Adani Green Energy Limited
O&M Excellence through ENOC
Feb 2021
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Adani Group: A world class infrastructure & utility portfolio

- Transport & Logistics Portfolio
  - APSEZ Port & Logistics (63.5%)
  - SRCPL Rail (100%)
- Energy & Utility Portfolio
  - ATL T&D (75%)
  - AGEL Renewables (55%)
  - ATGL Gas DisCom (37.4%)
  - APL IPP (75%)

- AEL Incubator
  - AAHL Airports (100%)
  - ATrL Roads (100%)
  - AWL Water (100%)
  - Data Centre (100%)

~USD 76 bn
Combined market cap

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

1. As on Feb 19, 2021, USD/INR – 72.6 | Note - Percentages denote promoter holding
2. NQXT – North Queensland Export Terminal | Light purple color represent public traded listed verticals
3. ATGL – Adani Total Gas Ltd

Adani
- Marked shift from B2B to B2C businesses -
  - ATGL - Gas distribution network to serve key geographies across India
- AEM - 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 2020 -
  - Transport & Logistics - Airports and Roads
  - Energy & Utility - Water and Data Centre
Adani Group: Decades long track record of industry best growth rates across sectors

**Port Cargo Throughput (MT)**
- 2014: 972 MT, 2020: 1,339 MT
- **5x** growth

**Renewable Capacity (GW)**
- 2016: 46 GW, 2020: 114 GW
- **6x** growth

**Transmission Capacity (ckm)**
- 2016: 320,000 ckm, 2020: 423,000 ckm
- **3x** growth

**CGD**
- 2015: 62 GAs, 2020: 228 GAs
- **1.5x** coverage

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Transformative model driving scale, growth and free cashflow

**APSEZ**
- Highest Margin among Peers globally
  - EBITDA margin: 70%, Next best peer margin: 55%

**AGEL**
- Worlds largest developer
  - EBITDA margin: 89%

**ATL**
- Highest availability among Peers
  - EBITDA margin: 92%

**ATGL**
- India's Largest private CGD business
  - EBITDA margin: 31%

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**Note:**
1. Data for FY20; 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 sales and excludes other items; 5. EBITDA margin of transmission business only, does not include distribution business; 6. Contracted & awarded capacity; 7. CGD – City Gas distribution; B. Geographical Areas - Including JVs | Industry data is from market intelligence.
Adani Group: Repeatable, robust & proven transformative model of investment

**Phase**

**Development**

**Operations**

**Post Operations**

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<tr>
<th>Activity</th>
<th>Development</th>
<th>Construction</th>
<th>Operation</th>
<th>Capital Mgmt</th>
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<td>Capital Mgmt</td>
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<td>Analysis &amp; market intelligence</td>
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<td>Life cycle O&amp;M planning</td>
<td>Redesigning the capital structure of the asset</td>
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<td>Concessions and regulatory agreements</td>
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<tr>
<th>Performance</th>
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<td>India’s Largest Commercial Port (at Mundra)</td>
<td>Longest Private HVDC Line in Asia (Mundra – Mohindergarh)</td>
</tr>
<tr>
<td>Highest Margin among Peers</td>
<td>Highest line availability</td>
</tr>
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</table>

- 648 MW Ultra Mega Solar Power Plant (at Kamuthi, Tamil Nadu)
- Constructed and Commissioned in nine months
- In FY20 issued 7 international bonds across the yield curve totalling ~USD4Bn

- All listed entities maintain liquidity cover of 1.2x-2x as a matter policy

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1. FY20 data for commercial availability declared under long term power purchase agreements
**AGEL: Replicating Group’s Transformational Growth Profile**

### Development

- **Total Portfolio**
  - 14,815 MW¹
  - 3,245 MW in Operation
  - 2970 MW in Ramp-up
  - 8,600 MW Awarded Pipeline

- **Diversified Portfolio**
  - 11 states
  - 72% solar; 11% wind; 17% wind-solar hybrid

- **ESG**
  - Pure-play Solar & Wind Assets

### Operations

- **100% Contracted Capacity**
  - Fixed tariff
  - PPA life: 25 years Tariff profile
  - Average Portfolio tariff: INR 3.24/unit

- **Counterparty profile²**
  - Sovereign: 78%
  - State DISCOMs: 15%
  - Non-govt.: 7%

- **EBITDA margin³**
  - 89%

### Value Creation

- **Efficient Capital Management**
  - Access to International markets
  - Diversified sources of funding
  - Elongated maturities up to 20 years

- **Monetization (DBFOT⁴)**
  - 50% stake⁵ bought by TOTAL SA in Operational Solar Projects
  - First phase - 2,148 MW
  - Second phase - 205 MW

- **Investment Grade (IG) Ratings**
  - First IG rated Issuance
  - Endeavor to maintain IG rating in all future issuances

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**Note:**

1. Includes 50*3 MW of wind projects under acquisition from Inox and 20 MW solar power plant under acquisition from Hindustan Powerprojects
2. Based on estimated revenue-mix on fully built-up basis for overall portfolio of 14.8 GW
3. EBITDA margin from power supply in FY20
4. Design Build Finance Operate Transfer
5. TOTAL SA invested INR 3707 Cr in the first phase and INR 310 Crore in the second phase towards 50% stake and other instruments in the JV that houses these assets

PPA - Power Purchase Agreement ; AGEL: Adani Green Energy Limited
Adani Green Energy Limited
Company Profile
AGEL: Transformational Renewable Company

**Largest Listed Renewable Company in India**
3,245 MW – Operational + 2,970 MW – ramp up in 5–12 months

**Development Pipeline**
8,000 MW Solar
600 MW Hybrid

**Amount**
Total 50%
Adani 50%

**Adani TOTAL JV**
Operational Solar 2,353 MW

**Site Plan**
Over 30 GW sites identified & under acquisition

**Upcoming Tenders**
Over 11,000 MW in pipeline

**Under ramp up 2,970 MW**
Operational Assets
Solar - 495 MW
Wind - 397 MW

**Development Pipeline 8,600 MW**
Solar – 8,000 MW
Hybrid - 600 MW

**Ramp up**
2,970 MW – ramp up in 5–12 months

**Total Operational Solar Assets**
2,353 MW

**Other SPVs**
205 MW

**Upcoming Tenders**
648 MW

**RG 1**
930 MW

**RG 2**
570 MW

**TN SPVs**
648 MW

1. Includes 20 MW solar plants under acquisition from Hindustan Powerprojects
2. Includes 150 MW wind assets under acquisition from Inox

RG1: Restricted Group 1, RG2: Restricted Group 2

**Business and asset development philosophy mirrors Group’s focus on Quality Development, Operational Efficiency and Robust Capital Management**
AGEL: Large, Geographically Diversified Portfolio

14,815 MW Portfolio 1 | 3,245 MW operational

- Operational
- Wind
- Solar
- Solar-Wind Hybrid

Presence across multiple states reduces resource risk

Average AGEL tariff below APPC 2

- APPC @ 3.60/kWh
- Lowest Tariff discovered in renewable bidding across months
- AGEL Portfolio Avg. Tariff

Resource and Counterparty Diversification
- 78% Sovereign Counterparties
- 11 resource-rich states
- 13 different counterparties

Presence across multiple states reduces resource risk

Fully Contracted Portfolio
- 100% Contracted portfolio
- 25-year fixed tariff PPAs

Ranked as Largest Solar Power Developer in the World by US based MERCOM Capital

1 Includes 150 MW wind assets under acquisition from Inox and 20 MW solar plants under acquisition from Hindustan Powerprojects
2 APPC: National average power purchase cost.
AGEL: O&M Excellence through ENOC
Best in Class O&M Policies

- AGEL is currently operating 80+ plants spread across 11 states. Portfolio managed by O&M team of 630 personnel
- Cluster based governance model: Personnel spread across Central office → Cluster teams → Site personnel
- Enables smooth governance allowing efficient utilization of manpower and spares across multiple project sites

### Centralized monitoring & Diagnostics
- Scalable operations with centralized monitoring and diagnostics
- Seamless integration of technology with ENOC
- Dust Detection System (DDS) for measuring the soiling loss and optimizing module cleaning cycle
- String monitoring for operational efficiency improvement
- Drone survey & IV curve scan for monitoring module health
- Surveillance cameras to ensure security & safety compliance

### Operational Philosophy
- Lean site organization structure
- Optimized module cleaning cycle by comparing revenue loss due to soiling against the cost of module cleaning
- Atomization of water cleaning through compressed air to reduce water consumption during module cleaning
- Vegetation management, table tilting
- Ongoing repowering to compensate module degradation losses

### Maintenance Philosophy
- Equipment and maintenance strategy classified based on criticality
- In-house O&M capabilities
- Warranty management for inverters & modules and AMC for transmission lines
- SAP based scheduling of plant maintenance
- Root Cause Analysis (RCA) framework decided based on severity, frequency and financial impact
- Cluster based governance model

### Spares Management
- Time based inventory management system
- Tier1: Site specific store (indoor & outdoor) for replacement items and consumables
- Tier 2: High value spares (Transformer, switchyard breaker, gear box, generator, etc.) being maintained at cluster level
- Min/ max level set in stringent manner ensuring optimum inventory

### Solar Plant Availability

<table>
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<tr>
<th>Year</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY19</td>
<td>99.6%</td>
</tr>
<tr>
<td>FY20</td>
<td>98.8%</td>
</tr>
<tr>
<td>9M FY21</td>
<td>99.5%</td>
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Note:
1. O&M – Operations and Maintenance; ENOC – Energy Network Operation Center

**Operational Excellence driving Value**

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<th>Traditional Approach</th>
<th>AGEL’s approach</th>
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<tr>
<td>Plant level O&amp;M</td>
<td>Centralized Operations via. ENOC</td>
</tr>
</tbody>
</table>

Predictive O&M process leading to reduction in:
- Frequency of scheduled maintenance,
- On-site labor costs
- Overall O&M cost
AGEL - ENOC: A state of Art, Live Monitoring Platform for Operational Plants

ENOC (Energy Network Operation Centre)

- Centralization of overall management of all Adani sites from a single location
- Data Analytics driven decision making
- Drive world class operational performance as sustainable competitive advantage
- Create potential for new business providing operations as a service to other power companies
- Sustainable & scalable platform

ENOC Benefits

- Centralized Management
  - Ability to manage large number of sites
  - Support increasingly complex operations

- Fully Automated Operation
  - Minimal manual intervention leading to reliable data
  - Reduce maintenance cost – increasing margins

- Real Time Data Availability
  - Access plant performance data anywhere (desktop mobile) & anytime – both real time and historical data

- Business Intelligence
  - Leveraging analytics and Machine learning to improve operational performance to industry leading levels

ENOC Operational Flow

Site(s) Level Data Capture

PV Solar & Wind Plants
Energy Meter
Weather Monitoring Stations

Data Analytics @ENOC

Predictive Analytics
- Predictive maintenance input PBS
- Rule based alarm input to site maintenance teams for real time corrections

Real Time Intervention

Management Dashboards
- Access across multiple devices & locations

The Ordinary Data → Deriving Intelligence → Informed Action

Note:
1. O&M – Operations and Maintenance
AGEL- CUF Waterfall to identify all the losses

ENOC allows to identify the reasons of gap in CUF to get actionable insights

Traditional Approach

Solar

<table>
<thead>
<tr>
<th></th>
<th>PS0 CUF</th>
<th>Gap</th>
<th>Actual CUF</th>
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<tr>
<td>Target</td>
<td>23.83%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27.53%</td>
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<td></td>
</tr>
</tbody>
</table>

ENOC – Gap Identification at Granular Level

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>PUS0 CUF</th>
<th>Full Ramp up (DC)</th>
<th>Grid Unavailability</th>
<th>Radiation Shortfall/Gain Unavailability</th>
<th>Plant AC loss other than design</th>
<th>Clipping loss other than design</th>
<th>Shadow loss (pitch) other than design</th>
<th>Shadow loss (tress) other than design</th>
<th>Shadow loss (adjacent table) other than design</th>
<th>Soiling loss other than design</th>
<th>Temperature losses other than design</th>
<th>Loss due to excess degradation</th>
<th>Unclassified losses</th>
<th>Actual CUF</th>
</tr>
</thead>
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<tr>
<td>Solar</td>
<td>23.83%</td>
<td>0.01%</td>
<td>0.03%</td>
<td>4.25%</td>
<td>0.13%</td>
<td>0.05%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.48%</td>
<td>0.00%</td>
<td>0.14%</td>
<td>27.53%</td>
</tr>
</tbody>
</table>

Note:
1. CUF – Capacity Utilisation Factor
2. ENOC - Energy Network Operations Center
Technology intervention enabling effective management of resource

Reduction in water usage for module cleaning

- AGEL has been a pioneer in adoption of latest technologies for module cleaning
- Due to these latest innovations, AGEL will be able to reduce the water consumption in FY21 from 117 mn liters to 64 mn liters y-o-y

Water consumption reduction initiatives

<table>
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<tr>
<th>Conventional Module Cleaning System (Manual)</th>
<th>Water Consumption / module / cycle</th>
<th>Innovation in Module Cleaning System (Semi - Automatic)</th>
<th>Water less module cleaning (proposed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.3 L</td>
<td>0.7 L</td>
<td>Near Zero</td>
</tr>
</tbody>
</table>

Indigenously developed module cleaning system

- Water consumption reduced by 46%
- Safe operations
- Manpower cost is reduced by 75%
- Increased efficiency
- Module cleaning cost reduced by 40%
- Scalable system
- Implementing this system would reduce the O&M cost by 7.5% annually across the existing portfolio

Efficiency in Land Usage

- Sites identified for setting up solar / wind projects process on waste land
- Land which cannot be utilized for agriculture
- Leveraging technology to reduce land requirement

Land use in Acres/MW

- FY15: 5.0
- FY20: 3.2

Note: 1. O&M – Operations and Maintenance;
AGEL: Way forward for O&M
AGEL: Solar O&M – AI/ML driven prescriptive analytics to lead the way forward

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<th>Way Forward (Prescriptive Analytics)</th>
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<td>• Underperformance identification at string level (set of 22 modules)</td>
<td>• Analysis of faults based on severity &amp; frequency using decision tree analysis</td>
</tr>
<tr>
<td>• R tool based models for inverter performance</td>
<td></td>
</tr>
<tr>
<td>• Analysis of faults based on severity (generation loss) &amp; frequency (number of occurrences)</td>
<td></td>
</tr>
<tr>
<td>• Tracker optimization to maximize generation gain</td>
<td>• Development of Asset Performance Monitoring (APM) tool to ensure:</td>
</tr>
<tr>
<td>• OEM Benchmarking leading to procurement insights for future projects</td>
<td>• zero unplanned downtime</td>
</tr>
<tr>
<td>• Plant scorecard</td>
<td>• Maintenance only when needed</td>
</tr>
<tr>
<td>• Breakdown loss analysis</td>
<td>• Ability to manage O&amp;M costs at acceptable levels</td>
</tr>
<tr>
<td>• Sensor accuracy analysis &amp; correlation between sensor values</td>
<td></td>
</tr>
<tr>
<td>• Inverter efficiency analysis</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. AI/ML – Artificial Intelligence/ Machine Learning
2. O&M – Operations & Maintenance
3. R Tool – a software for analytics
4. OEM – Original Equipment Manufacturer
AGEL: Wind O&M – AI/ML driven prescriptive analytics to lead the way forward

**Our Current Practices (Descriptive & Predictive Analytics)**

- Underperformance identification at Wind Turbine Generator (WTG) level
- R tool based models for WTG performance analysis
- Analysis of faults based on severity (generation loss) & frequency (number of occurrences)
- WTG performance enhancement by correcting pitch (blade) and yaw (turbine rotation) angle
- Scheduling controllable shutdowns for maintenance by analyzing Windy and non-windy hours
- OEM Benchmarking leading to procurement insights for future projects
- Breakdown loss analysis
- Sensor accuracy analysis & correlation between sensor values

**Way Forward (Prescriptive Analytics)**

- Analysis of faults based on severity & frequency using decision tree analysis
- IOT Based Forecasting & Scheduling (F&S) modelling to be developed in-house to enable:
  - Automatic fetching of breakdown data from the field directly
  - Revision of the forecasted generation
  - Resulting into reduced manual intervention & increased F&S accuracy
- Development of Asset Performance Monitoring (APM) tool to ensure:
  - zero unplanned downtime
  - Maintenance only when needed
  - Ability to manage O&M costs at acceptable levels
- Prescriptive analytics on real time basis for correcting pitch (blade) and yaw (turbine rotation) angle thereby enhancing WTG performance

**Notes:**
1. AI/ML – Artificial Intelligence/ Machine Learning
2. O&M – Operations & Maintenance
3. OEM – Original Equipment Manufacturer
4. IOT - Internet of Things
Thank You