Sustainable Buildings in Korea

February 2, 2011

http://www.skec.com

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1. Social Welfare Facilities Remodeling Project

1 Project goal

➢**Jointly executes the energy efficiency improvement project for the social welfare facilities as part of the 'Green Growth and Win-Win Management' in the MOU with Korea Energy Management Corporation (Dec. 2009).**

➢**Executes the energy zero remodeling project for existing buildings.**

2 Process

Kick Off
- Signed MOU with KEMCO

Select
- Selected one place near Seoul out of 200 places across the nation.

Diagnosis
- Investigated the infrastructure and facilities in the site.
- Analyzed the status of energy use.

Schematic Design
- Induced an energy efficiency improvement plan (proposal).
- Prepared a basic plan.

Analysis & Evaluation
- Forecasted energy performance. (simulation)
- Decided a final improvement plan (proposal).
- Reviewed budget.

Current step

Construction Design
- Prepare detailed design drawings and documents.
- Establish an operational plan.
- Establish an M&V plan.

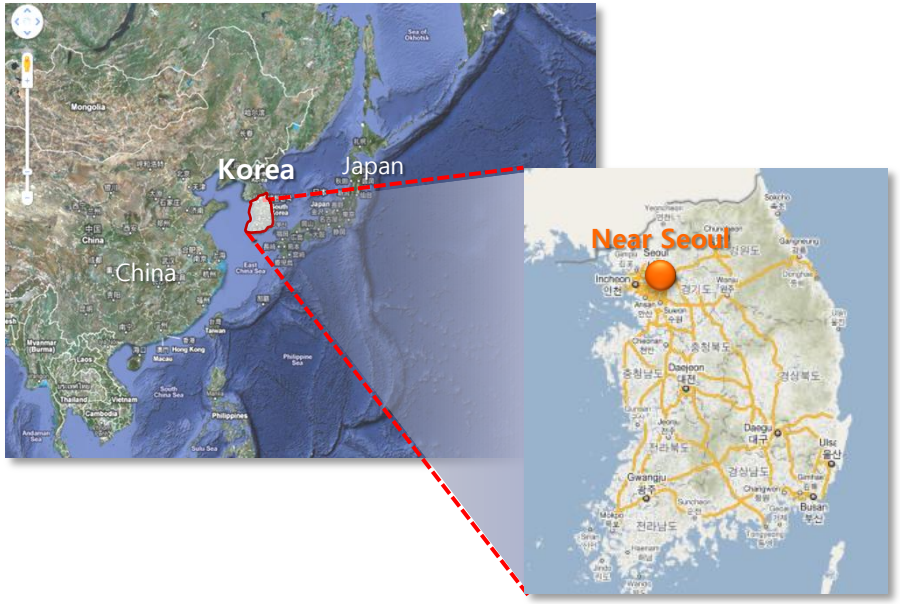
Construction
- Execute improvement construction. (spring, 3-4 mths)
- Commissioning

Verification
- Test, Adjusting, Balancing
- Commissioning

Operation & Maintenance
- Operation consulting
- Post commissioning
- M&V

2. Site Outline

1 Location

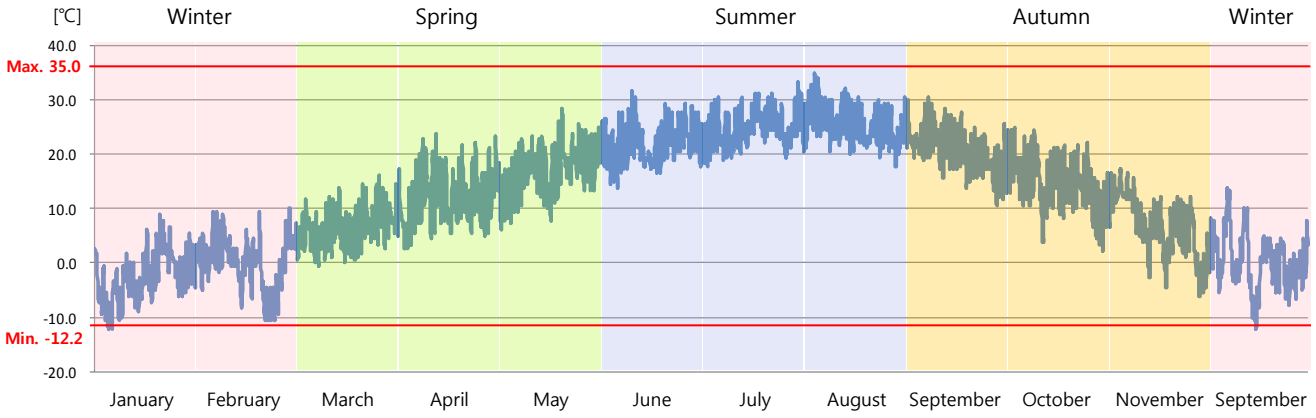


2 Building information

- ✓ ***Project Name***
  : Myoung Ryun orphanage
- ✓ ***Building uses***
  : A child welfare institution
- ✓ ***Residence type***
  : Child, 60 persons
- ✓ ***Location***
  : Near seoul, korea
  (Long. 127E, Lat. 37N)
- ✓ ***Area***
  : Site 1,600㎡ / Building 392㎡

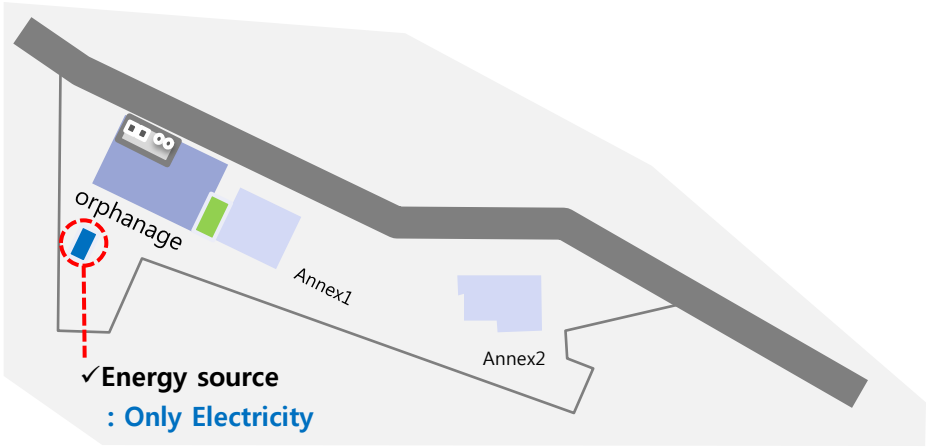
3 Climate

- Continental climate
- Winter
  : cold anticyclone
- Summer
  : high temperature and humidity
- Annual range : about 30℃ over



3. Infra & Facility

1 Infra



[Side view]

[Front view]

2 Facility

■ Architecture

✓ Window
1F : Single glass, wood frame (U=3.6 W/㎡.K)
2F : Double window, PVC frame (U=2.7 W/㎡.K)

✓ Wall : block, 50mm insulation (U=0.66 W/㎡.K)

✓ Roof : concrete & mortar, 80mm insulation (U=0.66 W/㎡.K)

✓ Floor : concrete & mortar (U=2.73 W/㎡.K)

■ Mechanical

✓ Cooling : Electric Packaged Air Conditioner

✓ Heating : Storage type Electric Boiler by Midnight Power

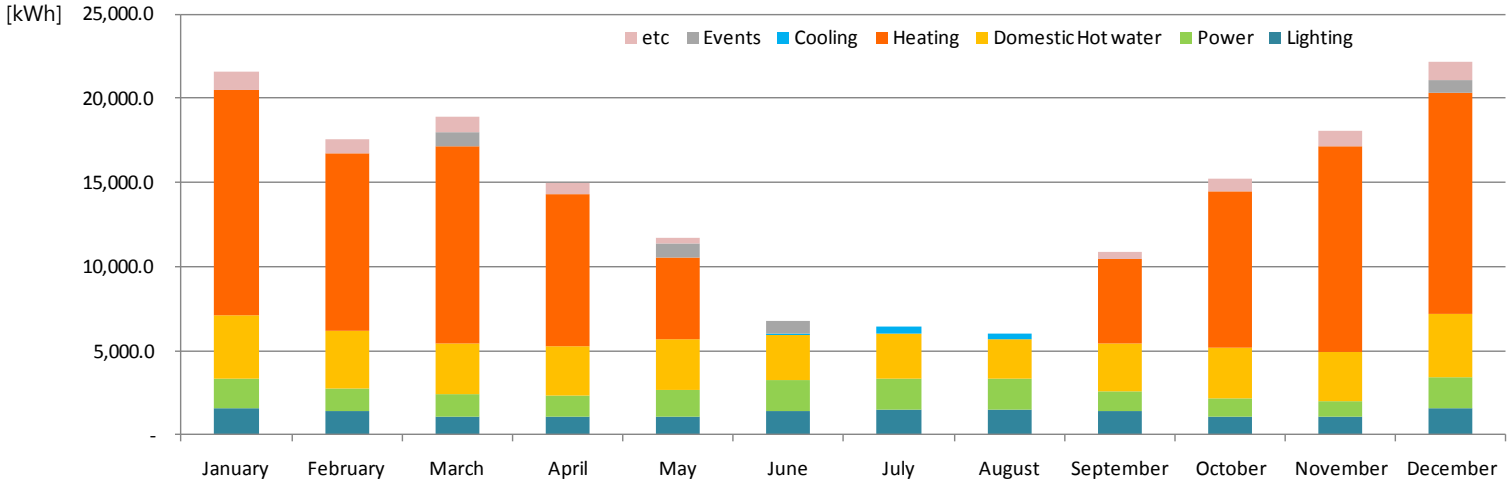
✓ Domestic Hot Water : Storage type Electric Boiler by Midnight Power

■ Electric

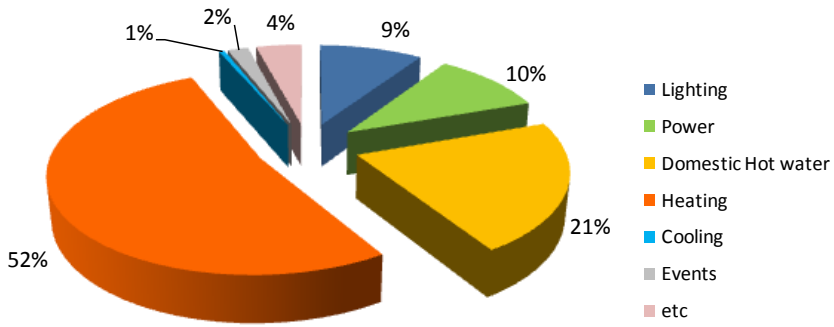
✓ Lighting : 36W, 55W, 20W fluorescent light
✓ Power : General & Midnight power 220V
✓ Units : TV, refrigerator, Computer, fan etc

4. Status of Energy Use

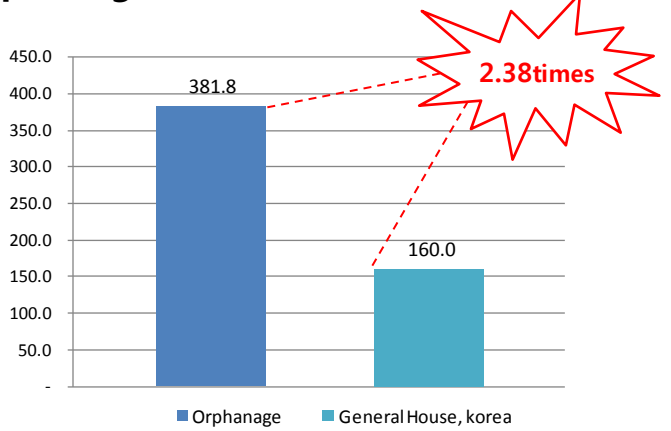
1 Monthly Energy consumption



2 Energy consumption by use



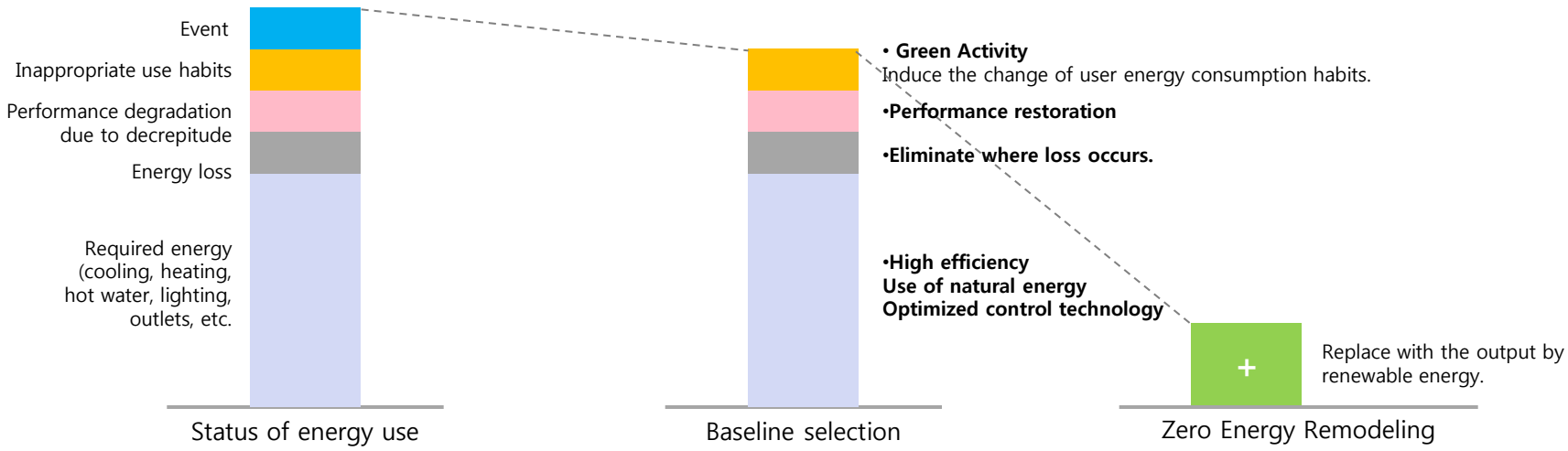
3 Orphanage Vs General house(korea)



•High dwelling density
•Dwellers are children, who are socially weak people.
•Many visitors

5. Energy Zero Plan

1 The concept of energy zero remodeling for existing buildings



2 Focus

Energy saving

- High Efficiency system & Equipment
- High insulation, Low leakage (wall, window, door)
- Green Activity

Economic feasibility

- Low initial Cost
- Low life Cycle Cost
- Into wide use for other projects

Operation & Maintenance

- Low running Cost
- Low maintenance Cost
- Verification of the efficiency of applied items.
- Energy control through BEMS

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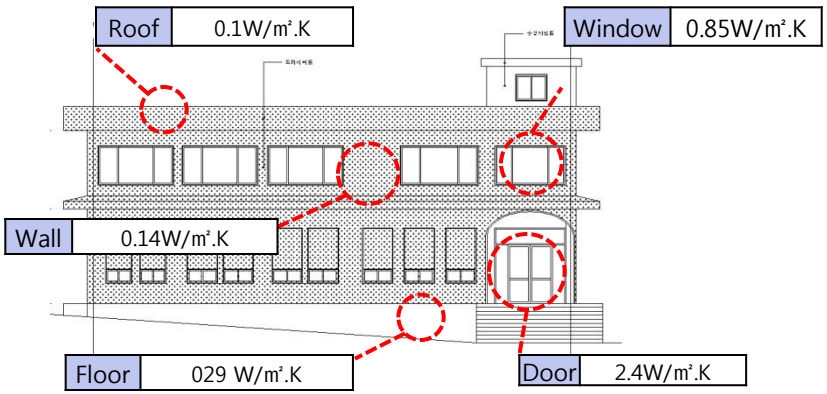
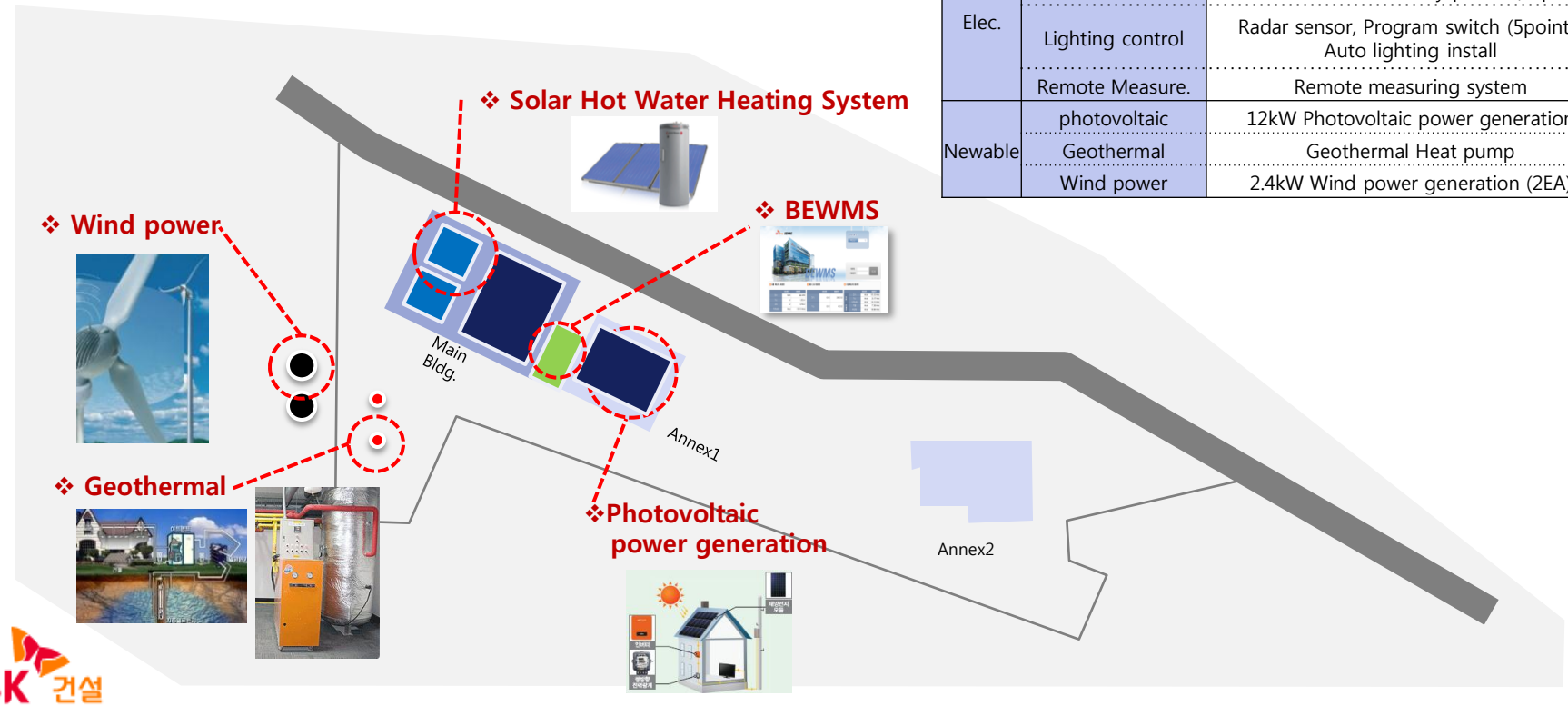
6. Applied Technologies

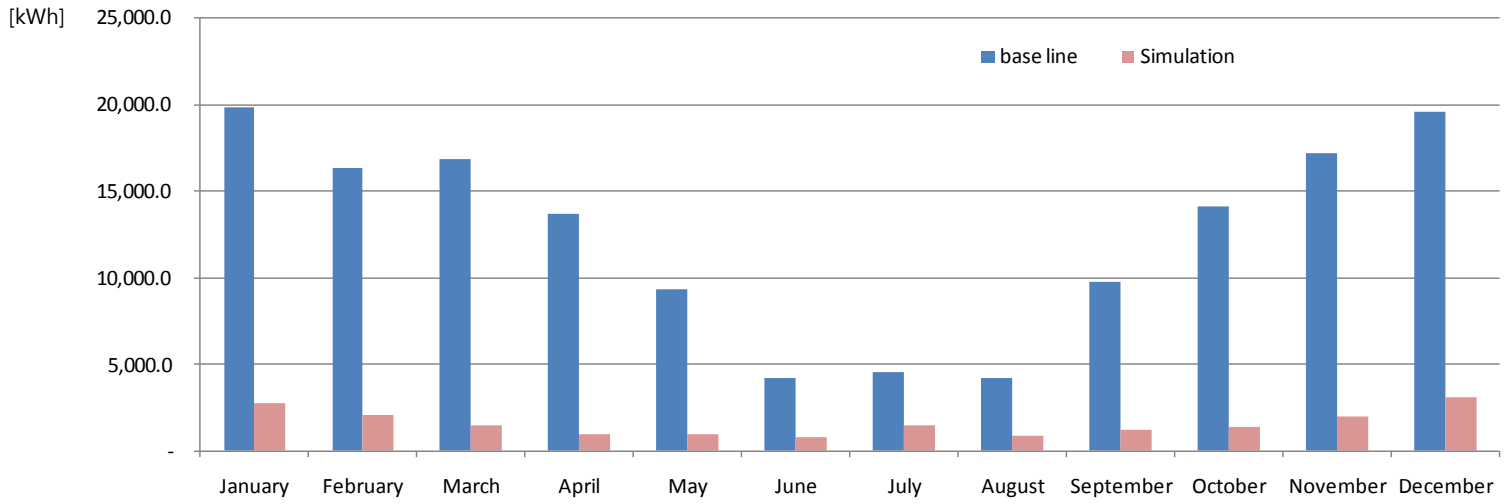


Items		Proposed
Arch	Window	246mm PVC double window (22mm Low-e double glass)
	Roof	Additional Insulation
	Wall	External surface insulation
	Floor	Additional insulation(Urethane spay coat)
	Door	protection against the wind
Mech.	Heating	Remote room temp.Control
	Domestic Hot water	Solar Hot Water Heating System 32m2
	Automatic control	BAS, BEMS
	Insulation	foam rubber insulation
Elec.	Lighting	LED lighting (54 points)
	Power	Socket for block stand by power (17points)
	Lighting control	Radar sensor, Program switch (5points) Auto lighting install
	Remote Measure.	Remote measuring system
Newable	photovoltaic	12kW Photovoltaic power generation
	Geothermal	Geothermal Heat pump
	Wind power	2.4kW Wind power generation (2EA)

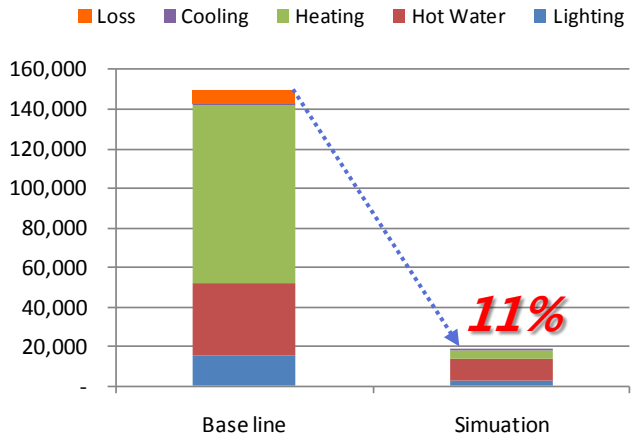


7. Energy Simulation

1 Comparison between base line and simulation by month



2 Comparison between base line and simulation by use



	Base line	Simulation	Remarks
Annual Energy consumption	**149,678 kWh**	**16,721 kWh**	**11%**
Annual Energy consumption by area	**381.8 kWh/m²**	**4.27 kWh/m²**	**it has decreased 89%**

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8. Implication

1 Realization of Energy Zero

Economics

- More renewable energy generation is required for ENERGY ZERO.
- Currently, cost for renewable energy facilities is high.
- To supply energy to houses easily, economically feasible renewable energy generation technology is required.

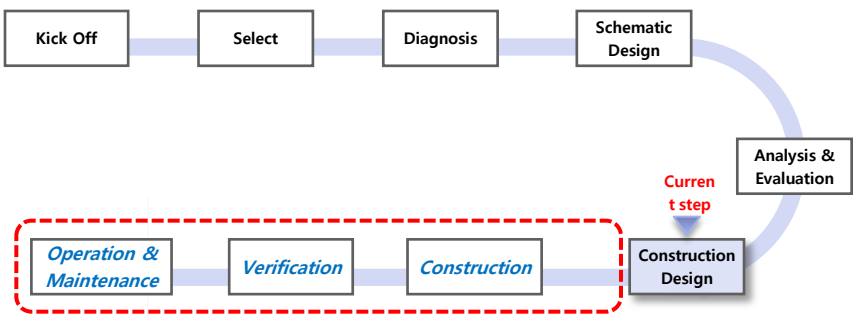
Climate

- As Korea has distinct four seasons and its annual temperature difference is 30 ℃ on average and 48 ℃ in maximum, it requires cooling and heating and lots of energy.
- For Energy Zero, it is most important to establish measures to reduce cooling/heating load through insulation and covering.
- In addition, it is necessary to reflect the method to deal with cooling/heating load by directly using natural energy to the plan in the early stage.

Site infra

- In applying renewable energy, it is important to select the site (installation spots, sunshine condition, and wind) properly and establish infrastructure (city gas, water supply, etc.).
- Effective if there is infrastructure around the project site, such as a local heating facility and a waste heat generation facility.
- Surrounding environments are important for natural ventilation and geothermal system.

2 Next Step



■ BEWMS Building Energy & Water Management System

- ✓ Verify the energy effect of each technology continuously by installing BEWMS developed by SK E&C.
- ✓ Evaluate energy performance after a year through measurement and verification by using BEWMS.

■ LCC, LCA Life Cycle Cost, Life Cycle Assessment

- ✓ Make efforts to develop buildings of excellent economic feasibility to supply energy zero houses.

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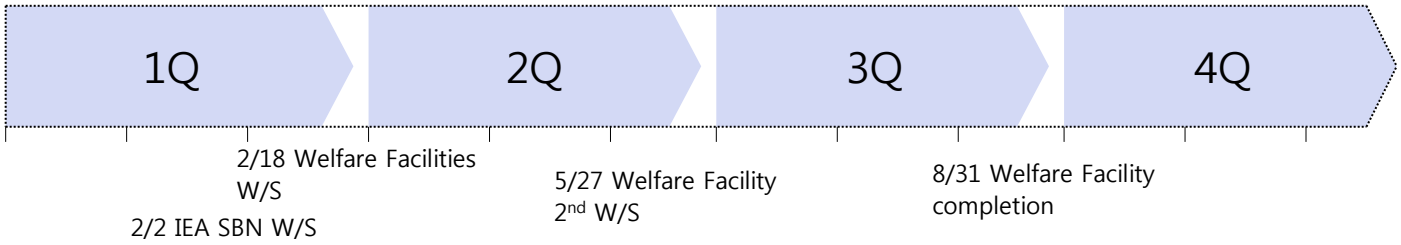
Other Projects & Next steps



1 Social Welfare Facilities

- Drawing documentation
- Construction
- Test of installed equipment
- Maintenance & Monitoring
- Workshop with KEMCO* KICT**APP
- Workshop with KEMCO & KICT

* Korea Energy Management Corporation
** Korea Institute of Construction Technology

2 Office Buildings

ZEOB Prototype Project for KEPCO

- Zero Energy Office Building Research contract with KEPCO
- ZEOB prototype development
- ZEOB technology optimization
- Final report

Sustainable Building: New construction targets

SK Networks Office Building
Ministry of Justice Training Center
KEPCO HQ building

Remodeling

One SK Group Company Office

- SK E&C conducted energy performance diagnoses for 28 government office buildings in 2010

1 Social Welfare Facilities Remodeling Project

2 Other Projects & Next Steps

3 Appendix : SK Chemicals Eco Lab

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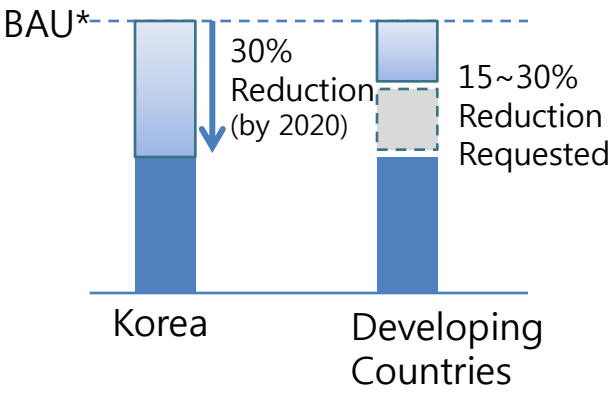
National Policy on Climate Change in Korea

' Low Carbon, Green Growth '

1 CO_2 Reduction



Korea GHG emission : million tCO_2 eq

1990	2005	2020
298	594	813(BAU) 569(Target)

* BAU : Business As Usual

2 Energy Saving

Policy Change

2010
Regulations for total amount of energy consumption

2012
Mandatory energy consumption certification

2013
Compulsory diagnosis of low efficient energy building

2025
Compulsory construction of Zero Energy House for new

Others
- **Smart Grid**

3 Incentives

New Buildings

1st grade in energy efficiency
+
1st grade in green building certification

12% ↑ 15% ↓

Floor Area Ratio

Acquisition & Registration Tax

Others
- FIT*/RPS**
- Subsidy

*FIT : Feed in Tariff
**RPS : Renewable Portfolio Standard

LEED Platinum Projects by SKEC*

1 Domestic

SK Chemicals Eco Lab

Location Sungnam, South Korea
Stories 9 floors / 5 basements
Site Area 6,230m²
G.F.A 47,670m²
Value USD 90.7M
Period 2008.07~2010.09

2 Overseas

KAPSRAC R&C *

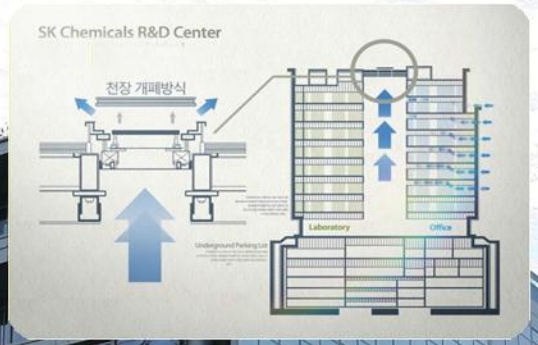
Location Riyadh, Saudi Arabia
Composition 191 Houses, 9 Buildings
Site Area 600,000m²
G.F.A 141,157m²
Value USD 320M
Period 2010.05~2012.06

* King Abdullah Petroleum Studies And Research Center for ARAMCO

***SK E&C Founded in 1977 / Sales USD 4.1B / Employees 4,800 /**
Business areas : Housing / Building / Civil Engineering / Plant / Industrial plant / u-Business

SK Chemicals Eco Lab - Main energy technologies

Triple glazed curtain wall

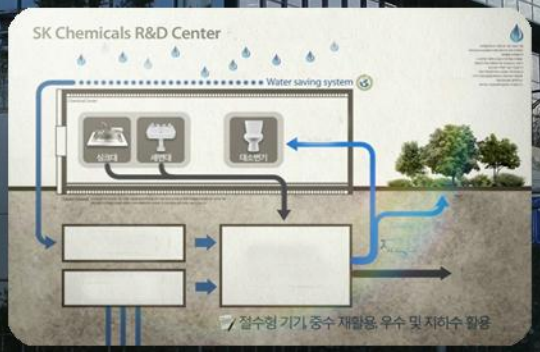


Atrium Natural Ventilation

Radiation cooling & heating

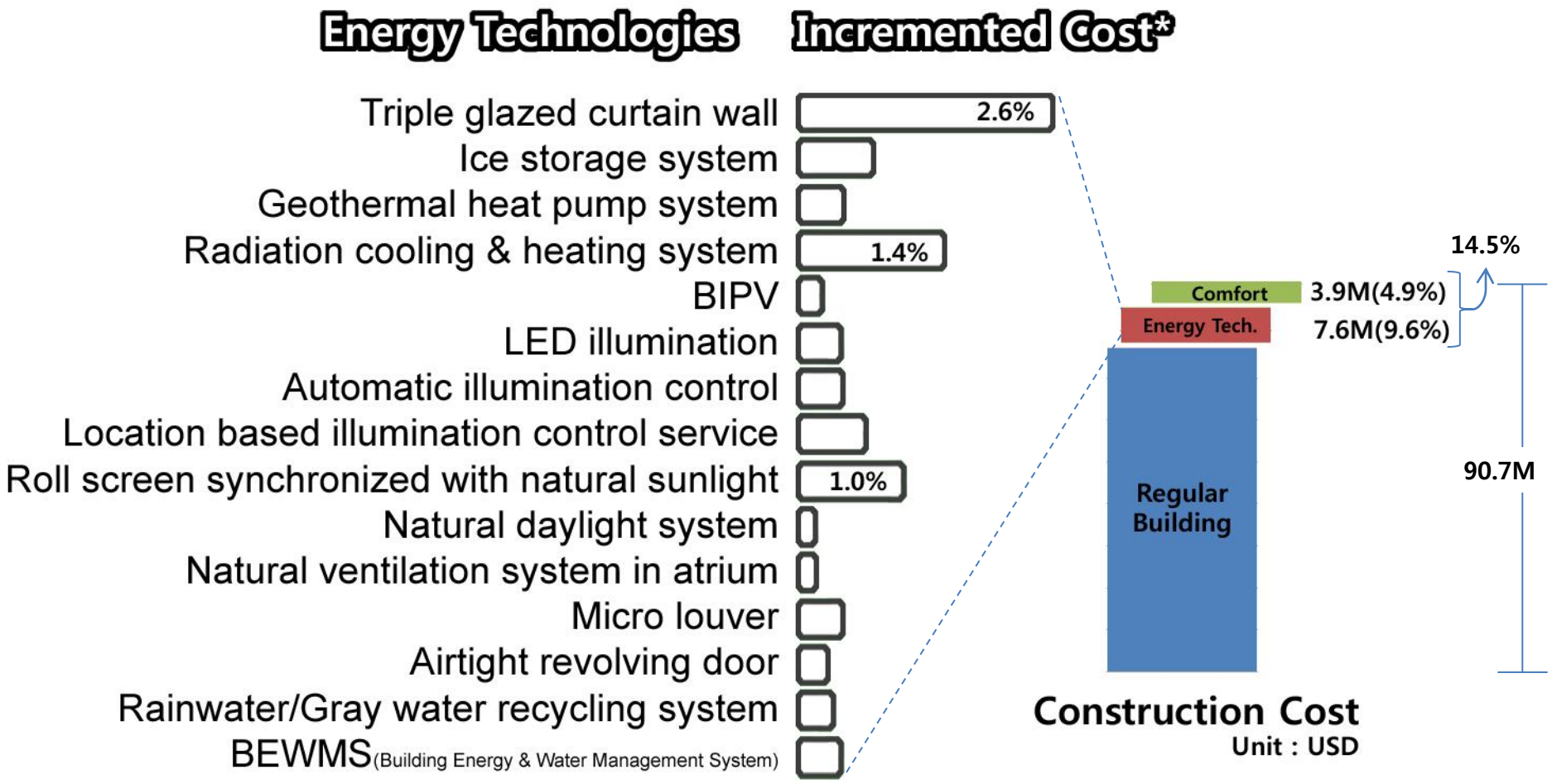
Building Energy & Water Management System(BEWMS)

Shading & BIPV



Rainwater & Graywater Recycling

SK Chemicals Eco Lab - Cost for energy technologies

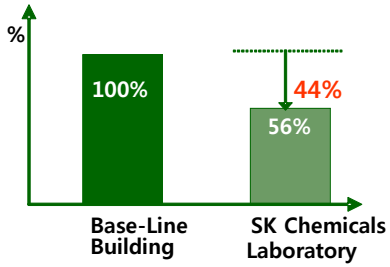


* Compared to regular building standards

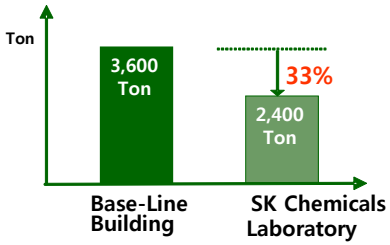
SK Chemicals Eco Lab - Results

1 Performance

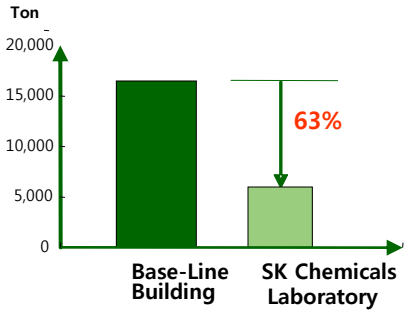
Energy Savings
Annual energy use



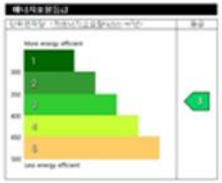
CO_2 Reduction



Water Efficiency



2 Certification



Efficiency for Building Energy

Obtained the 1st grade with primary energy consumption 248.5kWh/㎡.yr*

* 1st grade granted below the 300kWh/㎡.yr in Korea

GBCC*

Obtained the best grade with the highest score

* GBCC : Green Building Certification Criteria in Korea

LEED

Platinum grade will be obtained

Next Plan

1 **Achieve More High-Performance Building Concept Buy-in**

- SK Group sister companies, government guidelines & publicity

2 **Develop Performance Guarantee Proposal Model**

- Establish Alliance with Energy Data Monitoring & Analysis Business Entity
- Develop Customer Value Proposition in Performance Guarantee Model

3 **Internalize Operation & Maintenance Management Capabilities**

4 **Optimize Cost Model: Zero Extra Cost in Five Years**

- Optimize technologies applied to achieve target performance
- Utilize procurement levers such as global sourcing & substitute materials
- Increase sustainable building projects for the economies of scale