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II. SR Test-Bed Project
III. Outputs of SR Project
IV. Business Models
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I. Jeju island SG Pilot Project

JEJU SG Pilot Projects

For the Technical Verification of SG, and Business Model Development

SG Road Map

VISION
Foundation for Low-Carbon Green Growth based on Smart Grid

PHASE
1st Phase (2013)
Field Test in JEJU

2nd Phase (~2020)
Application in Wide Area (SG City Project)

3rd Phase (~2030)
Nationwide Application

Main 5 Sectors
Smart Power Grid | Smart Place | Smart Renewable | Smart Transportation | Smart Elec. Service
I-1. Smart Power Grid

**Targets**
New Intelligent Power Grid Management System with “Smart” Functions based on IT technology

**Benefits**
Labor Cost and Time Saving, Reliability & Efficiency Improvement

**Contents**
- Two 154kV Substations and Feeders will be digitalized based on IEC 61850
- Fault Prediction System with Intelligent sensors
- Intelligent Distribution Management System

※ DAS installation completed on 2004

**Schedule**
- 1st (2010. 6~2011. 5) : Device installation
- 2nd~4th (2010. 1~ 2013. 11) : Device test, Operation and Assessment
I-2. Smart Place

**Targets**
Load Management by Demand Response under AMI environment

**Benefits**
Load Leveling, Energy Efficiency Improvement, Cutting Electric Charge

---

### Contents
- Smart Meters / MDMS
- Integrated Metering System / Energy Portal
- Two-way Power Exchange / Other Services

※MDMS – Metering Data Management System

### Schedule
- 3rd (2011.6~2012.5): Field Test
- 4th (2012.6~2013.5): Conclusion
I-3. Smart Renewable

**Targets**
Stabilization of unstable power from renewable energy sources

**Benefits**
DGs’ stable interconnection with Network

**Contents**
- 4 Types of System Configurations
- 3 Types of Power Stabilization Mode, including control Algorithm

**Schedule**
- 1st (2009.12~2010.5): Designing
- 2nd (2010.6~2011.5): Device Production
- 3rd (2011.6~2012.5): Field Test
- 4th (2012.6~2013.5): Conclusion
I-4. Smart Transportation

**Targets**
Preparation for EVs Charging Infrastructure

**Benefits**
Contribution for EV’s fast spread, Power Sales Increment

---

**Contents**
- Various charging stands by case
  - Quick, Slow, Inductive, High Capacity Storage
- Operation System for Charging Station / Information Security / Other services
- Standardization of Charging Interface

**Schedule**
- 1st (2009.12~2010.5): Designing
- 3rd (2011.6~2012.5): EV operation & Test
- 4th (2012.6~2013.5): Assessment

---

* CIM : Customer Information Management
I-5. Smart Electric Service

**Targets**
Support of Power Trade on RTP market, and integrated Operation Center

**Benefits**
Business platform Development in the future

**Contents**
- Virtual Power Market Operation System (EMS)
- Real-time Tariff Test,
- Energy Information Portal

**Schedule**
- 1\textsuperscript{st}(2009.12~2010.5): Designing
- 2\textsuperscript{nd}(2010.6~2011.5): Installation & Pilot test
- 3\textsuperscript{rd}~4\textsuperscript{th}(2011.6~2013.5): Integrated Field Test, Assessment
II. SR Test-Bed Project

Road Map

1st (2009.12~2010.5)
- Designing
  - Developing Lithium Battery
  - Constructing Power Resources

2nd (2010.6~2011.5)
- Devices Production
  - Drawing up Test scenario and manual

3rd (2011.6~2012.5)
- Field Test
  - Constructing Test Bed

4th (2012.6~2013.5)
- Analysis & Commercialization
  - Starting Power Exchange
II. SR Test-Bed Project

Sky View of SR Test Bed
II. SR Test-Bed Project

Test-Bed Outline

Group A
- Wind (750kW)
- PC (500kW)
- Li-BES (250kWh)
- STATCO (1MVAR)
- 220/380V
- Low Voltage Grid

Group B
- Wind (660kW)
- PC (800kW)
- Li-BES (200kWh)
- STATCO (1MVAR)
- 22.9kV-y
- High Voltage Grid

Group C
- Small Hydro (60kW)
- PV (100kW)
- Lead-Acid Battery (60kWh)
- PCS (100kW)
- PCS (100kW) w/ BMS
- PCS (500kW)
- AV (50kVAR)

Operation Center
- EM (Group)
- EM (Group)
- EM (Group)
- DRIM
- Security System

Total Operation Center

Power Line
- Blue: Data Control
- Green: DRIM Terminal
II. SR Test-Bed Project

- EMS [Energy Management System]
- PCS [Power Conditioning System]
- AVC: Automatic Var Compensator
- BMS [Battery Management System]
- STATCOM [STATic synchronous COMpensator]
### Energy Storage

<table>
<thead>
<tr>
<th>Power</th>
<th>Capacity</th>
<th>Developer</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind 660kW</td>
<td>Li 250kWh</td>
<td>LG Chem</td>
<td>45Wh/cell (energy density)</td>
</tr>
<tr>
<td>Wind 750kW</td>
<td>Li 200kWh</td>
<td>SAMSUNG SDI</td>
<td>50Ah (cell capacitor)</td>
</tr>
<tr>
<td>PV VRLA 60 kWh</td>
<td>ATLAS BX</td>
<td></td>
<td>7.5 years (life time)</td>
</tr>
<tr>
<td>Small Wind</td>
<td>Li 72 kWh</td>
<td>KOCAM</td>
<td>2,500times (life time)</td>
</tr>
</tbody>
</table>

- Valve Regulated Lead Acid

### Power Conditioning System

<table>
<thead>
<tr>
<th>Power</th>
<th>Capacity</th>
<th>Developer</th>
<th>Conversion Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind 660kW</td>
<td>500kW</td>
<td>LSIS</td>
<td>95%</td>
</tr>
<tr>
<td>Wind 750kW</td>
<td>800kW</td>
<td>HYOSUNG</td>
<td>95%</td>
</tr>
<tr>
<td>PV 100kW</td>
<td>Intech FA</td>
<td></td>
<td>93%</td>
</tr>
<tr>
<td>Small Wind</td>
<td>100kW</td>
<td>EN Technology</td>
<td>93%</td>
</tr>
</tbody>
</table>
III. Output of SR Project

PQ Compensator

STATCOM (STATic synchronous COMpensator)

<table>
<thead>
<tr>
<th>Power</th>
<th>Capacity</th>
<th>Developer</th>
<th>Reaction time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>660kW</td>
<td>1MVAR</td>
<td>LSIS</td>
</tr>
<tr>
<td></td>
<td>750kW</td>
<td>1MVAR</td>
<td>HYOSUNG</td>
</tr>
</tbody>
</table>

Distributed Resource Interconnection Management System (DRIMS)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Developer</th>
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</thead>
<tbody>
<tr>
<td>Main, Terminal</td>
<td>KEPCO, KDN</td>
</tr>
</tbody>
</table>

[STATCOM Producting]

[DRIMS screen view]
### III. Output of SR Project

#### Power Exchange

- **Energy Management System (EMS)**

<table>
<thead>
<tr>
<th>Power</th>
<th>Controlling Point</th>
<th>Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>660kW</td>
<td>20,000</td>
<td>LSIS</td>
</tr>
<tr>
<td>750kW</td>
<td>5,000</td>
<td>HYOSUNG</td>
</tr>
<tr>
<td>PV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Wind</td>
<td>1,000</td>
<td>KDN</td>
</tr>
</tbody>
</table>

#### Wind Power Forcasting System

<table>
<thead>
<tr>
<th>Function</th>
<th>Developer</th>
<th>Accuracy</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short &amp; Super Short term</td>
<td>KEPCO-E&amp;C</td>
<td>85%</td>
<td>ARIMA statistic model</td>
</tr>
<tr>
<td>Forcasting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short term (2.5h)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long term (3.8h)</td>
<td></td>
<td>80%</td>
<td>Meteorological model</td>
</tr>
</tbody>
</table>

[Monitoring] [screen view]
IV. Business Models

Business Model

- Cost Reduction: Connection cost reduction between SR power and grid.
- Increasing Profit: Increasing SR power efficiency and profit.
- Energy Shift: Stores energy in low load time, and discharges in peak time by using large capacity storage.
- Intentional Islanding: Supplies power to customers in isolated grid.
Adding quality compensation equipment → Stabilizing SR power
Setting up connection capacity regulation to common line
(under 3MW → over 3MW)
Power-factor of wind power alone: 0.4~0.9

Power-factor improvement by STATCOM → Increasing active power and profit
(STATCOM: STATic synchronous COMPensator)

As is

To be

22.9KV grid

Economic feasibility of STATCOM and SR power profit in Jeju Project
Charging in low load time, Discharging in peak by ESS → Energy Shift
※ ESS : Energy Storage System

Demand controlled application and UPS (uninterruptible power supply)

Point at Issue

Expensive Battery → Technical development

RPS expectional item : ESS → Support by Goverment policy
※ RPS : Renewable Portfolio Standard
### IV. Business Models

**Intentional Islanding**

#### Outline

- KEPCO Parallel Operation
- Stand alone Operation
- KEPCO low voltage line
- SW
- Energy Storage
- Load
- Wind
- PV
- Small Hydro
- Load

#### Functions

- **Ordinary**: Minimize consumption of power from Grid, Renewable energy sources service electricity for the area
- **Grid black out**: Island Grid can supply enough power for the area without black out
- **After recovery**: Automatically close switch and re-connect with Grid
IV. Business Models

**Intentional Islanding**

**Domestic Market**

- Substitution for diesel power in island region
  - case: Denmark Samso island

**Overseas Market**

- Supply power to customer in isolated region without grid connection
  - target
    - Area where enough electricity is not available
    - Area where Extremely high Power Quality is necessary
IV. Future Plan

- SR Equipment Development
  - 2011: Test being linked
  - 2012: Standard & Patent
  - 2013. 5: Equipment Upgrade

- SR Demonstration
  - 2011: Demonstration Scenario
  - 2012: Short Term Demonstration
  - 2013. 5: Long Term Demonstration

- SR Biz Model
  - 2011: BM Evaluation
  - 2012: Analysis & Commercialization
Smart Renewable

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