# Application for Awards

**Korea District Heating Corporation(KDHC)**

## Summary

**About facility modernization performance through enhancing efficient energy use**

■ **Sales of Korea District Heating & Cooling**

■ **General Information of KDHC**

■ **KDHC's heat supply performance**

■ **Major Contents of Application for Awards**

○ **Energy Efficiency through Metropolitan Pipeline Networking**

- **Installed KDHC integrated operation center**
- **CHP plants at 11 business sites were interconnected**
- **Great Energy Savings**
- **Reduction of CO2 emissions**

○ **Newly developed District Cooling "Desiccant District Cooling"**

- **Developed absorption refrigerator to operate District Cooling on the lower heat**
- **Developed Desiccant District Cooler for District Cooling in the area of apartments,**
- **Improvement of indoor environment / health enhancement**

■ **Attachment #1, #2**

## 1. Sales of Korea District Heating & Cooling

1) Residential Types of Korea (thousands)

| Apartments (over 3F) | Single houses or Villas (below 3F) | Total |
|---|---|---|
| 8,500 (60.7%) | 5,500 (39.3%) | 14,000(100%) |

2) Types of Heating in Apartments

| Section | Central Heating | District Heating | Individual Heating | Total |
|---|---|---|---|---|
| Households in 1000s | 800 | 2,300 | 5,400 | 8,500 |
| Ratio (%) | 9.4% | 27% | 63.6% | 100% |

3) The situation of businesses & households getting heat supply by district heating

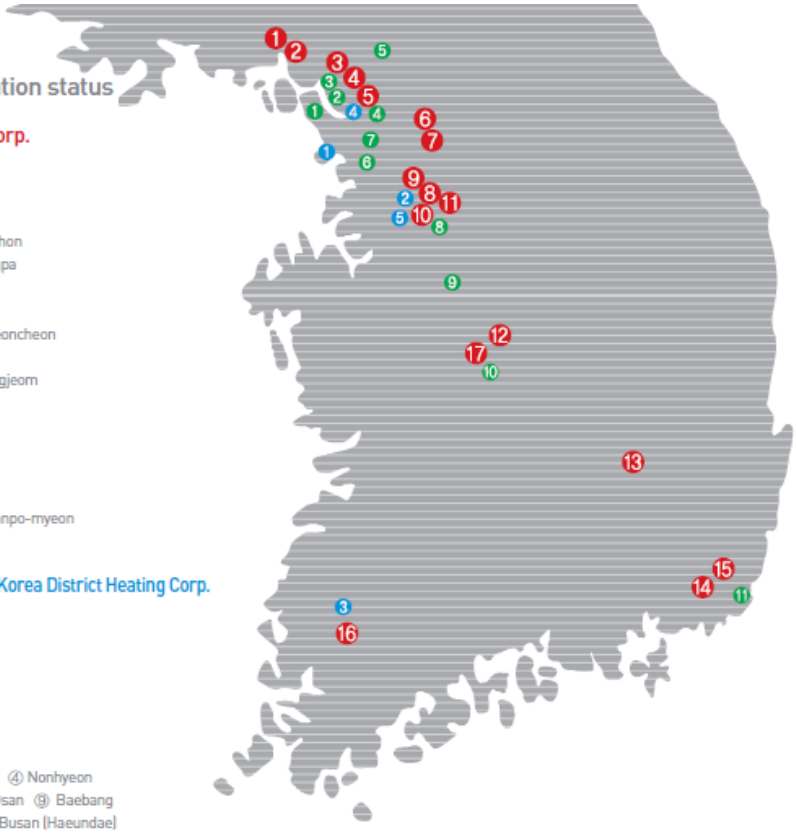
KDHC was the first provider of district heating in Korea, occupying 56.5% of domestic heat supply as of the end of 2013. It currently supplies a total of 1.3 million households with heat (heat supply started on 11. 01. 1987)

| Section | | KDHC | GS Power | Seoul City | 29 Private Operators | Total |
|---|---|---|---|---|---|---|
| Heat Supply | Households in 1000s | 1,300 | 300 | 240 | 460 | 2,300 |
| | Businesses | 16 | 2 | 2 | 29 | 49 |
| | Ratio (%) | 56.5% | 13.0% | 10.4% | 20.1% | 100% |

## 2. General Information of Korea District Heating Corporation (as of December 2013)

1) Government Owned Company
   (Government & Public Company: 75% / General Shareholder: 25%)
2) Established in 1985
3) Began providing heating service from 1987
4) Number of Employees: 1600
4) 17 Branches
   (Refer to pictures of Heat pipeline Distribution Networks in Metropolitan area below)
5) 11 Combined Heat and Power (CHP) Plants for 1628 MW
6) 13 Heat Only Boilers (HOB) for 3128 G/H
7) Total Assets: 3,292,683,000EURO
8) Annual Sales: 2,049,484,166 EURO
   (Electricity: 1,199,940,669 EURO / Heat: 1,005,532,607 EURO)
9) Net Profits: 92,303,128 EURO

## District Heating Distribution status



### Korea District Heating Corp.

① **Paju** - Gyoha · Unjeong
② **Goyang** - Ilsan · Hwajeong
③ **Samsong** - Eunpyeong New Town
④ **Mapo** - Yeouido · Banpo · Sangam · Ichon
⑤ **Gangnam** - Gangnam · Seocho · Songpa
⑥ **Pangyo**
⑦ **Bundang**
⑧ **Suwon** - Youngtong · Gwonseon · Cheoncheon
⑨ **Gwanggyo**
⑩ **Hwaseong** - Dongtan · Taean · Byeongjeom
⑪ **Yongin** - Suji · Jukjeon · Dongbaek
⑫ **Cheongju** - Bungpyeong · Habokdae
⑬ **Daegu** - Seongseo-Daegok
⑭ **Gimhae** - Jangyoo
⑮ **Yangsan** - Mulgeum
⑯ **Gwangju Jeonnam** - Geumcheon · Sanpo-myeon
⑰ **Sejong** - Geumnam · Nam-myeon

### Mutual Investment Companies of Korea District Heating Corp.

① **Incheon** - Songdo
② **Suwon** - Homaesil
③ **Gwangju** - Suwan
④ **Seoul** - Wirye
⑤ **Hwaseong** - Hyangnam

### Other Business Places

① Bucheon ② Mokdong ③ Gangseo ④ Nonhyeon
⑤ Nowon ⑥ Ansan ⑦ Anyang ⑧ Osan ⑨ Baebang
⑩ Daejeon(industrial complex 3, 4) ⑪ Busan (Haeundae)


service area of KDHC
service area in Seoul
service area in Ansan Urban Development Corp.
service area of Incheon Total Energy Company
service area of GS Power
Korea District Heating Corp
Mutual investment companies of Korea District Heating Corp.
Other business places
heat pipeline distribution network

# For stable heat distribution, KDHC has established heat pipeline distribution networks and plans to expand to meet new demand
# The length of heat pipeline networks nationwide is 3,520 km(1,760 km*2 channels, distribution and return line). This is equivalent to the distance covering three roundtrips from Seoul to Busan, and accounts for 67 percent of all heat pipeline networks in Korea.
# Heat pipeline expansion in the Seoul Metropolitan area based on the connection line of 99km*2 channels, from Paju to Hwaseong, raises the efficiency and stability of heat distribution, as well as leading to wider heat distribution in the region.

## 3. KDHC's heat supply performance

1) First in Korea, it revamped the existing thermoelectric power plants and apartment complexes intoa district heating method and started supplying heat generated by district heating system in 11. 1987.

○ In 1986, it revamped Seoul Thermoelectric Power Plant (Capacity 340MW) located near the HanRiver into a district heating facility generating 300MW of electricity, 369 Gcal/h of heat.
○ Around1974,itrevamped the existing heating system for 38,000 houses of the apartment complexes inhabited by residents (Yeouido, DongbuIchon-dong, Banpo District) into a district heating system, whose heat was used by the residents from 11. 1987.

2) First in Korea, it supplied 0.4 million households of the newly developed residential areas (New Town) with heat produced by district heating system.

○ In 1989, it made a national construction plan to build a total of 0.4 million apartment houses in a total of 4 districts within 50 KM radius from the center of Seoul.
○ It made a plan to install 4 combined heat & power plants generating a total of 2,700MW in the 4 residential development districts, and supplied a total of 0.4 million households with heat produced by the district heating system 1992 to 1998.

3) First in Korea, it supplied local new town districts with heat produced by the district heating system.

○ In 1996, new towns as in the capital area began to be formed in other localities, and the apartment complexes and commercial zones of the new towns were supplied with heat generated by the district heating system.

4) First in Korea, it supplied district cooling using heat produced by district heating & cooling system (1992)

○ In 1992, KDHC's main building began to be supplied with district cooling.
○ Korea needs to be cooled for about 4 months from May 15$^{th}$ to September 15$^{th}$.
○ As of 12. 2013, there are about 800 buildings cooled by district cooling.

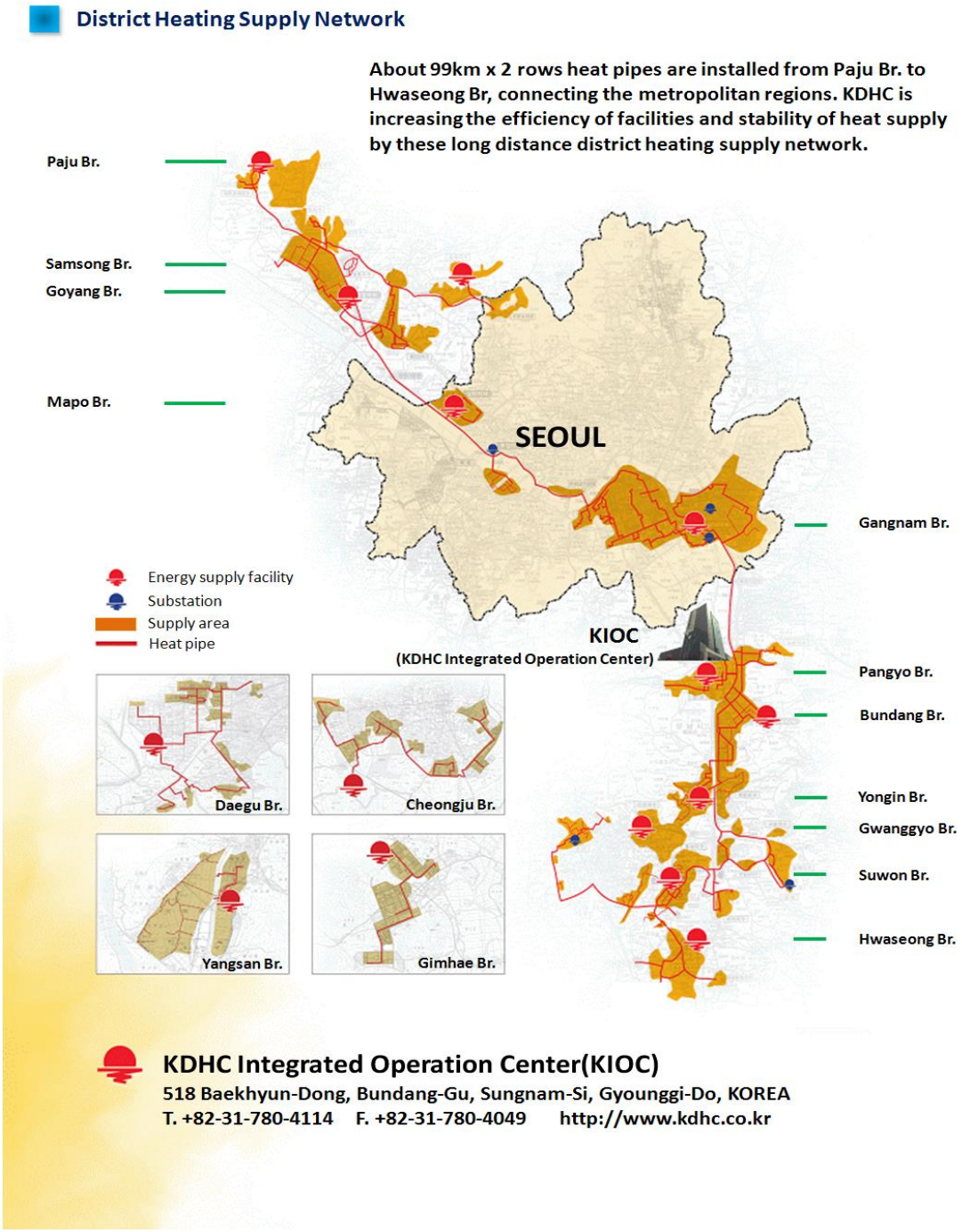
## 4. Major Contents of Application for Awards

1) Section
Awards for facility modernization performance through enhancing efficient energy use.

2) Contents of application for Awards
① A world-class system enhancing energy efficiency.

○ KDHC installed its integrated operation center connected to business sites in 2009, and conjoined Paju, a city situated 35 km north of Seoul and Hwasung, a city situated 64km south of Seoul, a total of 99km, with heat pipes whose diameter varied from 600m/m to 800m/m.

○ Subsequently, CHP plants at 11 business sites were interconnected, supplying 1.013 million households with heat. KDHC installed an Integrated Operation Center in 2009. It is getting an optimum heat production from 11 branches considering the weather change and heat demand. The contents of KIOC (KDHC Integrated Operation Center) is in the attached file (# Attachment.2). The District Heating Supply Network is as follows;




○ Comparison of the year 2005 when this heat pipes conjoining cities in the Seoul metroplex was

completed with year 2013 is shown in the below table.

○ The table shows, CHP's yearly production ratio before the heat pipe netting was 61% while it grew up to 70% in 2013.

○ PCB Peak Load Boiler whose heat production cost is high was at a high rate of 31% in 2005 while it was 16% in 2013.

○ Especially, since it supplied heat in conjunction with the heat generated at sewage treatment facilities run by local authorities such as Seoul, Yongin and etc., new and renewable heat has grown from 8% up to 14%.

○ Consequently, the general heat production cost decreased and heat charge was reduced to 4.9% in 2012, alleviating people's financial burden.

② Great Energy Savings in 2013

○ The energy amount saved in 2013: 634,178 Gcal

○ The energy converted amount saved: 704,643 Gcal

○ The amount of energy savings (based on LNG): 7751 million㎥

○ Reduction of Residential Heating Expense: 39,391,000 EURO

[KDHC's annual heat generation performance and composition by heat source]

(1000*Gcal)

| | | Year 2005 | Year 2009 | Year 2013 |
|---|---|---|---|---|
| CHP | | 6,626 | 7,158 | 9,110 |
| IncineratorWaste Heat | | 929 | 1,655 | 1,637 |
| PLB (Peak Load of Boiler) | | 3,373 | 2,770 | 2,055 |
| Solar Heat | | - | 0.4 | 0.4 |
| Biogas | | - | - | 20 |
| Sewage Heat | | - | 4 | 120 |
| Total | | 10,928 | 11,595.4 | 12,942.4 |
| Ratio (%) | CHP | 61 | 62 | 70 |
| | PLB | 31 | 24 | 16 |
| | New & Renewable | 8 | 14 | 14 |

③ The performance of CO2 emission units following energy saving through metropolitan heat pipe networks

The following table shows performance of CO2 emission units following energy saving due to conjoined metropolitan heat pipe networks

[Annual status of greenhouse gas emission per apartment house]

| Year | Greenhouse emissions | Use of Energy | Emission Units |
|---|---|---|---|
| '05 | 2,010 | 800 | 2.51 |
| '09 | 6,556 | 2,953 | 2.22 |
| '13 | 9,709 | 4,490 | 2.16 |

○ In 2005, CO2 emission unit per apartment house supplied with heat was 2.51 while the emission indices as of 2013 rapidly lowered.

④ Long-term Plan of Metropolitan Pipeline Networking (2015-2025)

○ KDHC had a central managing system (from 2009 to 2013) by building a network among business units

○ From 2015, KDHC plans to initiate Metropolitan Pipeline Networking Project that links to other heat suppliers. For example, we plan to build a networking heat service for Yeouido district, which is one of KDHC's heat services in Seoul, and Mokdong district 4km off Yeouido district. Currently, Mokdong district is run by Seoul City and so KDHC will discuss with Seoul City to provide this heat networking service. Like this, KDHC, based on 5-year experience, has a long-term plan to build a heat service network with Seoul, Incheon, Kyunggi Province and Uijeongbu.

⑤ Expansion and propagation of District cooling by District Cooling refrigerator for buildings

○ From 1992, KDHC has made an effort to propagate District Cooling. During the summer season, District Cooling can be possible by providing hot water of more than 100 degrees. However, supply of more than 100℃ heat showed high rate of heat loss in the situation of low heat demands in summer. So, KDHC developed an absorption refrigerator for District Cooling in 2008 and it was developed so as to operate District Cooling even on the 90℃ heat in summer. In addition, from 2009 to 2014 KDHC was trying to expand the District Cooling as follows.

○ In 2012, power peak demands were reduced by 540,724KW. (Effects of investment evasion instead of power plant investment costs for new construction, 7.56 billion won)

[Annual status of building supplied with district cooling]

| | 2009 | 2010 | 2010 | 2012 | 2013 |
|---|---|---|---|---|---|
| Buildings | 532 | 552 | 630 | 697 | 849 |
| Capability(USRT) | 319,437 | 333,722 | 413,602 | 461,369 | 513,192 |

○ Compared with individual A/C units (using electricity), district cooling has excessive investment costs, so charges for district heating heat was 70% discounted, and 10% of investment cost for cooling facilities was subsidized.

○ This leads to a yearly increase in the number of buildings connected to District Cooling.

⑥ The First Asian "Desiccant district cooling" (refer to Attachment #1) in the area of apartments

○ In the area of apartments, it's difficult to expand the District Cooling by the existing absorption refrigerator. So, new method (Desiccant Cooling) has been used from 2008.

○ It developed and distributed a "Desiccant district cooler" to enlarge district cooling in the sector of apartment houses. This desiccant district cooler is the first kind in Asia as well as Korea, contributing regional cooling distribution.

○ Especially, it developed ''desiccant district coolers" that require less costly investment, and demonstratively installed at 40 households in 2012 for future full-blown distribution.

○ "Desiccant district coolers" of this kind have not been developed anywhere else in the world.

○ KDHC plans to supply 2,000 apartment houses with district cooling until 2018.

○ Effect of Desiccant Cooling System

A. Energy Conservation

a) Required electricity (the same for air-conditioner)

- Cooling capacity (7Kw)

| | Desiccant district cooling | Electric air- conditioner |
|---|---|---|
| The amount of electricity used | 1.39kW | 2.66kW |

b) 48% lower than electric air-conditioner

B. Improvement of indoor environment / health enhancement

a) 5 merits: cooling, desiccation, ventilation, anti-bacterial effect and deodorization
b) Analysis of indoor air pollutant reduction
- (after 3 hours) VOC* 74%, 90% of Formaldehyde, 97% of fine dust were removed.

* VOC (Volatile Organic Compound): one of the most representative carcinogenic substances.

c) It was confirmed that this system reduces indoor air pollution for vulnerable facilities (e.g. day care center and kindergarten) and is very effective.
- More excellent in removing VOC, floating germs and radon than existing air-conditioners
- It was confirmed that this system is effective in reducing allergic diseases of young child and infant.

Thank you

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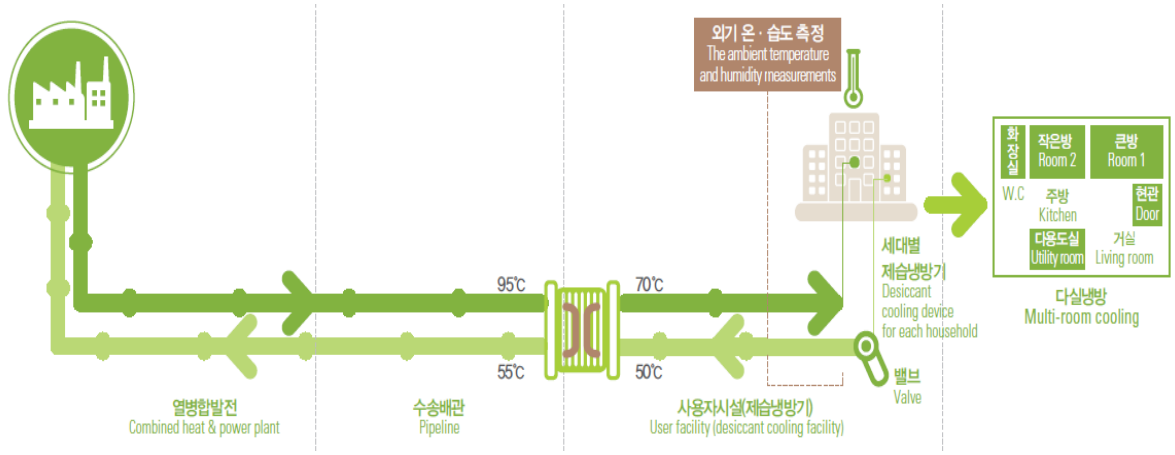
**Attachment # 1**

**Summary of Desiccant District Cooling**

1. Desiccant District Cooling : Concept

A system of air-conditioning households in apartments in residential area using the hot water generated at the centralized cogeneration plant or incinerator, via the existing district heating pipes.



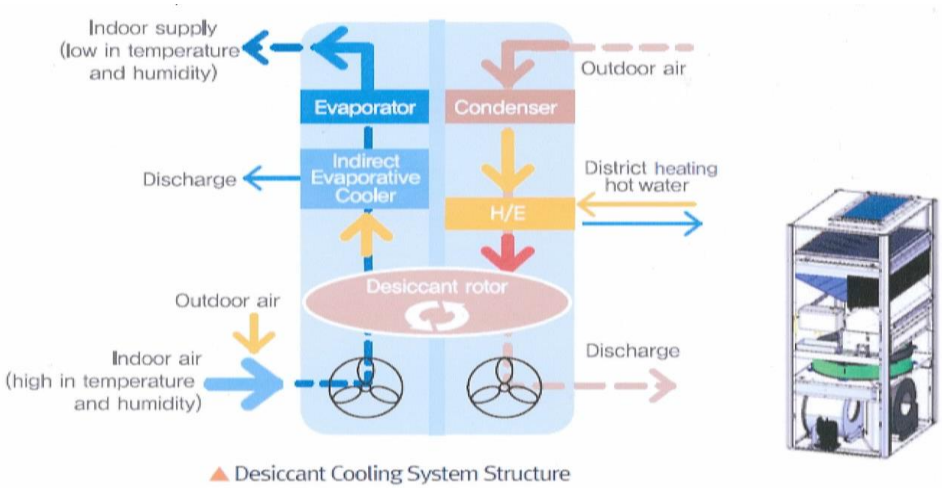

2. Principles

1) Desiccation part

the air mixed witr the hot & humid indoor air and the outdoor air becomes dry as it runs through the desiccating rotor, and is instantly cooled in the indirect evaporative cooler by the principle of latent evaporative heat.

2) Regeneration part

continues to reheat the water absorbed into the desiccating rotor using the hot water provided as part of district heating



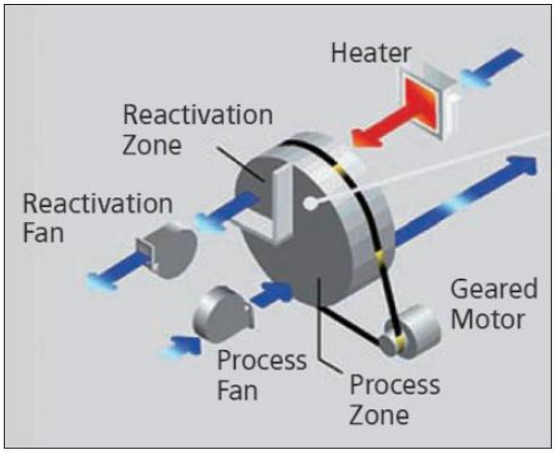

▲ Desiccant Cooling System Structure

3. Principles of Desiccation

1) The hot and humid indoor air becomes dry as it runs through the desiccating rotor, which removes humidity and moisture from the air before supplying it indoors.

2) The water absorbed by the desiccating rotor is discharged via the regenerator unit.

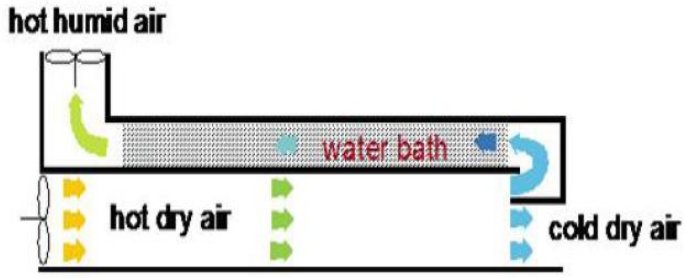
3) The desiccating rotor is operating continuously as it repeats the absorption-regeneration cycle

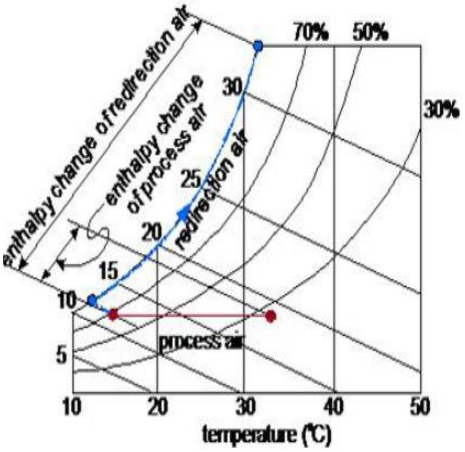



4. Principes of Indirect Evaporative Cooling

1) Part of the air dyied(30%) in the desiccating rotor enters the wet channel.

2) The wet channel sprays the water so as to instantly cool the hot dry air that runs through the dry channel by principles of evaporation latent heat cooling.



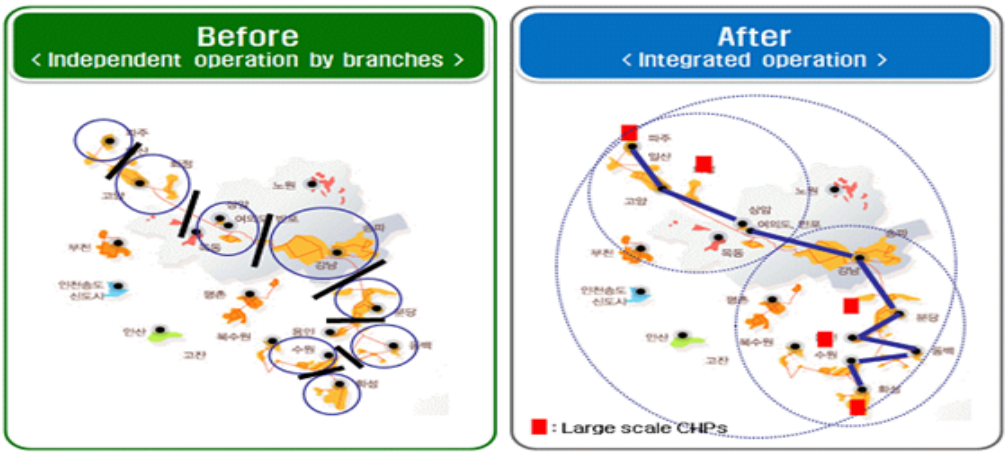



**Attachment #2**

# KIOC Intro.

## KIOC is KDHC Integrated Operation Center, which is for

- Unification of independent operation work divided by branches
- Economical operation by scientific and strategic analysis
- Realtime monitoring for all facilities of whole branches
- Improvement of operation efficiency and facilities' stability




# KIOC Purpose

## Cost reduction

- Optimum production of heat and electricity by scientific analysis
- Increase of connecting heat energy among branches by efficient management

## Facility stability enhancement

- Quick response in emergency by real-time monitoring
- Establishment of systematic management plan for facilities

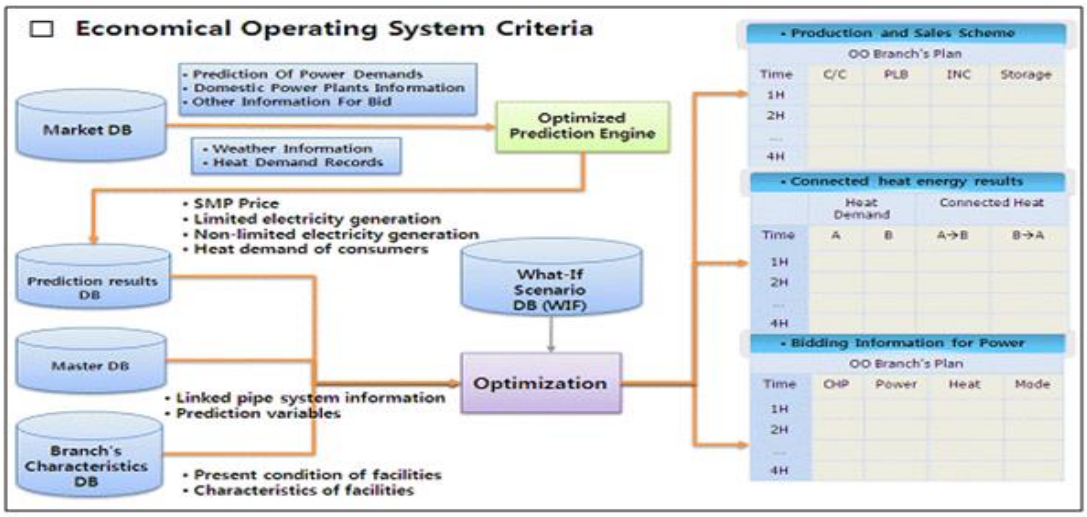
## Work efficiency improvement

- Work simplification by automatic data management
- Improvement of data utilization by offering various operation records

# KIOC Main Function

## Economical Operation System

- Establishment of optimum production and sales plan by prediction of heat and electricity demand
- Offering various information for efficient facility operation




## Realtime Monitoring System

- Realtime monitoring of facilities in whole branches and quick response in emergency
- Realtime comparison between target value by economical operation system and actual value by facilities' operation

## Records Management System

- Showing various operation data collected from whole branches
- Operation data management through search and statistics, analysis


## Electricity Trading System

- Electricity trading by prediction for electricity market
- Bid, change, calculation for electricity trading