

# **Dry Solid Sorbent CO<sub>2</sub> Capture Project of 10MWe Scale**

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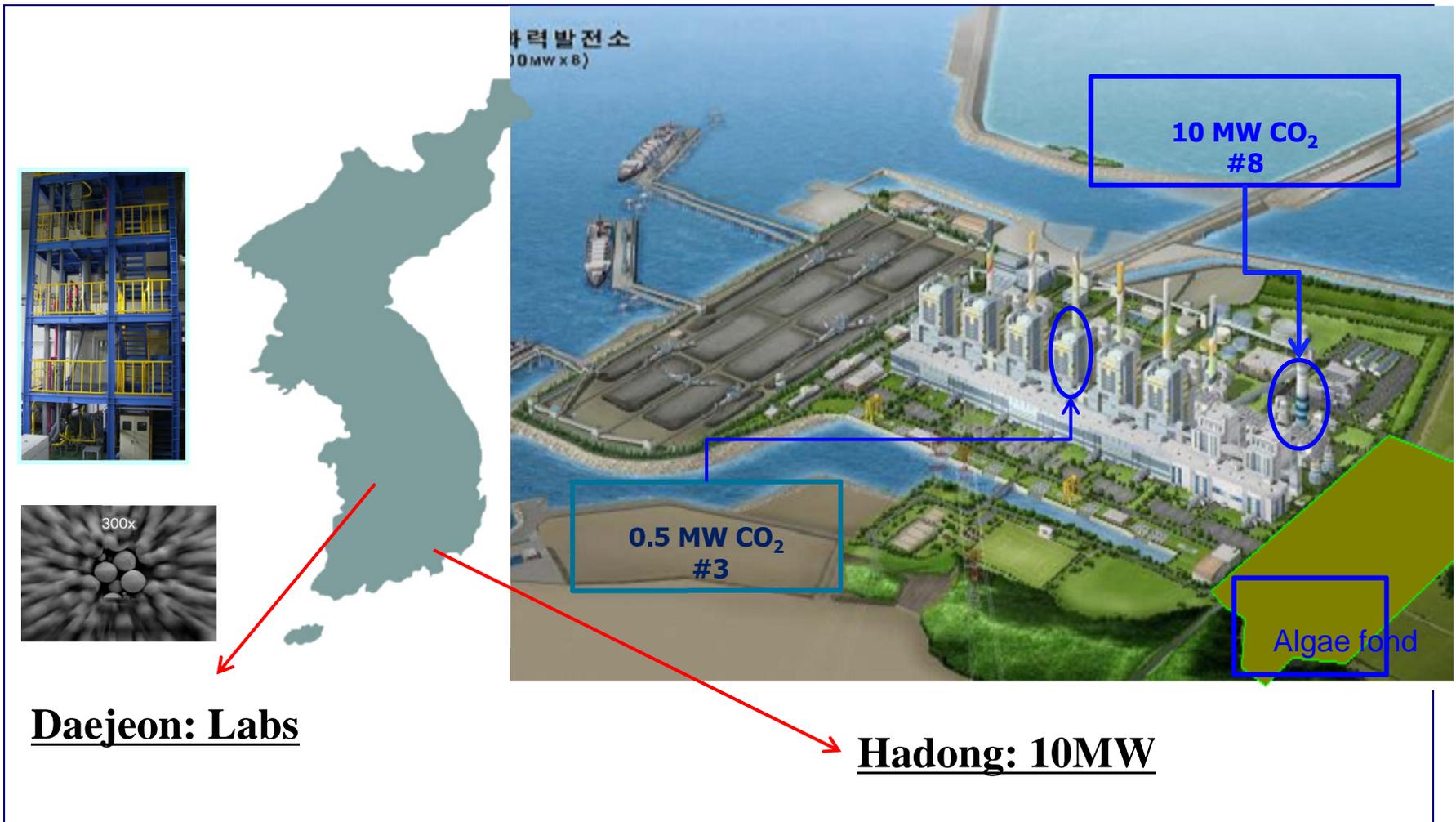
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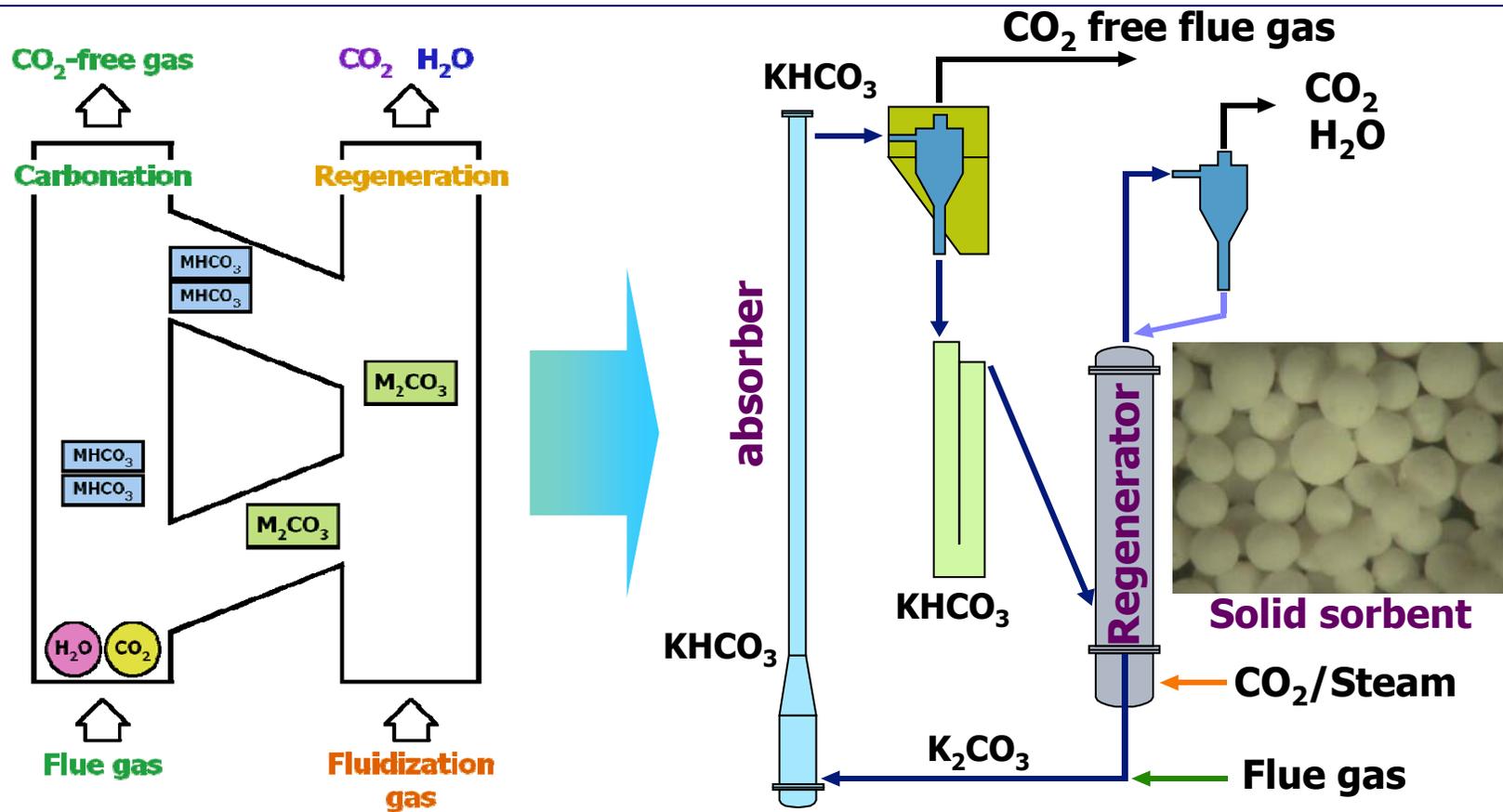
**Carbon Sequestration Leadership Forum**

**Nov. 1~5, 2015**

# Locations: Hadong & Daejeon, Korea



# Post CO<sub>2</sub> Capture by Dry Solid Sorbent



# Characteristics of Dry Solid Sorbent

## Carbonation



$$\Delta H = -3.25 \text{ GJ/tCO}_2$$



Operating temperature: 40-80°C

- No Volatile
- No waste water
- Little Corrosion

- Easy to control heat for exothermic reaction

## Regeneration



$$\Delta H = 3.25 \text{ GJ/tCO}_2$$



Operating temperature: 140-200°C

- Recover high-concentrated CO<sub>2</sub> after condensing H<sub>2</sub>O

- Use waste heat, steam for endothermic reaction

- Solid sorbents for fluidized-bed applications
  - High sorption capacity
  - High mechanical strength

# Outline of Project

## Title

- **Dry solid sorbent CO<sub>2</sub> capture project of 10 MWe scale**

## Goal

- To operate and optimize 10 MWe pilot plant by dry solid sorbent to decrease 20% energy penalty and 20% capital cost

## Period

- ~ May. 2018

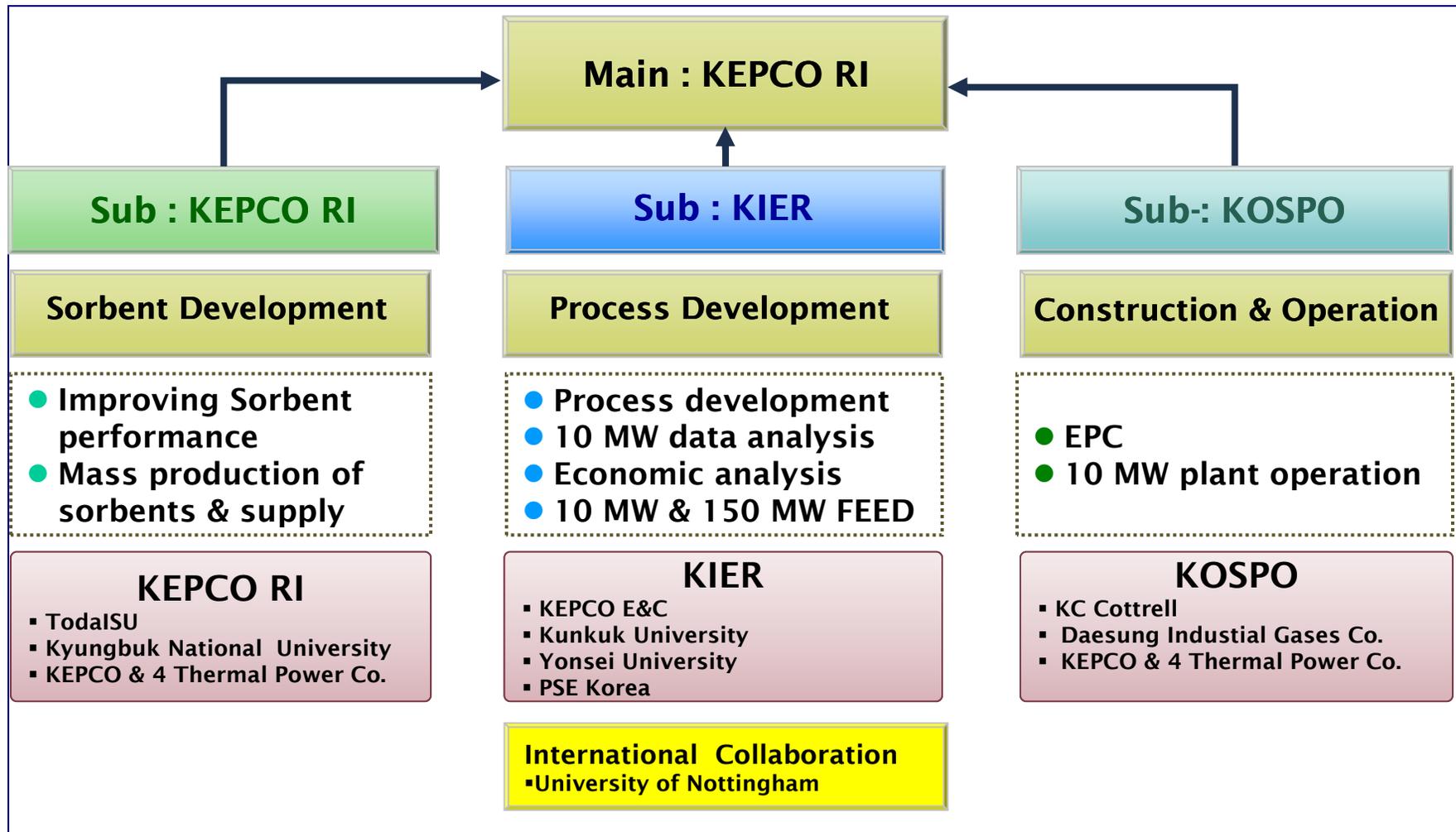
## Objectives

- To demonstrate the feasibility of dry CO<sub>2</sub> capture technology
- To optimize the 10MWe-scale CO<sub>2</sub> capture process

## Anticipated Outcomes

- CO<sub>2</sub> capture cost target: <\$40/tCO<sub>2</sub> captured
- 200 tCO<sub>2</sub>/day CO<sub>2</sub> capture rate with more than 95% CO<sub>2</sub> purity
- >160 days operation annually

# Project Structure

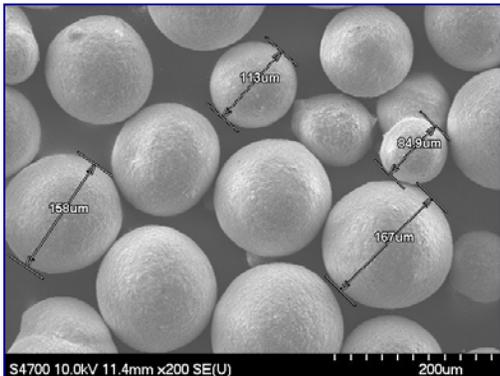


# Project Participants



# Sorbent

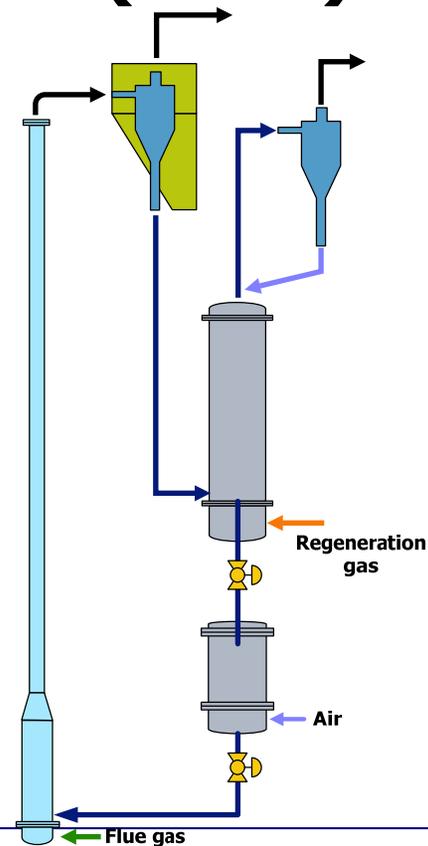
- ◆ **Dry sorbent has been developed by Korea Electric Power Research Institute (KEPCO RI)**



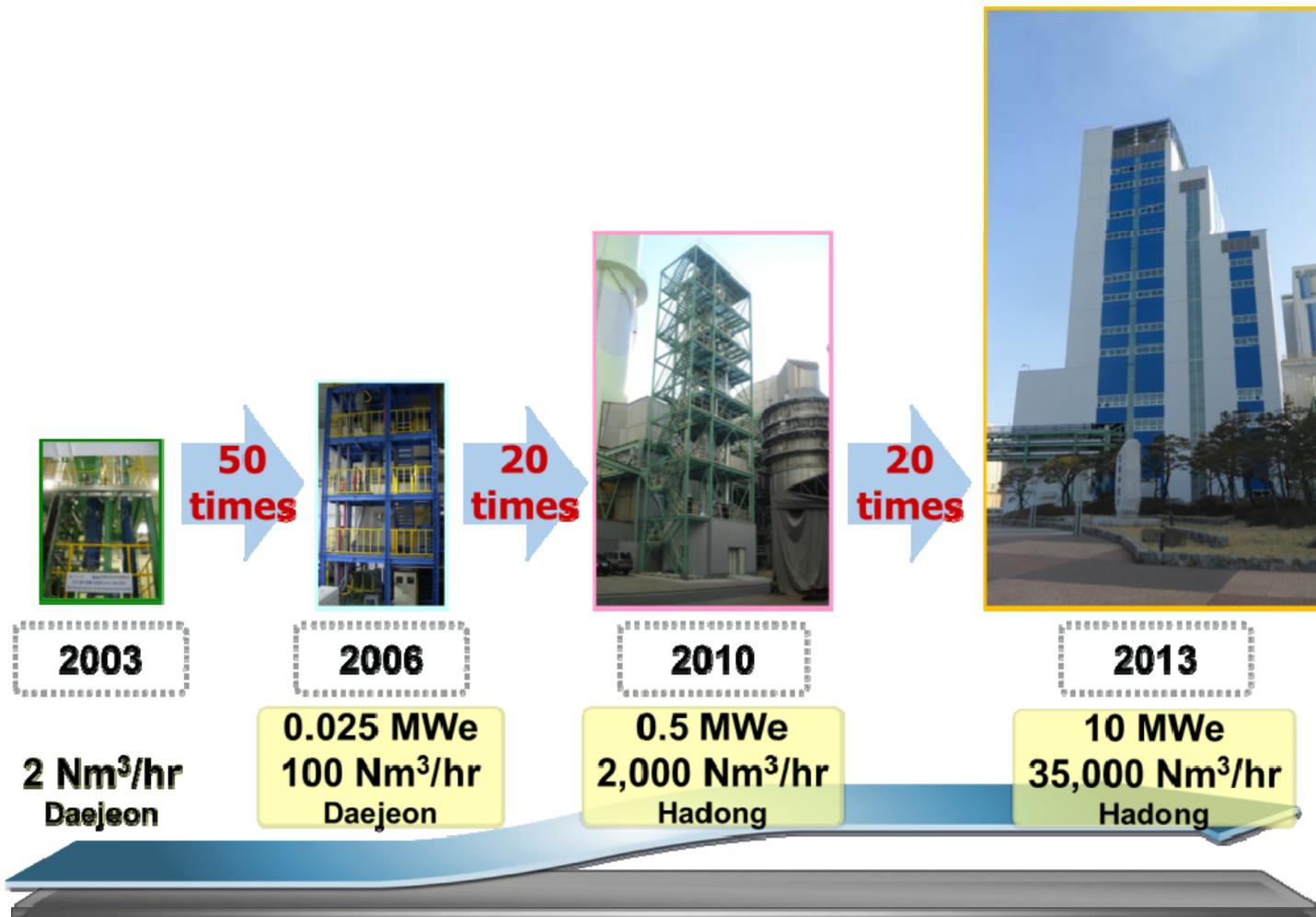
|                                |   |
|--------------------------------|---|
| Sorbent name                   | KEPCO2P2<br>(by KEPCO RI)                             |
| Composition                    | <b>35% <math>K_2CO_3</math></b><br><b>65% support</b> |
| Mean particle size [ $\mu m$ ] | <b><math>\sim 100</math></b>                          |
| Bulk density [ $g/cm^3$ ]      | <b><math>\sim 0.9</math></b>                          |
| ASTM attrition loss [%]        | <b>2 ~ 8</b>  |

# KIERDRY<sup>®</sup> Process

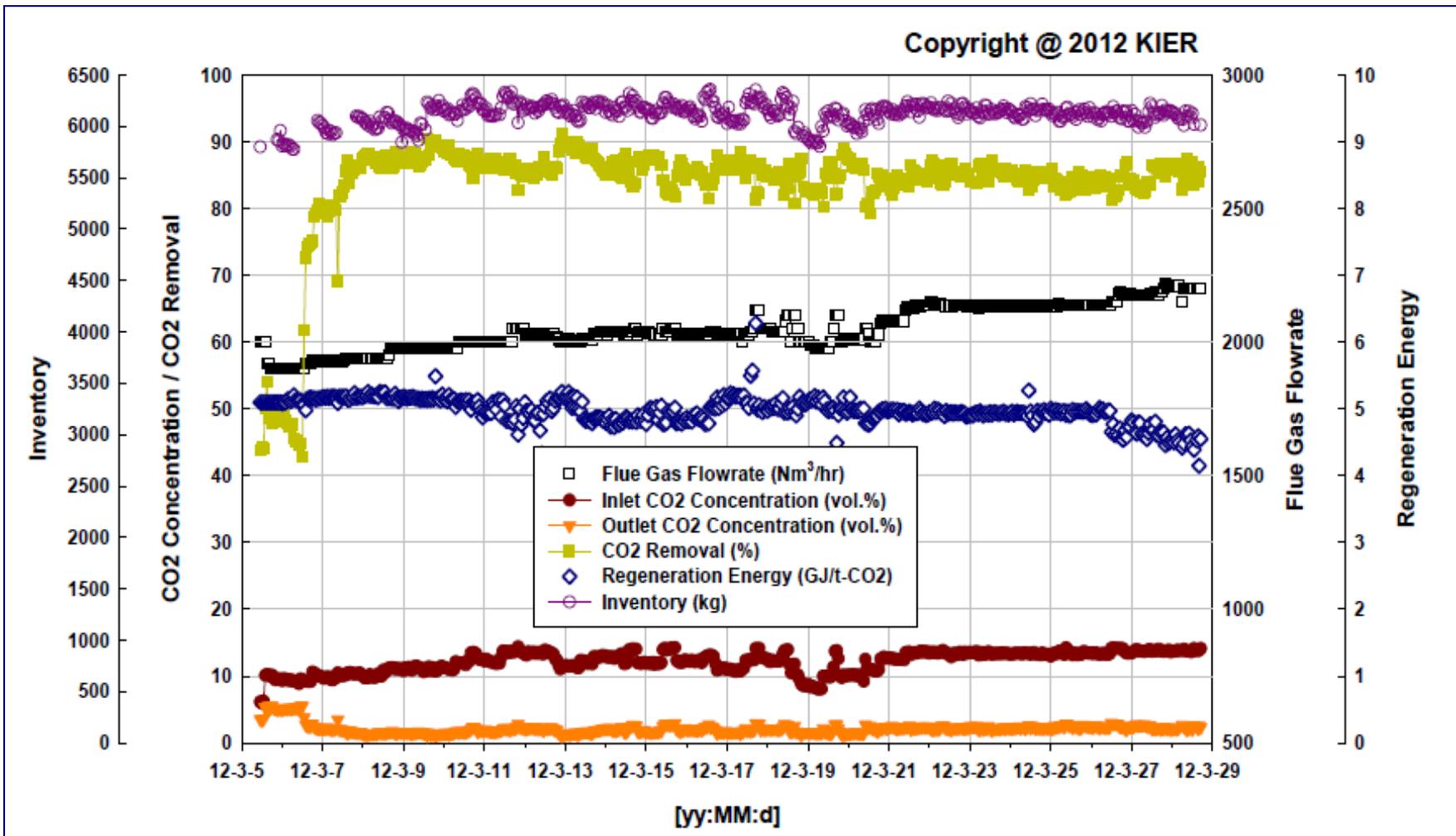
- ◆ Process has been developed by Korea Institute of Energy Research (KIER)



# Process Development History

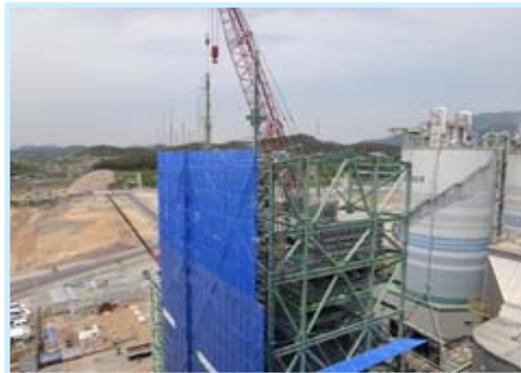


# 30-day Campaign: 0.5MW test bed



# KOSPO's 10 MW Pilot Plant Construction

- Integrated with KOSPO's Hadong thermal power station (Unit #8)
- Starting construction (Aug. 2012)
- Completing construction (Oct. 2013)
- Test operation (October, 2013 ~ June, 2014)
- Long-term continuous operation



Cyclone



Regenerator



Main Boosting Fan



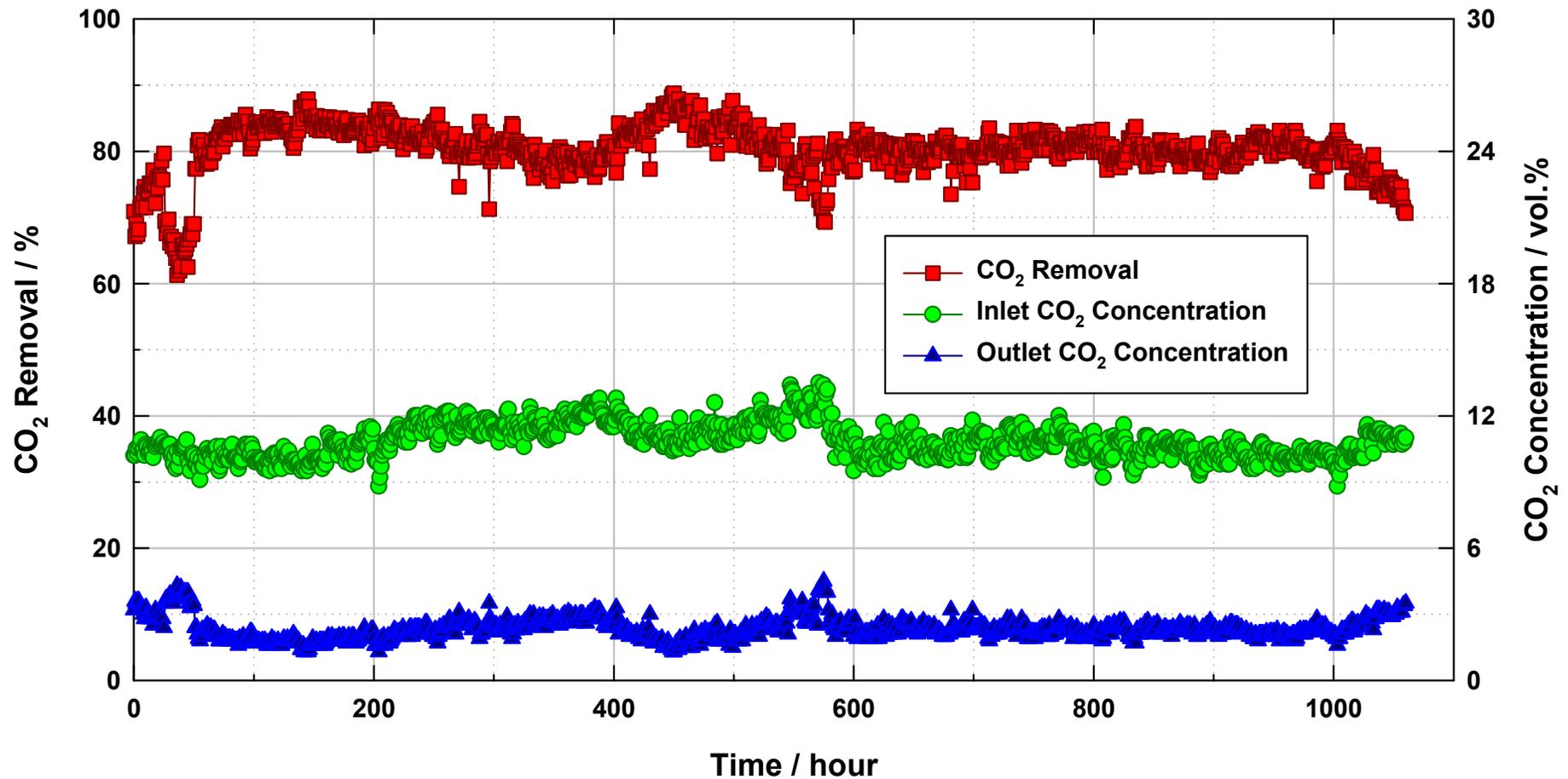
Riser

# 10MW Hadong Dry CO<sub>2</sub> Capture Plant



# 10MW Pilot Plant: Long-term Operation

Pilot Unit – CO<sub>2</sub> Removal Performance



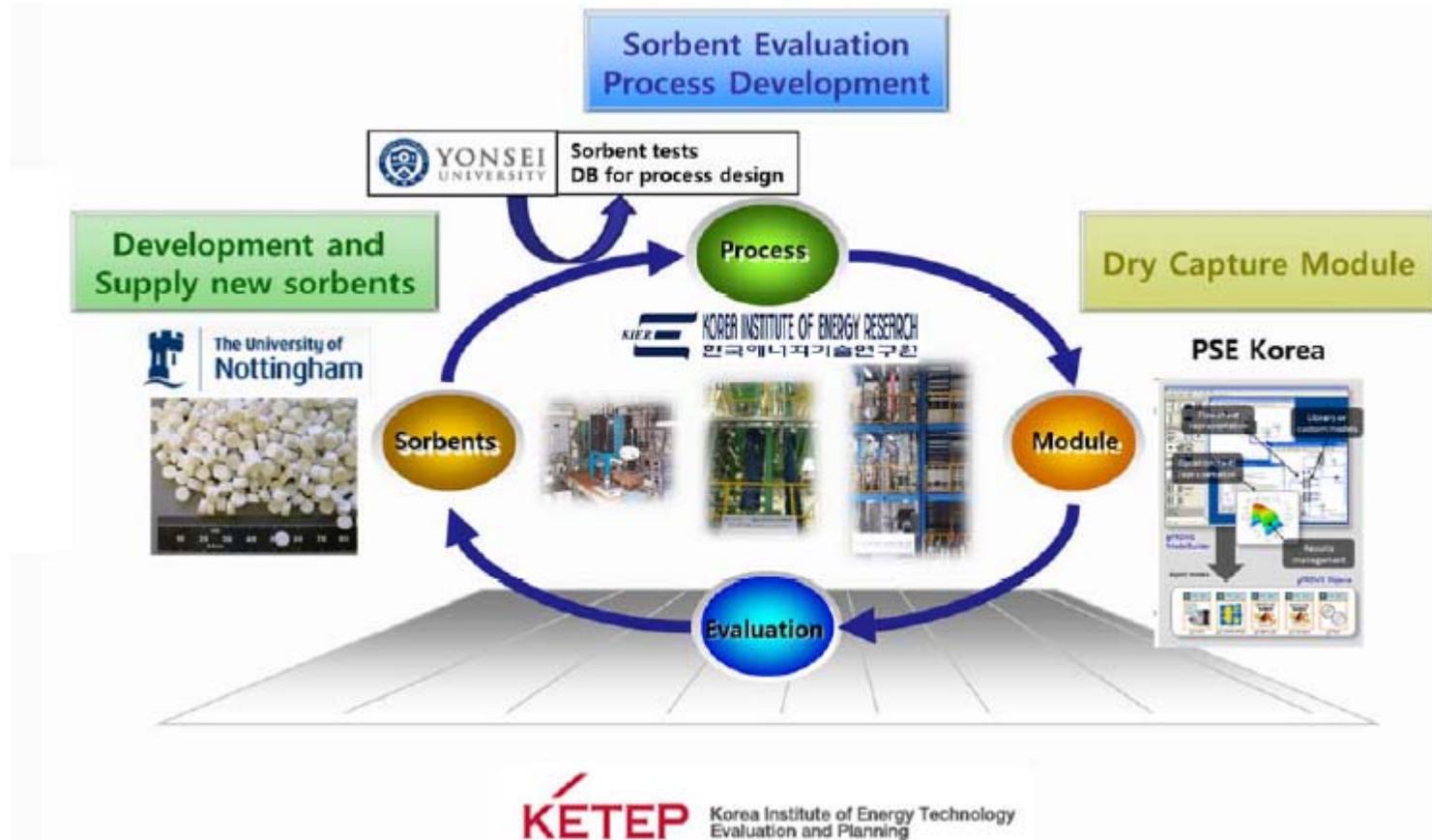
# 10 MW Dry Solid Sorbent Process



**10 MW Pilot Plant at KOSPO's Hadong coal-fired power plant, Unit # 8**

- ❑ **Scale: 10 MW slip-streamed from 500 MW coal-fired power plant(SC)**
- ❑ **Capacity: 200 tCO<sub>2</sub>/d**
- ❑ **Flue gas: coal-fired boiler**
- ❑ **Sorbent: KEP-CO2P2**
- ❑ **Achievement**
  - **> 80% CO<sub>2</sub> capture rate**
  - **95% CO<sub>2</sub> purity**
  - **Completed 1000 h continuous operation**
- ❑ **Targets:**
  - **20% capital cost reduction**
  - **20% cost reduction (<US\$ 40/tCO<sub>2</sub>)**
- ❑ **Startup: October, 2013**
- ❑ **Plot area: 34 (L) x 15 (W) x 59 m(H)**
- ❑ **Location: Hadong, Korea. KOSPO's Hadong Thermal Power Station (unit #8)**

# International Collaboration



# Vision

## ◆ Improvements in process and sorbent

|   | $K_2CO_3$ | $K_2CO_3 \cdot 1.5H_2O$ | PEI-Silica* | K-AC SALT* |
|---|-----------|-------------------------|-------------|------------|
| Heat of Reaction<br>(GJ/tonCO <sub>2</sub> )        | 3         | 1                       | 1.5         |            |
| Total steam consumption<br>(GJ/tonCO <sub>2</sub> ) | 5         |                         | 2.2         | 0.6        |

\*Ref.: Univ. of Nottingham

- ◆ Platform for the dry solid sorbent technology development
- ◆ Role of dry solid sorbent technology as the next generation technology

# Thank You !

