Example of using Wind Power Generators based on Digital Twin technology

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Director, NADA Co., Ltd

Presenting on behalf of JUNG, Hohwan (Korea East-West Power)
1. Introduction (EWP at a Glance)

- Public enterprise 100% owned by KEPCO, with ratings on par with the Korean government
- KRW7.0tn revenue in FY2022
- KRW12.7tn total assets and generation capacity of 9,574MW as of 1Q 2023

Company Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name</td>
<td>Korea East-West Power Co., Ltd. (&quot;EWP&quot;)</td>
</tr>
<tr>
<td>Establishment Date</td>
<td>April 2, 2001 (Spun off from KEPCO)</td>
</tr>
<tr>
<td>Ownership</td>
<td>100% owned by KEPCO (51% owned by the Korean Government)</td>
</tr>
<tr>
<td>Assets</td>
<td>KRW12,715bn (1Q2023)</td>
</tr>
<tr>
<td>Generation Capacity</td>
<td>9,574MW (1Q2023)</td>
</tr>
<tr>
<td>Revenue</td>
<td>KRW6,994bn (FY2022)</td>
</tr>
<tr>
<td>Electricity Sales Volume</td>
<td>37,505GWh (FY2022)</td>
</tr>
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Industry Framework

- Act on the Management of Public Institutions
- Electricity Business Act
- Power Supply and Demand Basic Plan
- Environmental Laws
- New Energy Business
  - Roof-top Solar
  - ESS: ESS
  - Virtual Power Plant: PV: 300kW
  - Energy Management: EE: 10kW
  - Smart Energy City

Business Overview

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<tbody>
<tr>
<td>Note: Portfolio as of March 31, 2023</td>
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<tr>
<td>(1) Renewable energy portfolio includes total capacity of 162MW operated by EWP as well as domestic invested assets</td>
<td></td>
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<tr>
<td>(2) Includes 2,040MW of Ammonia co-firing (out of 4,040MW for coal)</td>
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<td>(3) Includes 1,772MW hydrogen co-firing (out of 6,614MW for LNG)</td>
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1. Introduction (Presenter)

**Government R&D Project**

**Project Title**

*Demonstration of digital twin-based wind power generator diagnosis and output prediction platform*

- **Host**
  - [Company Logo]

- **Participating**
  - [Company Logos]

- **Period**
  - 2022. 04. 15~ 2022. 12. 31 (8.5M)
  - 2023. 01 ~ 2023. 12 (12M)

- **Cost**
  - Cost 49.625 Billion won
    - (Gov 28.5B, EWP 14B, Etc 7.125B)
  - Cost 14.42 Billion won
    - (Gov 9.5B, EWP 2.54B, Etc 2.38B)

Digital Twin Researcher Forum

Digital Transformation Conference
2. Business (necessity and target)

Business necessity

Require Industry
- Increasing importance of carbon neutrality, spread of new and renewable energy, expansion of wind power generation expected
- Korea plans to expand renewable energy by 25.8% and wind power generation by 35% by 2034 with a carbon neutral policy

Policy

Current Issue
- Efficiency improvement
  - Inefficiency due to wind speed and inconsistent wind direction depending on geographical characteristics
- Technology acquisition
  - New technology needs to be applied to enlarge facilities and expand power generation complexes
- IT Technology
  - Need to apply real-time data-based digital conversion technology

Business Target

1. 3D Based Driving Monitoring
   - Live monitoring system
     - 3D digital model-based driving monitoring

2. Prediction maintenance AI
   - Major components failure diagnosis
     - Provides fault diagnosis, predictive maintenance, and decision-making information

3. Output prediction simulation
   - Optimal power supply plan
     - Provides power generation output prediction simulation

4. Integrated operating system

Digital Twin based platform build

Major Components failure diagnosis
- Provides fault diagnosis, predictive maintenance, and decision-making information

EWP Renewable E Center
- Security & Equipment dedicated line
- Gyeongju Wind Power Control Room dedicated line
2. Business (Target site)

Demonstration target site

Gyeongju Wind Power Plant 2

Selection of domestic generator
- Unison U113 Model (2.3MW)
- Of the total 739 generators in Korea, 145 are from Unison (15.44%, As of 2020)

Selection of onshore wind power
- Overcome short-term business due to immediate environment
- Of the total 739 generators in Korea, (Onshore 688, Offshore 51, As of 2020)

High utilization rate
- High utilization rate compared to the average wind power utilization rate (16.5%)
  - ('18) 33.74%, ('19) 33.96%, ('20) 37.15%

Building hardware network infra
- Install of sensors and analysis devices for each unit
- SCADA data interconnection and security network
- Digital Twin server and situation room exist
### 2. Business (Target System)

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<tr>
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<tbody>
<tr>
<td>Sensor Data</td>
<td>Data acquisition</td>
<td>Vibration, Temperature, Motion, Partial discharge</td>
<td>Edge Server</td>
</tr>
<tr>
<td>Vibration (Lightning)</td>
<td>Operation Data</td>
<td>Vibration, Operation, Inspection, Sensor, Environment, Thermal Image, Video, Behavior</td>
<td>Database</td>
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<td>Behavior monitoring</td>
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<tr>
<td>Video amplification</td>
<td>Data mart</td>
<td>Fingerprint calculation, Equipment information and operation data</td>
<td>Digital Twin Engine</td>
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<tr>
<td>Operation Maintenance</td>
<td></td>
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<td>By category AI Score calculate</td>
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<tr>
<td>Weather Information</td>
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<tr>
<td>Real-time data connection and transmission</td>
<td><strong>3D Monitoring and AI Management Solution</strong></td>
<td><strong>3D Visualization and monitoring</strong></td>
<td>Streaming and data management</td>
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<td>Power generation forecast GPU server</td>
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<td></td>
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<td>3D visualization and forecasting</td>
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<td>Failure monitoring and analysis</td>
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<td></td>
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<td>AI Solution</td>
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<th>5. DT AI model</th>
<th>6. Interface</th>
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<tr>
<td>AI model learning for Fault diagnosis</td>
<td>3D Condition Monitoring</td>
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<td>AI model learning for Predictive maintenance</td>
<td>Breakdown Management Solution</td>
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<tr>
<td>AI model learning for Wind speed prediction</td>
<td>Maintenance Management Solution</td>
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<tr>
<td>AI model learning for Output prediction</td>
<td>Wind Power Output</td>
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<th>7. Site</th>
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<tr>
<td><strong>Operation Monitoring</strong></td>
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<tr>
<td>Fault diagnosis Prediction Decision</td>
</tr>
<tr>
<td>Output prediction Simulation</td>
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**3D Monitoring and AI Management Solution**
3. Platform UI

System integration UI construction

Dash Board #1

Dash Board #2

Main Screen

Equipment Screen
3. Platform UI

3D Model advancement

1st year

2nd year the first half

2nd year second half
3. Platform UI

3D Model advancement
3. Platform UI

3D Model advancement
3. Platform UI

3D Model advancement
3. Platform UI

Digital Twin Control Room
Thank You Very Much!