Energy Asset Management in Smart Grid
(Use of IoT)

Woo-Seok Roh / LSIS
June 5, 2017
Growing into a top global company in the industrial electric, electronics, materials and energy fields
## About R&D Campus of LSIS

<table>
<thead>
<tr>
<th><strong>Building Name</strong></th>
<th>LSIS R&amp;D Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
<td>R&amp;D Center</td>
</tr>
<tr>
<td><strong>Address</strong></td>
<td>LS-ro 116 beongil 40, Dongan-gu, Anyang-si, Gyeonggi-do, 14118, Korea</td>
</tr>
<tr>
<td><strong>Intelligent/Green Building Certification</strong></td>
<td>Building Energy Efficiency Rating Grade : 2nd Grade</td>
</tr>
<tr>
<td><strong>Site area</strong></td>
<td>5,056 m²</td>
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<tr>
<td><strong>Construction Floor Area (CFA)</strong></td>
<td>28,691 m²</td>
</tr>
<tr>
<td><strong>BCR(Building Coverage Ratio)</strong></td>
<td>42.7 % CFA / Site area</td>
</tr>
<tr>
<td><strong>Construction commencement date</strong></td>
<td>2013.07 (Building use permit issued date : 2014.12)</td>
</tr>
<tr>
<td><strong>Number of floors</strong></td>
<td>Above ground: 9 Basement levels: 3</td>
</tr>
</tbody>
</table>
| **Remarks**       | - The 1st APIGBA award (Gold Prize)  
- The 1ST Certification on ESS for Emergency Operation |
 Cooling Equipment performance evaluation (COP/Load Factor)

 Energy Consumption Analysis & Simulation.

 Indoor environmental assessment (Temp./Humid, CO₂)

 HVAC Equipment

 Air Handling Unit

 FCU

 Field Device


 Energy Consumption Analysis

 Heating and cooling capacity of the air

 FAN efficiency (Evaluate the Efficiency of Supply fan and Ventilation fan)

 Indoor environmental assessment (Temp./Humid, CO₂)

 EMS interlocking control I/F for maximum energy savings

 Refrigerator

 Boiler

 Field Device

 Temp. Pressure Power. Flow Gas

 Energy Production, Distribution, Equipment Status.

 Power/Gas/Pressure Equipment.

 Inlet/Outlet Temp. Water Usage.

 Energy Analysis in each system

 using Geothermal System & PV System & EV System

 Energy analysis & Peak Demand Controller

 Surveillance total electrical power by monitoring each zone

 • Peak shaving & load management

 BEMS Building Energy Management

 User Information.

 User Information.

 Dimming Mode Status.

 Lighting Energy Usage.

 Real-Time/Cumulative Power.

 Inlet/Outlet Temp.

 Lighting Energy Usage.

 Dimming Mode Status.

 Energy Production, Distribution, Equipment Status.

 Power/Gas/Pressure Equipment.

 Inlet/Outlet Temp.

 Inlet/Outlet Temp.

 Distribution Panel

 Peak Demand Controller

 ESS

 PV System

 Geothermal System

 Power meter

 EV Charge spot

 Solar System

 Lighting System

 Master Slave

 LED Lighting System

 Automatic dimming by lighting level

 Schedule/Zone/Pattern controls(ON/OFF)
Application at each Floor

**Energy Grid**
- Photovoltaic (50kW)
- Smart Meter
- LED Lighting (8F)
- Smart Plug (8F)
- Automatic Blind (8F)

**Office Space**
- HVAC
- D/R
- BEMS
- Power
- Lighting
- AMI
- ESS

**Common Space**
- PV
- Status board
- EV & Charging infrastructure

**Operation Center**
- Power Grid
- Heat Grid

**Outside Interface**
- Energy Information Screen
- Screen
- Solar LED Lighting
- KIOSK
- Automatic Blind (8F)
- Smart Plug (8F)
- Automatic Switchboard (Motion Sensor)

**B1**
- Measuring & Metering
- Geothermal Inverter
- Demand Controller

**B3**
- Energy Storage System (ESS)
- Battery (1MWh)
- PCS (1MW)

**Communication**
Quality, Amount, Processing, Storage of Data

- Energy Management (lighting)
- Energy Saving (HVAC)
- Energy Saving (DR)
- Demand Response (Lighting)
- Demand Response (HVAC)
- Demand Management ESS Operating
- ESS Condition Monitoring
- Energy Monitoring
- Measuring & Metering Info.
- Renewable Energy
- Power SCADA
- BEMS
- External Systems Interface (ADR)
- Energy Saving (HVAC)
- Energy Saving (DR)
- Emergency Power Supply
- Emergency Generator

- AMI
- HVAC
- Lighting

Interface types:
- Physical Interface
- Logical Interface
Monitoring, Analytics, Management

< PV Generation >

PV Generation System

Operation & Reduction Status
- Generation Time: 07:16:23
- Amount of Generation: 299.8 kWh
- Accumulated Generation: 3,735.0 kWh
- Temperature on PV Module: 58.8°C
- PV Generation Status: on Generation

PV Generation (this month)
- Current Generation: 48.5 MWh
- Amount of Generation: 209.8 kWh

< Energy Storage System >

Energy Storage (ESS)

Operation & Reduction Status
- Power Utilisation Efficiency: 10.271.0 kWh
- Power Utilisation Efficiency: 21.457.5 kWh

Energy Storage System
- Stored Energy: 817.5 kWh
- Discharged Energy: 671 kWh
- Accumulated Energy: 1,013 kWh

PV Operation Status
- Current Generation: 9.73 kW
- Current Output: 15 MWh
- Ambient Temperature: 31°C
- Sunlight Intensity: 785.9 W/m²
- System Efficiency: 4.12%
Others (Emergency Operation of ESS)

Smart Grid Building Case Study
Monitoring, Analytics, Management

< BEMS >

< LED & Diming >

Smart Grid Building Case Study
Monitoring, Analytics, Management

< Automatic Blinding >

Sun Lighting Blind

Operation & Reduction Status

- Windows orientation
- Sunlight exposure
- Ambient temperature
- Projected reduction

Effect of Blind

Temperature (outside)

Sunlight (inside)

779.4 W

< Automatic Access Sensor >

Automatic Access Sensor

Operation & Reduction Status

- Windows orientation
- Sunlight exposure
- Ambient temperature
- Projected reduction

Effect of Access Sensor

Before: 62.2 W

After: 39.1 W

It saves 52% of restroom and meeting room electricity by using Automatic Access Sensor

Power Saving by Floor

40% - 90.2 W

- 63% - 0.9 W

- 14% - 1.3 W

- 31% - 1.4 W

- 26% - 1.6 W

Saving Power (Today)

Total: 147.8 W

- 52% savings
Monitoring, Analytics, Management

< Energy Analytics >

< Energy Management >
Monitoring, Analytics, Management

< Energy Flow & Energy Saving >

- BEMS Station (B1F)
- ESS Station (B3F)

< BEMS & ESS Station >

■ = Smart Grid, ■ = Building Automation, ■ = Office Automation / Tele-Communication
### Benefits

#### PV
- Capacity: 50kW
- Module: 265WX190EA
- **64,605 kWh**
- **$8 k**

#### ESS
- PCS Capacity: 1MW
- Battery: 1MWh
- Emergency: 300kWh
- **38,762 kWh**
- **$37 k**

#### LED
- 22WX2X309EA (8F)
- 16/22WX322EA (B2F)
- **54,995 kWh**
- **$6 k**

#### Geothermal
- **64,273Nm³**
- **$44 k**

#### Automatic Blind
- 8F application
- Automatic Blind
- Unused: 800W/m²
- Use: 200W/m²
- **80,180,807kCal**
- **$10 k**

#### Access sensor
- Meeting rooms
- Toilets
- hallway
- **10,787 kWh**
- **$1 k**

#### EV
- EV 1 ea
- Slow charger 2 ea
- **Gasoline 2.4k Liter**
- **$4 k**

#### Dimming control
- Illumination Sensor (8F)
- Motion Sensor (B2F)

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**Peak Demand**: 10~14%
**Energy Saving**: 9~11%
**Energy Cost**: **$114 k**
Reminding Energy Management

Promotion & Education of BEMS

< Trend of Visitors >

< BEMS Station(B1F) >
Challenges

- Monitoring vs Control: Focus on Monitoring
- Renewable Energy System Item: Adding BIPV, Fuel-cell

Solution

- According to Government Initiative
  - “Zero Energy Building”
  - “ESS Installation in Public Building”

Next Steps

- Analytic Performance upgrade with Big-Data
- Application of Demand Response
- Development of ESS with UPS Function
Thank you!

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