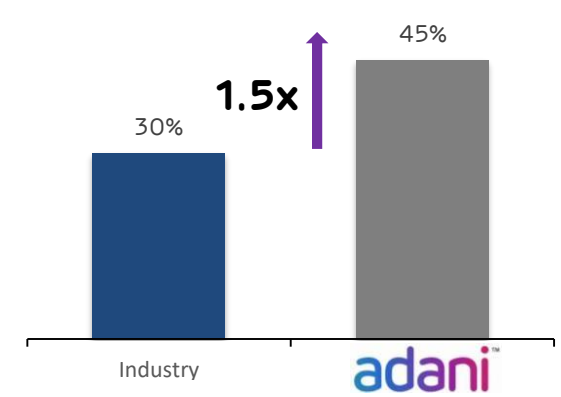
2016	320,000 ckm	6,950 ckm
2021	441,821 ckm	18,801 ckm



## ATL

Highest availability among Peers  
EBITDA margin: 92%<sup>1,3,5</sup>  
Next best peer margin: 89%

CGD<sup>7</sup> (GAs<sup>8</sup> covered)



2015	62 GAs	6 GAs
2021	228 GAs	38 GAs



## ATGL

India's Largest private CGD business  
EBITDA margin: 41%<sup>1</sup>  
Among the best in industry





Transformative model driving scale, growth and free cashflow

Note: 1 Data for FY21; 2 Margin for ports business only, Excludes forex gains/losses; 3 EBITDA = PBT + Depreciation + Net Finance Costs – Other Income; 4 EBITDA Margin represents EBITDA earned from power supply 5. Operating EBITDA margin of transmission business only, does not include distribution business. 6. Contracted & awarded capacity 7. CGD – City Gas distribution 8. GAs - Geographical Areas - Including JV | Industry data is from market intelligence 9. This includes 17GW of renewable capacity where PPA has been signed and the capacity is under various stages of implementation and 29GW of capacity where PPA is yet to be signed'

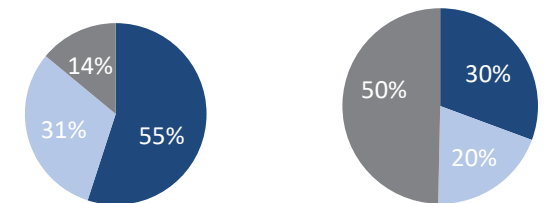
# Adani Group: Repeatable, robust & proven transformative model of investment



Activity	Origination	Site Development	Construction	Operation	Capital Mgmt
	<ul style="list-style-type: none"> <li>Analysis &amp; market intelligence</li> <li>Viability analysis</li> <li><b>Strategic value</b></li> </ul>	<ul style="list-style-type: none"> <li>Site acquisition</li> <li>Concessions &amp; regulatory agreements</li> <li><b>Investment case development</b></li> </ul>	<ul style="list-style-type: none"> <li>Engineering &amp; design</li> <li>Sourcing &amp; quality levels</li> <li><b>Equity &amp; debt funding at project</b></li> </ul>	<ul style="list-style-type: none"> <li><b>Life cycle O&amp;M planning</b></li> <li>Asset Management plan</li> </ul>	<ul style="list-style-type: none"> <li>Redesigning <b>capital structure</b> of assets</li> <li><b>Operational phase funding consistent with asset life</b></li> </ul>

Performance	Origination	Site Development	Construction	Operation	Capital Mgmt
	<p>India's Largest Commercial Port (at Mundra)</p> <p>↓</p> <p>Highest Margin among Peers</p> 	<p>Longest Private HVDC Line in Asia (Mundra - Mohindergarh)</p> <p>↓</p> <p>Highest line availability</p> 	<p>648 MW Ultra Mega Solar Power Plant (at Kamuthi, TamilNadu)</p> <p>↓</p> <p>Constructed and Commissioned in nine months</p> 	<p>Energy Network Operation Center (ENOC)</p> <p>↓</p> <p>Centralized continuous monitoring of plants across India on a single cloud based platform</p> 	<p>Revolving project finance facility of \$1.35Bn at AGEL – fully funded project pipeline</p> <p>First ever GMTN<sup>1</sup> of USD 2Bn by an energy utility player in India - an SLB<sup>2</sup> in line with COP26 goals - at AEML</p> <p>Issuance of 20 &amp; 10 year dual tranche bond of USD 750 mn - APSEZ the only infrastructure company to do so</p> <p>Green bond issuance of USD 750 mn establishes AGEL as India's leading credit in the renewable sector</p>

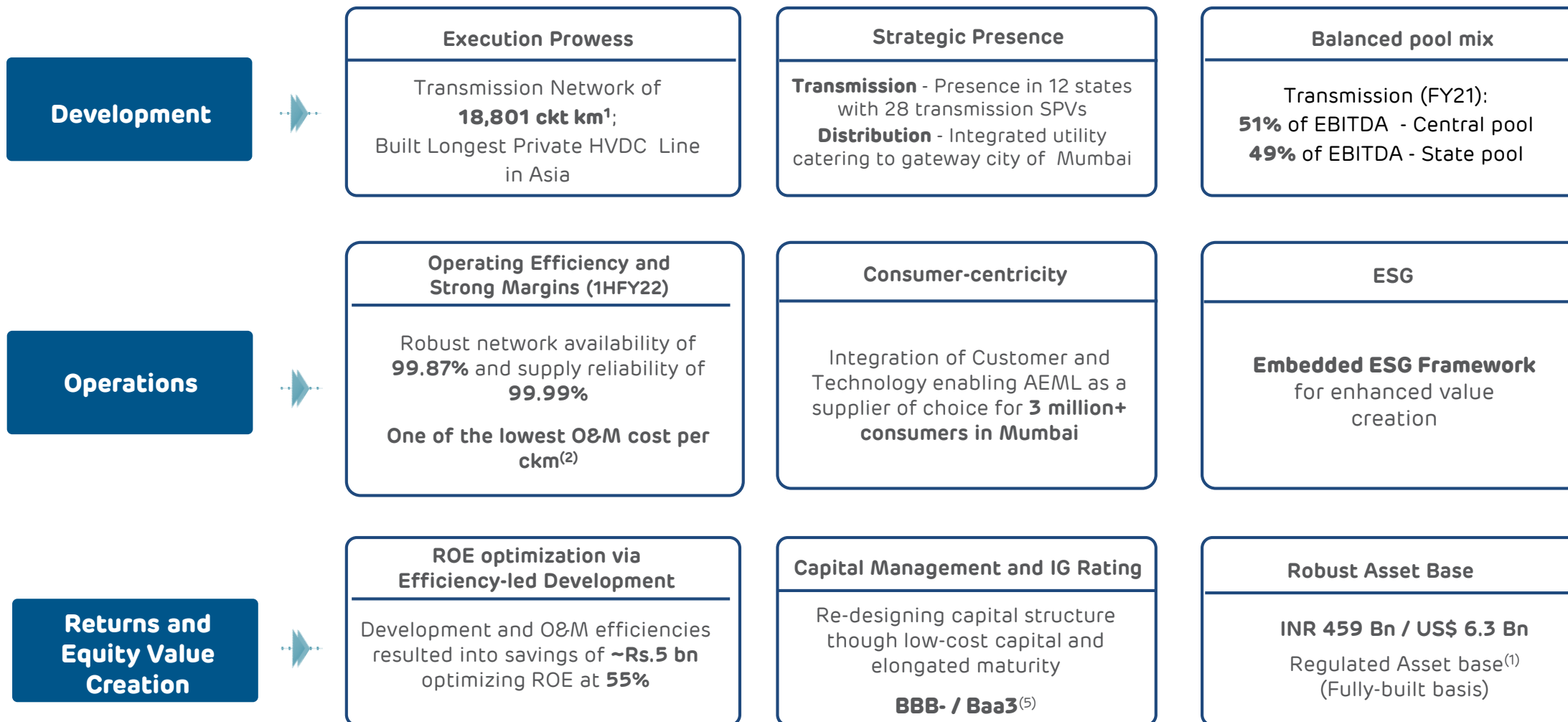
**Debt structure moving from PSU's banks to Bonds**



● PSU ● Pvt. Banks ● Bonds

Notes: 1. GMTN – Global Medium Term Notes 2. SLB – Sustainability Linked Bonds

# ATL: A platform well-positioned to leverage growth opportunities in T&D business



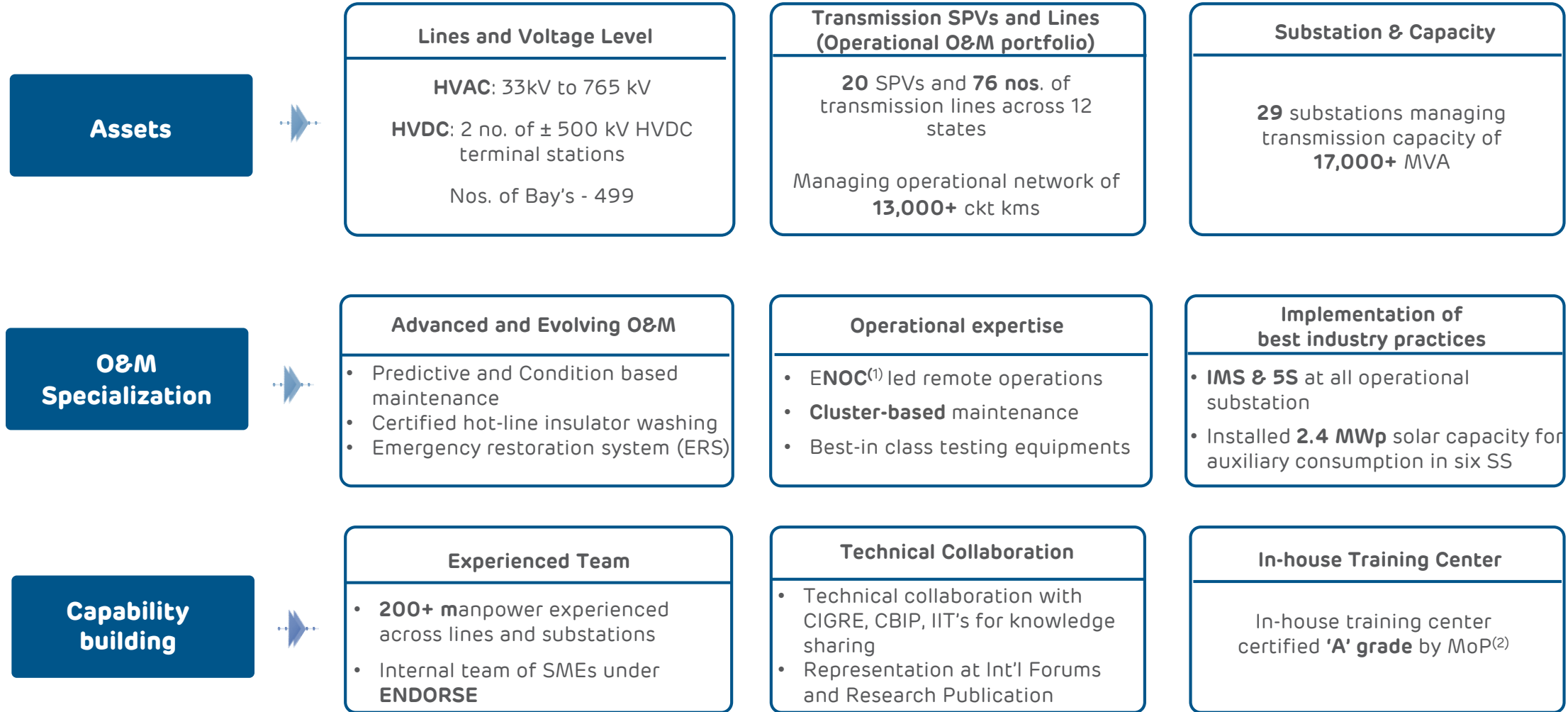
Notes: 1) Transmission network is as of September'21 and includes operational, under-construction and LOI assets; 2) As per internal benchmarking on global transmission peers for Jan-Dec 2020 period



**ATL Operational Excellence –  
Reliability, Longevity, Sustainability and Safety**

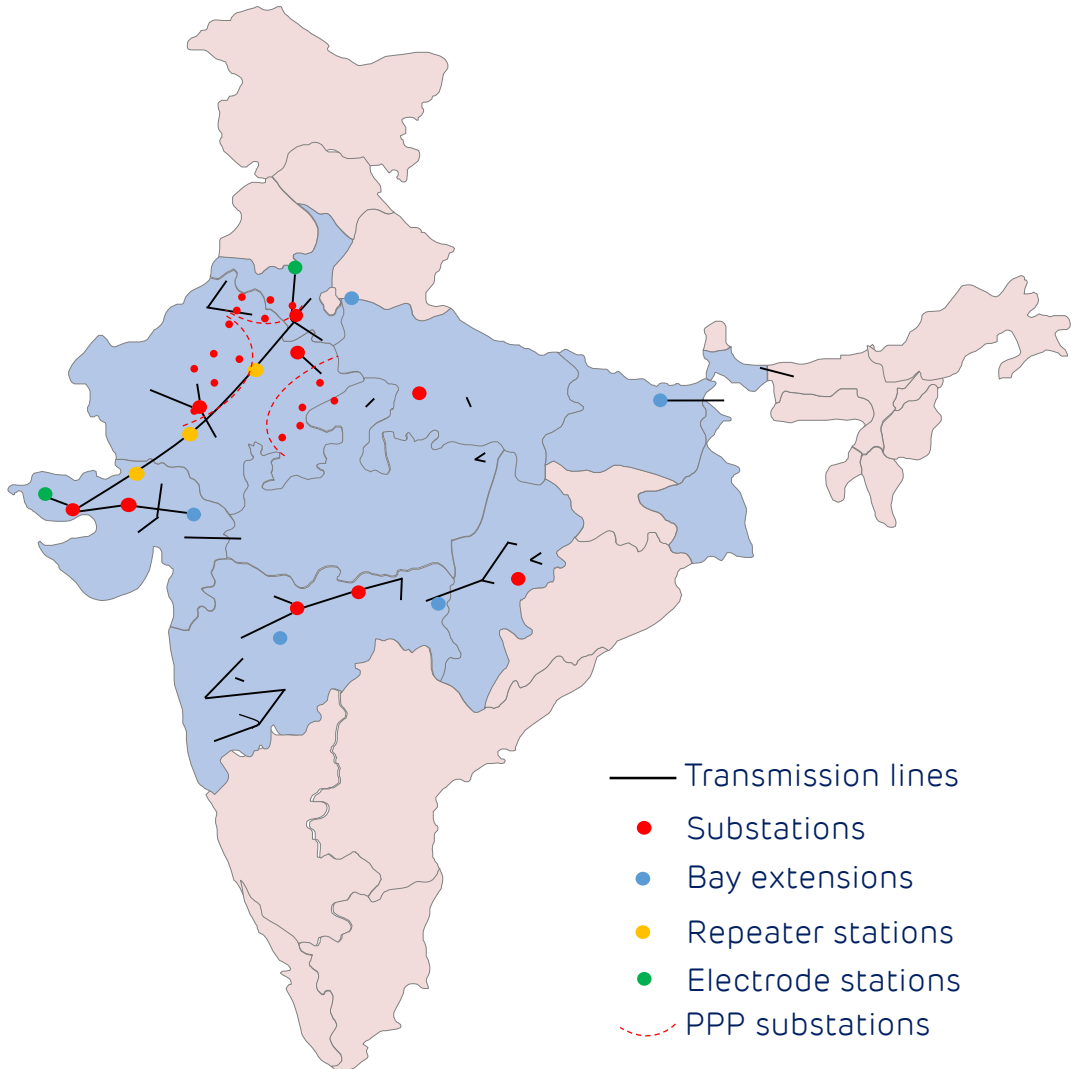


# ATL - O&M Portfolio and Prowess



# ATL - Geographical Footprint and Key Milestones

## O&M network - Pan-India presence



## The many firsts of ATL in the industry

- O&M for the first privately owned HVDC in Asia
- First private utility to successfully digitalized condition based monitoring remotely at 765 kV AIS SS in Asia
- Highly experienced team delivering best-in-industry system availability of more than 99.8%
- State-of-the-art Energy Network Operation Center (ENOC) for remote operations of sub-stations
- One of the lowest O&M cost per ckt km among domestic and global peers with highest safety

We are proud to be one of the very few private utilities in the world to operate and maintain India's maiden private HVDC system of  $\pm 500$  kV, 2,500 MW power flow capacity of 1000 km bi-pole HVDC link from Mundra in Gujarat to Mahendragarh in Haryana (ISTS link)

# ATL - Scope of O&M Activities



Hotline washing of insulators



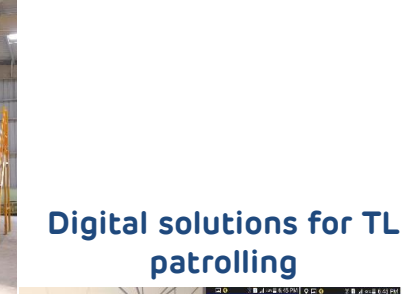
Remote operation of substations (ENOC)



In-house solar maintenance team



5S maintained store facility



Digital solutions for TL patrolling

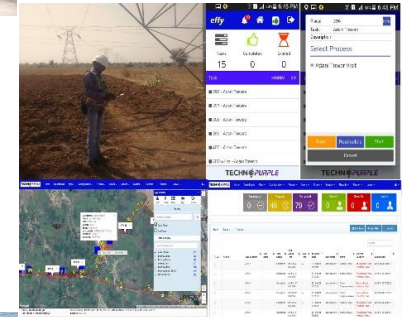
First private HVDC O&M team



Remote operation of substations (ENOC)



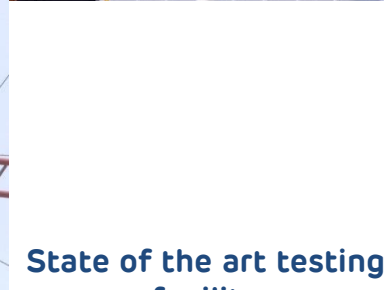
5S maintained store facility



Drone inspection of transmission line



Hot line maintenance work



State of the art testing facility



Sensorization of 765 kV circuit-breaker

Robotic Inspection



Hot line maintenance work



Sensorization of 765 kV circuit-breaker

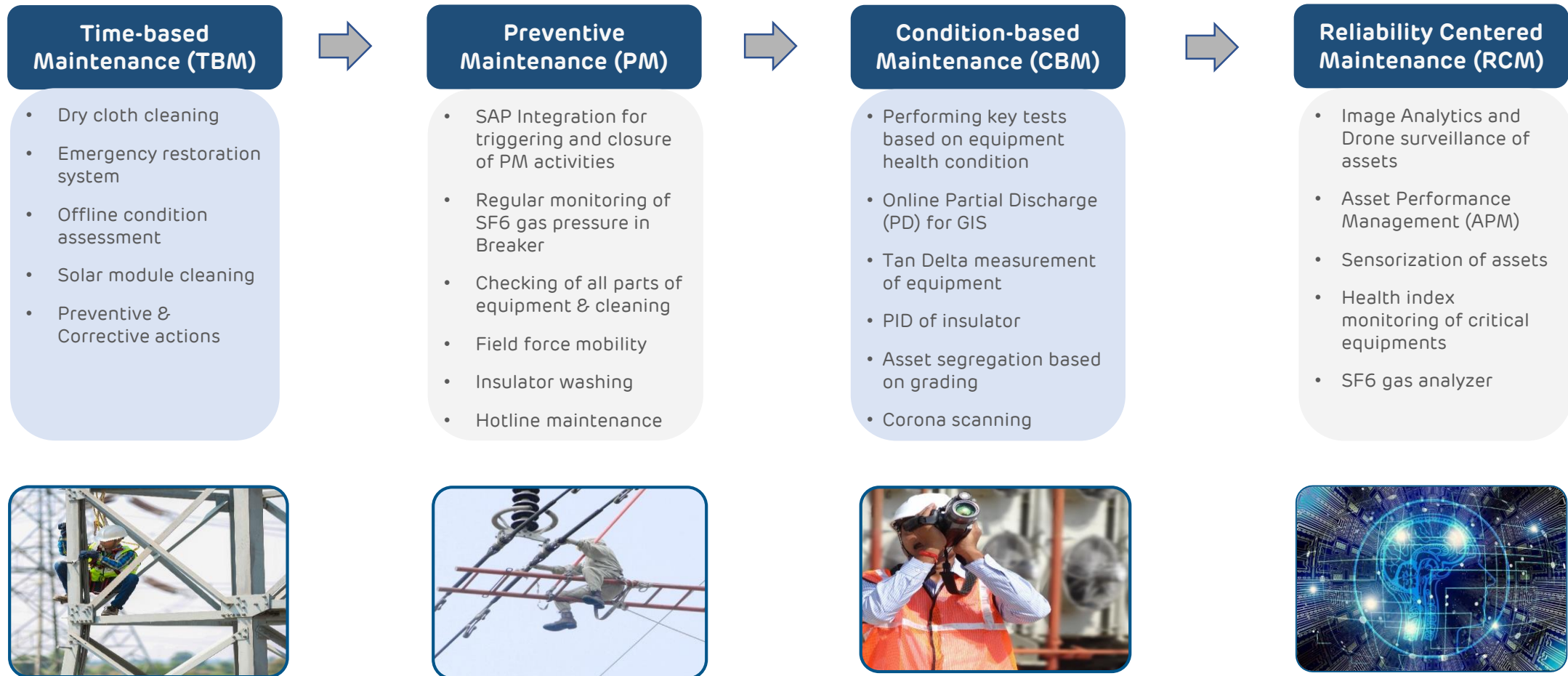
Safety Training





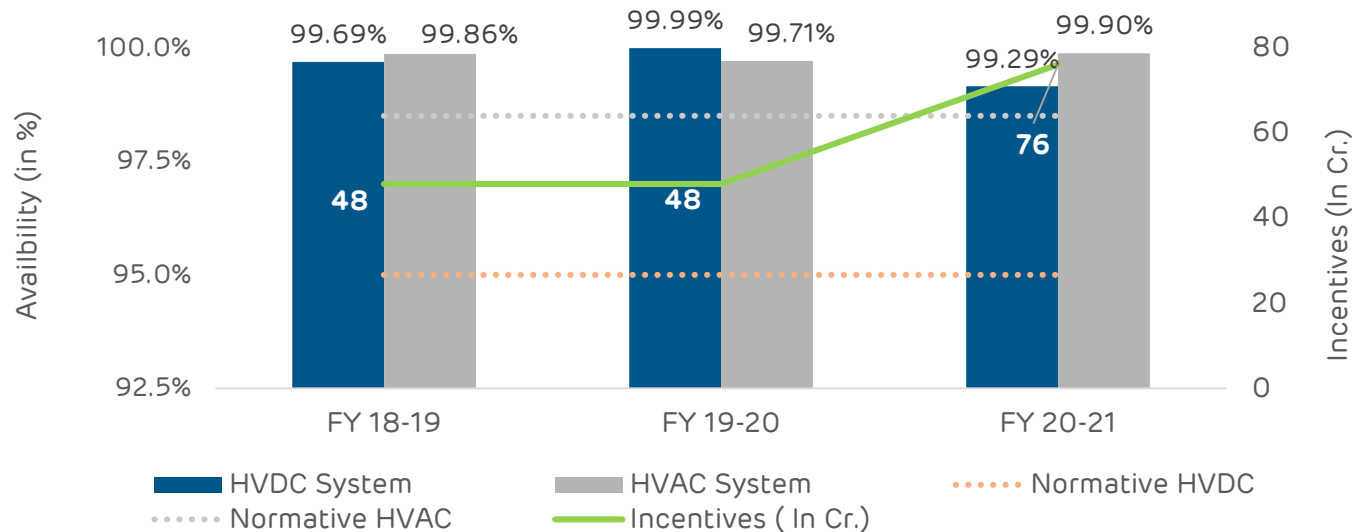
# Evolving O&M Philosophy - Reliability, Longevity, Sustainability & Safety

As a mature and evolving O&M player, we are shifting from Time-based Maintenance to Reliability Centered Maintenance





# Reliability - Industry-leading System Availability



- Consistently maintaining **high availability much above normative**, as specified by regulators and thus earning every **nickel-and-dime of incentive**
- **HVDC**: 3 yrs. average availability is  $\Delta$  4.65 % above the normative
- **HVAC**: 3 yrs. average availability is  $\Delta$  1.32 % above the normative

## Robust Outage Management System in Place

- Vigorous planning and close team coordination for minimum outage time with highest standards of safety
- Best utilization of opportunity shutdown for preventive maintenance activity
- Continuous monitoring of assets to minimize break-down

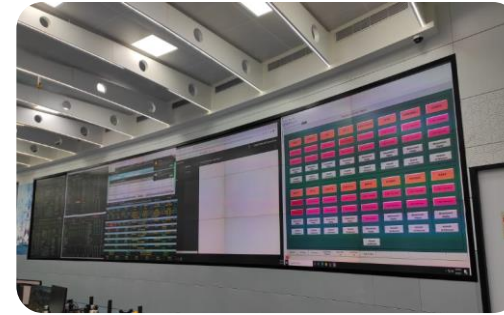
# Reliability - Remote Operations of Substations through ENOC



16 Nos. of 33/132 kV & 132/220 kV substations



Deedwana - 400 KV SS  
Remote Operation  
(Central SCADA)



**ENOC** at  
Adani Corporate House –  
Ahmedabad (main center)



Back-up ENOC at Mundra  
as a Disaster Recovery  
System (DRS)

## Benefits of ENOC

- Video Monitoring System (VMS)
- Asset Performance Management (APM)
- Data Analytics
- Security Automation System (SAS)
- Enhanced Safety

Commissioning of Central SCADA at Deedwana Sub-station; configuration of SCADA including signal mapping, fire wall & network architecture mapping etc. at Deedwana & rest of the 16 sub-stations in Rajasthan

- ENOC architecture is considered with all cyber security aspects including redundant firewall at each layer with creating DMZ zone
- The remote solution is scalable and modular - we are working towards remote monitoring and operating all transmission substations from ENOC center based in Ahmedabad



# Business Sustainability - Adoption of globally renowned processes



## ABEM (Adani Business Excellence Model)

- Adopting the renowned **Malcolm Baldrige framework** for business performance excellence
- Covering process improvement aspects like **IMS, 5S, TP, Six Sigma, Kaizen** etc.



## Integrated Management System (IMS)

- **Certified for ISO standards**
- Covering aspects like Social Accountability, Energy Management, Asset Management



## Business Continuity Management (BCM)

- **Emergency restoration system (ERS)** in place in case of line failure
- Frequent **mock drills** for handling business emergency situation
- Internal expertise used in supporting other utilities in emergency situations like Tauktae cyclone (**50+ foundation and erection work and 7+ kms of stringing work**)



## Cluster Based Maintenance & Inventory Management

- Optimizing and Enhancing maintenance services from a **centralized location**
- **Centralized Inventory Concept and Classification**
- Availability of **best-in class testing equipments** to optimise and support



## Cyber Security

- Enhanced **end-to-end surveillance of IT/ OT** connectivity
- Internal cyber security experts for monitoring and implementation
- Internal policies and governance to ensure IT/OT security



## Technical Assessment

- SMEs employed for continuous enhancement of technical aspects
- Knowledge sharing across sites and implementation of Management of Change
- Continuously enhancing various SOPs based on learning of RCA/CAPA



# Enhanced Safety through Technology Inclusion

## Robust Safety Framework Leading to "Zero" Fatalities in O&M



### Safe Connect

- 28 sessions conducted with participation from entire management



### Daily take-away meeting

- Cross business learning and awareness
- Safety Ideation
- Incident Reporting through app - Gensuite



### ATL Safety Performance Index (SPI)

- Site-wise comparison on safety performance based on set parameters



### Role Based Safety Training Matrix

- Analytics to identify trainings based on roles and safety gaps



### Sponsorship of LSSR by Leaders

- **LSSR** identified and enforced by leadership



### Trend, Target, benchmark and analysis

- Facilitates understanding comparatives, gaps, requirement



### Spreading Safety Culture

- Demonstrating safe behavior and helping communities (Award from local police in Bilaspur)



### Safety - Checks & Assurances

- Identified and closed 67 out of 69 vulnerable areas in the business

## Safety Enhancement through Tech

AI and ML based real-time detection of violation of safety PPE

Smart patrolling with weather forecasting software

Intelligent Wearables Solution for field connectivity and communication

Exploring remotely operated robots with smart cameras to work under high EMI fields

# Harnessing Cutting-edge Technology for advanced O&M

- **Failure Modes And Effects Analysis (FMEA) Solutions** – Performing FMEA to identify potential failure modes and mitigate risks

- **Smart wearables testing at Sami:** Exploring intelligent wearables solution at advanced stage for assisting worker remotely

- **Portable Remote Operating Camera:** Portable Remote Operating Camera for HV maintenance work – Observed reduction in errors leading to severe operational & safety violations

- **Safety violation monitoring:** Real time detection of violation of safety PPE - To arrest safety violations during O&M and improve overall



- **Transmission-line Wireless Sensorisation** –Satellite link used and data flow obtained from site<sup>(1)</sup>
- **High Frequency Analysis (HFA)** of earth grid to monitor earthing system in sub-stations

- **APM Tool:** Tool implementation for condition-based monitoring of assets - predictive maintenance and equipment health analysis

- **Drone Surveillance:** Drone inspection of transmission line for maintenance with minimum human intervention

- **Robotic Crawlers:** Usage of Robotic crawlers for transmission line maintenance
- **Robotic Inspection:** Robotic inspection of oil-filled transformer to perform an internal inspection without draining the oil at Sami SS



# O&M Case Studies

## 1 Emergency Restoration System (ERS) of lines

### Problem Statement

- Restoration of 765 kV S/C Tiroda - Koradi Line II on ERS.

### Key Findings

Due to thunderstorm and rain followed by heavy wind, multiple towers collapsed and damaged in 765 kV Tiroda - Koradi line Ckt-II near Nagpur-Maharashtra

### Outcome Achieved

- The line was restored on ERS within 15 days and on permanent coordinates within 32 days
- Proper planning, managing available resources effectively and precise execution stayed as a key component to the restoration plan

## 2 Power Quality Improvement in Mahendragarh

### Problem Statement

- Low (lagging) power factor due to inductive auxiliary load
- Variation in power factor due to site specific conditions
- Variation in auxiliary load with respect to operational requirements

### Key Findings

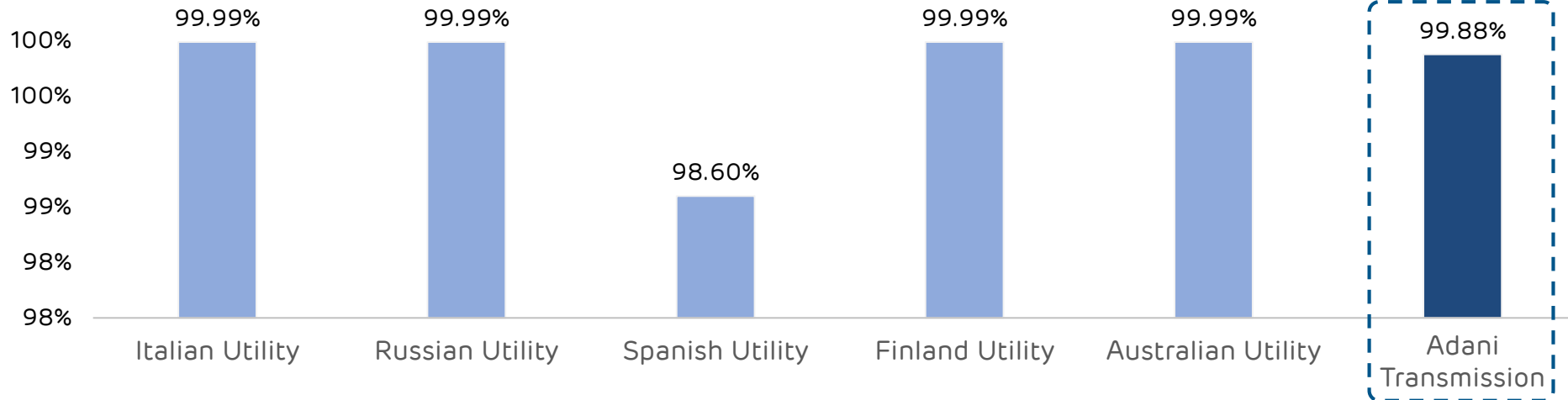
- Correction of power factor leading to sizeable savings in Aux power cost
- Total Voltage Harmonic Distortion's (VTHD) at 33 kV switchgear was well within the acceptable IEEE519 limits
- Variation of load profile during the measurement was -15% with respect to maximum loading
- By using STATCOM system can provide variable compensation between  $\pm 1000$  kVAR at 33 kV based on PWM technique

### Benefits Achieved

- Power factor of Auxiliary supply system increased from 0.76 to unity. It has decreased the Auxiliary power consumption and has led to considerable savings in auxiliary power expense

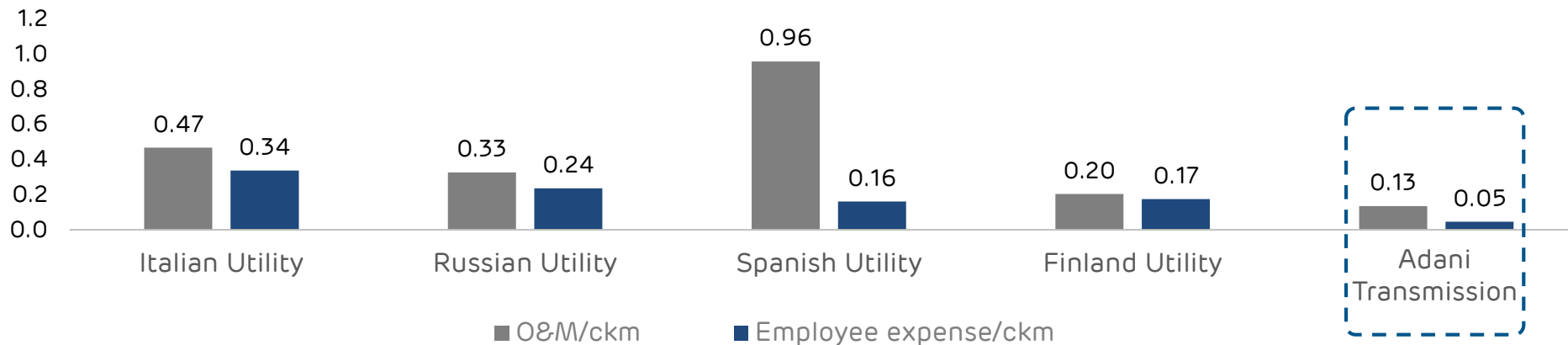
# Global Peer Benchmarking – Operating Parameters (Jan-Dec'20)

System Availability (%) in line with global standards



Maintaining system availability in line with global standards

One of the lowest O&M cost per ckm (INR million per circuit km)



O&M excellence leading to one of the lowest O&M cost per ckm without compromising safety and asset life

Notes: Benchmarking is based on Internal Analysis; we have taken top utilities from Italy, Russia, Finland, Spain and Australia as global peers for above benchmarking; Data populated is only for transmission business and pertains to period from Jan 2020-Dec 2020; Average Exchange rate of Jan-2020 to Dec-2020 has been considered for evaluation.





# O&M – Sustainable Initiatives

# ESG Initiatives at sub-stations/sites centered around UNSDGs

**ESG Initiatives are mapped to UN Sustainability Goals for adoption and alignment as per best global standards**

## United Nations Sustainable Development Goals 2030



United Nation Global Compact	CDP Disclosure
IR Reporting	GHG Protocol
GRI Standards	TCFD

### Ecology

1. Reduction in Auxiliary Consumption
2. Use of energy efficient commodities
3. Energy consumption monitoring

**Sami, Mahendragrah, Akola, Morena, Rajnandgaon, Koradi**

- Installed 2360 kWp capacity of solar plant
- Replacement of conventional bulbs with LED
- Installation of energy meters for monitoring & saving
- DG set efficiency monitoring to reduce conventional fuel usage
- Micro-grid at one of our 765Kv sub-station & will be deployed by Nov'21

### Access to Education

1. Quality Education
2. Reduced Inequalities

**Tiroda, and Sami**

- Physical infrastructure & e-learning platform in rural areas
- Educational Kits Distribution (2830 students benefited) & School Uniforms to Anganwadi children (5780 students benefited)

### Sustainable Communities - #Safety Culture

1. Safety Awareness
2. Best Practices in Occupational Health & Safety

**All Sites**

- Helping community on safety awareness through various programs
- Appreciation on Road Safety by local bodies

### Water Secure Nation

1. Water consumption checks
2. Rainwater harvesting

**Rainwater harvesting at Akola and Koradi SS**

- Recharge well construction for conserving rainwater
- Installation water meter to keep check on water consumption

### Sustainable Waste management

1. Waste Optimization
2. waste segregation as per the laws

**SUP free - (Mundra, Mahendragarh, Koradi) ZWL - All Sites**

- Certified as "Single Use plastic"
- Zero waste to Landfill

### Green Initiatives

1. Tree Plantation activities
2. Green Cover in substations

**Plantation - All Sites Green Cover – 8 sub-stations**

- IN FY2021, we had planted more than 750+ trees.
- Nonelectrical areas in substations are covered with sustainable vegetation

Notes: TCFD – Task force on Climate related Financial Disclosures; GHG – Green House Gas; GRI – Global Standards for Sustainability Reporting; CDP – Carbon Disclosure Project; IR – Integrating Reporting  
Some of social activities undertaken are under Adani Foundation

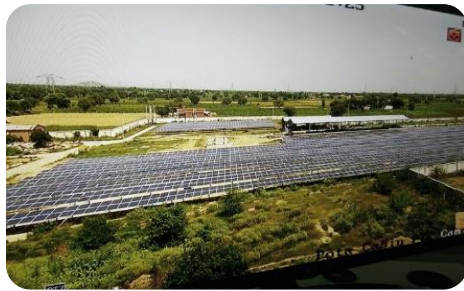
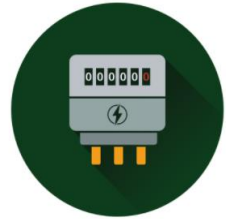
# Case study - Energy Conservation (1/2)

## Greentech Award in Energy Conservation



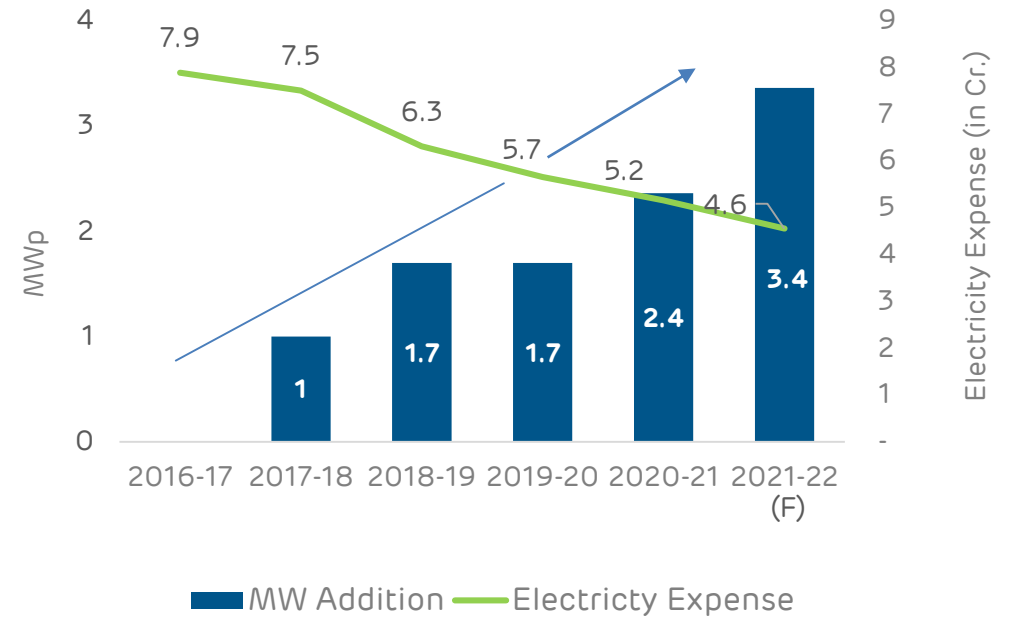
Transition to green energy by meeting auxiliary requirements of substations through solar plant (commissioned at Sami, Morena & Rajnandgaon SS in FY21) reducing 2613 ton of CO2

Close monitoring of energy consumption by installing energy meters on individual feeders & achieved energy consumption objective (~ 1% saving from baseline)



- Drive initiated for converting conventional fuel vehicles to CNG
- Awareness session for entire O&M staff (200+ employee) to reduce energy wastage
- Adoption of micro-grid at one of our 765Kv sub-station & will be deployed by Nov'21

## Solar MWp Addition



- Addition of solar plants for compensating auxiliary electricity expenditure
- **Corresponding reduction of 42% in electricity expenditure with a 340% increase in green power over the period**

# Case study - Financial benefit realized (2/2)

## Total portfolio = 2.362 MWp

Mahendragarh	1.00 MWp
Akola	0.35 MWp
Koradi	0.35 MWp
Sami	0.16 MWp
Morena	0.234 MWp
Rajnandgaon	0.268 MWp

## Solar implementation done at Morena, Sami & R'gaon SS in FY20-21

**A) Without Solar plant:** Units billed W/o Solar plant = 11.97MWh

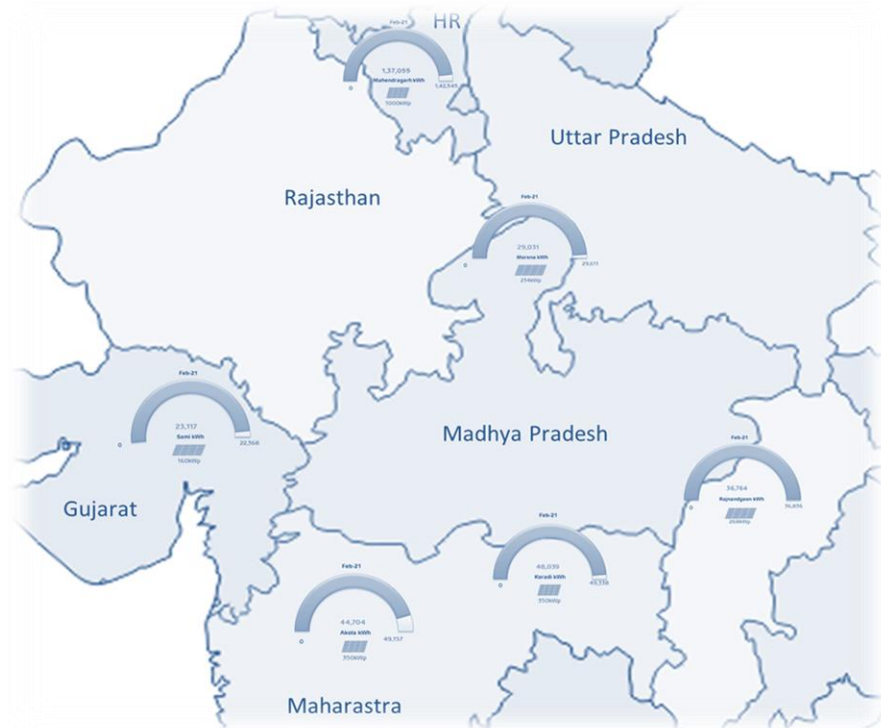
Charges to be paid = 77.23 Lacs

**B) With Solar plant:** Units generated by Solar = 10.20MWh

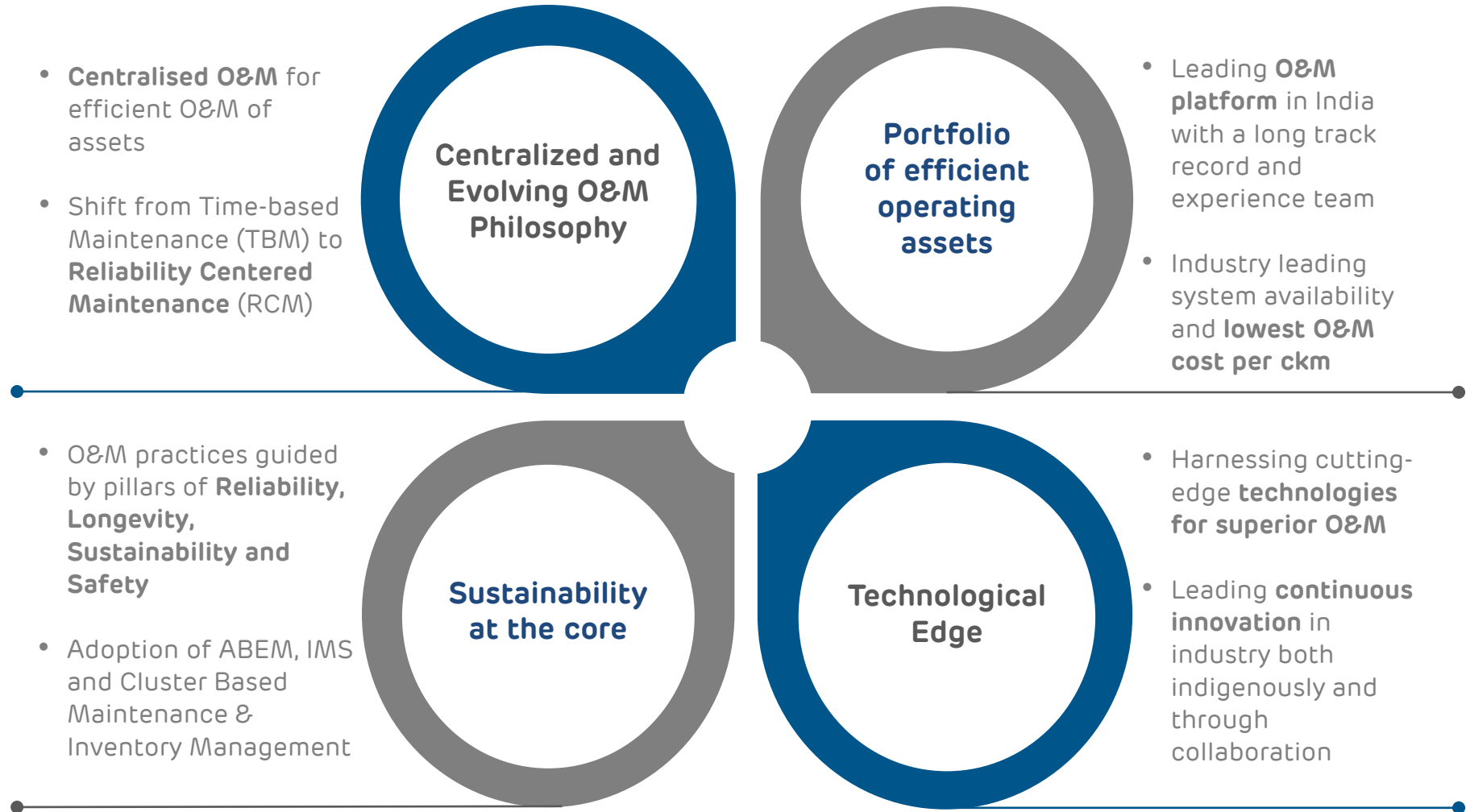
Actual units billed = 1.76MWh

Charges to be paid = 11.48 Lacs

**C) Net Saving (A-B) =** (77.23-11.48) = 65.76 Lacs



Invested Amount in FY 20-21	Savings in FY 20-21	Forecasted saving in asset life cycle (~ 25 yrs)
Rs. 2.94 Cr	Rs. 0.66 Cr	Rs. 16.44 Cr
Invested Amount in past	Savings in FY 20-21	Forecasted saving in asset life cycle (~ 25 yrs)
Rs. 7.10 Cr	Rs. 2.52 Cr	Rs. 62.93 Cr
Total Investment till date	Savings in FY 20-21	Forecasted saving in asset life cycle (~ 25 years)
Rs. 10.04 Cr	Rs. 3.18 Cr	Rs. 79.37 Cr





**Thank you**

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