Dry Solid Sorbent CO_2 Capture Project of 10MWe Scale

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Carbon Sequestration Leadership Forum
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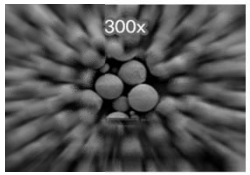
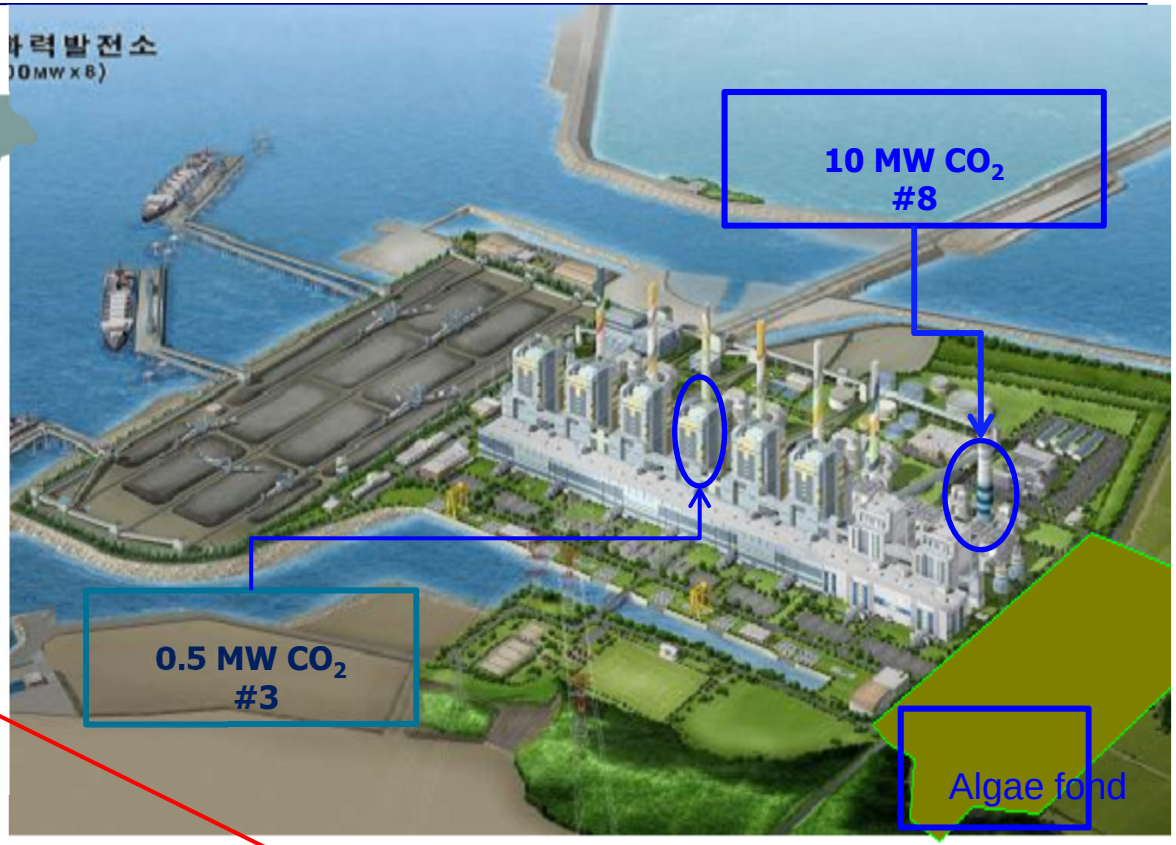
Locations: Hadong & Daejeon, Korea

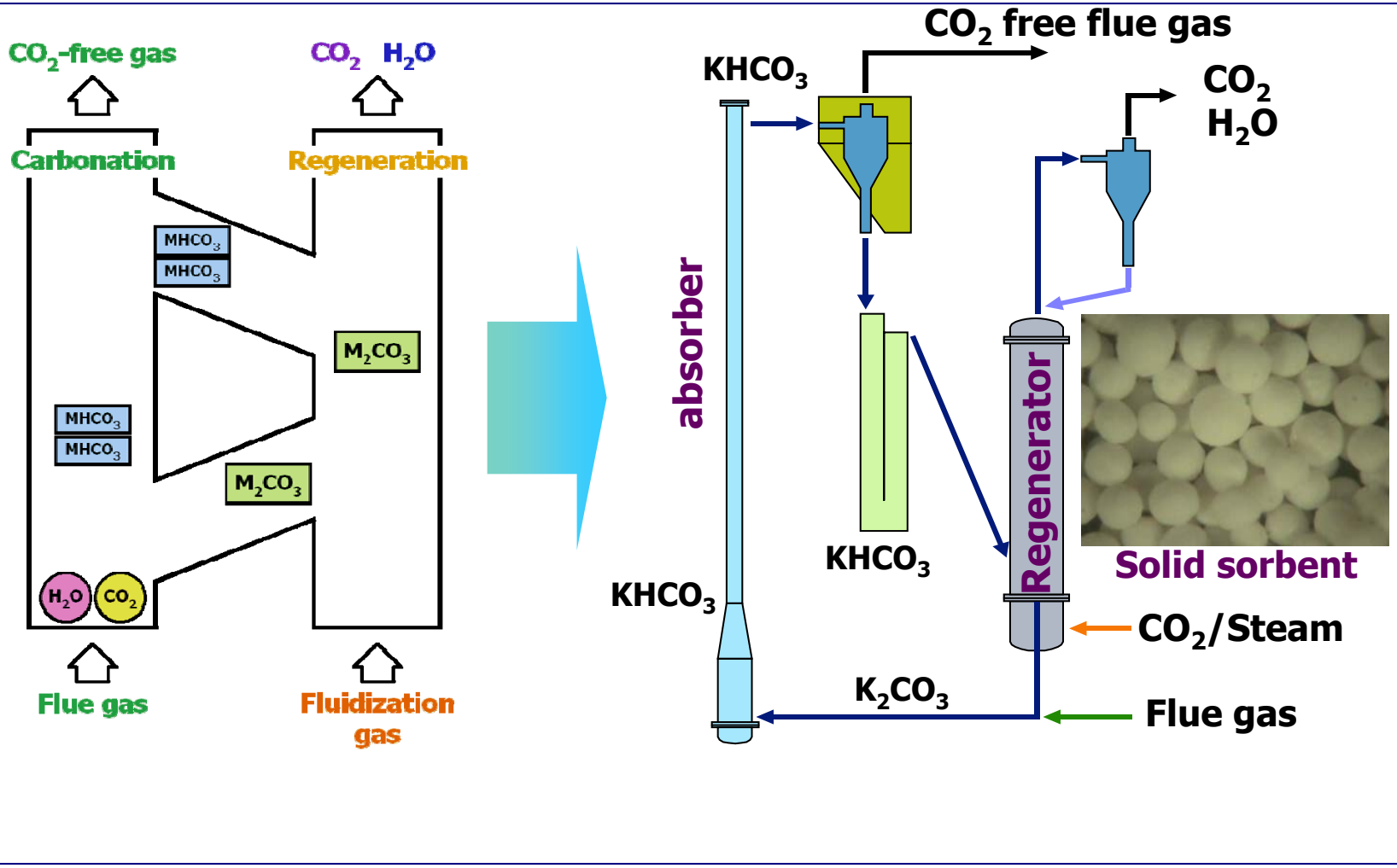




Daejeon: Labs

Hadong: 10MW

Post CO_2 Capture by Dry Solid Sorbent



Characteristics of Dry Solid Sorbent

Carbonation

$K_2CO_3(s)+CO_2(g) + H_2O(g) \rightarrow 2KHCO_3(s)$
$\Delta H = -3.25\ GJ/tCO_2$
$K_2CO_3 \cdot 1.5H_2O(s) + CO_2(g) \rightarrow 2KHCO_3(s) + 0.5\ H_2O(g)$, $\Delta H = -1.0\ GJ/tCO_2$

Operating temperature: 40-80°C

- No Volatile
- No waste water
- Little Corrosion

- Easy to control heat for exothermic reaction

Regeneration

$2KHCO_3(s) \rightarrow K_2CO_3(s)+CO_2(g)+H_2O(g)$
$\Delta H = 3.25\ GJ/tCO_2$
$2KHCO_3(s) + 0.5\ H_2O(g)) \rightarrow K_2CO_3 \cdot 1.5H_2O(s) + CO_2(g)$, $\Delta H = 1.0\ GJ/tCO_2$

Operating temperature: 140-200°C

- Recover high-concentrated CO_2 after condensing H_2O

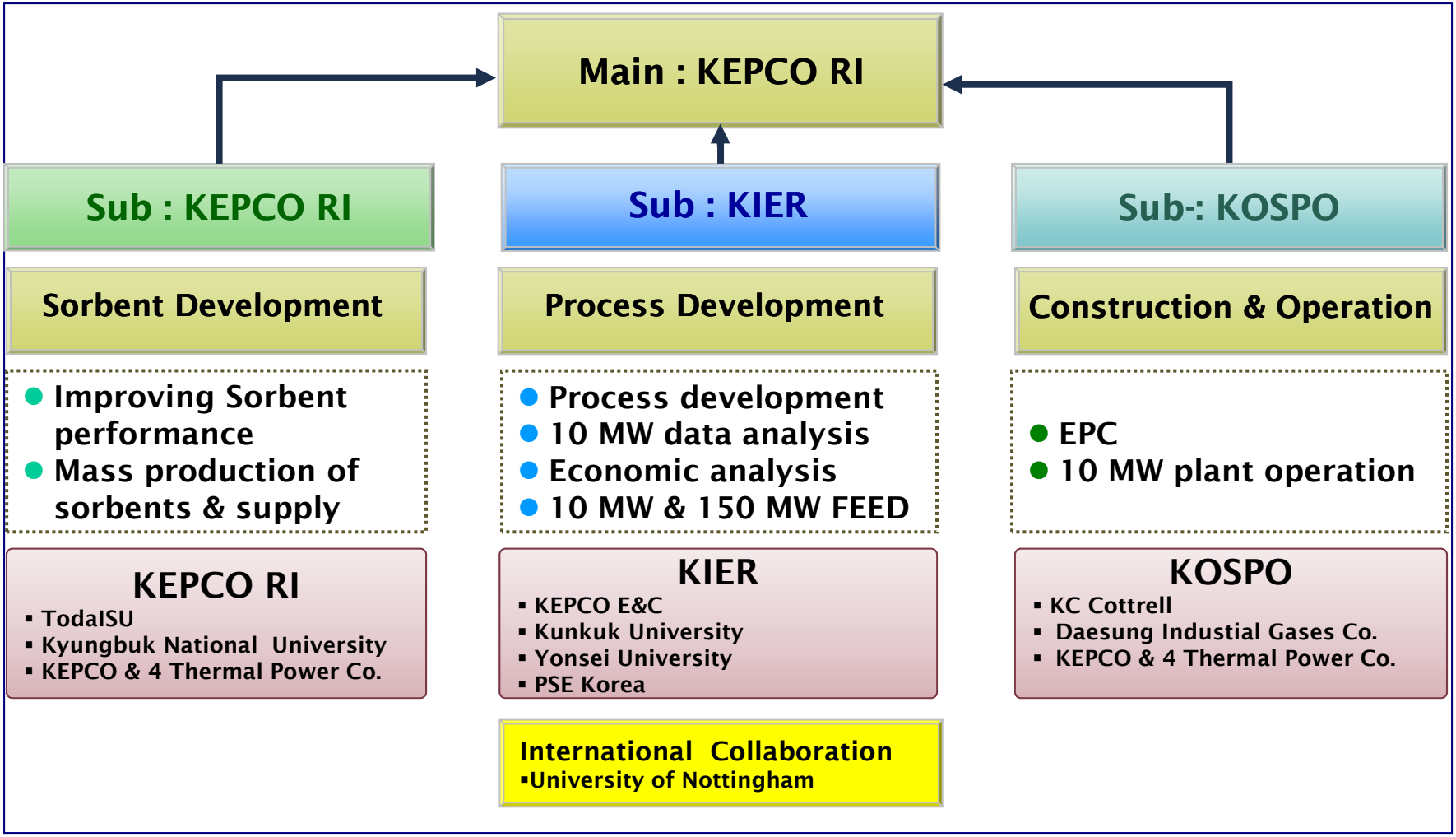
- Use waste heat, steam for endothermic reaction

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

Outline of Project

Title	▪ **Dry solid sorbent CO_2 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_2 capture technology ▪ To optimize the 10MWe-scale CO_2 capture process
Anticipated Outcomes	▪ CO_2 capture cost target: <$40/t$CO_2$ captured ▪ 200 tCO_2/day CO_2 capture rate with more than 95% CO_2 purity ▪ >160 days operation annually

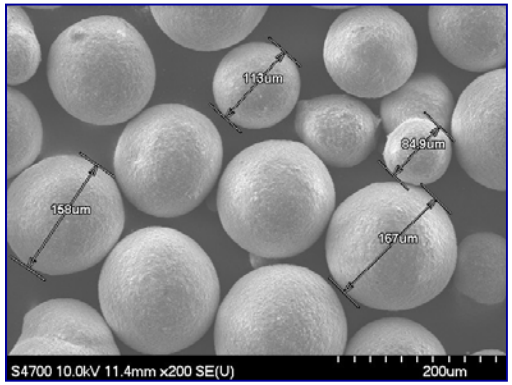
Project Structure



Project Participants

Sorbent

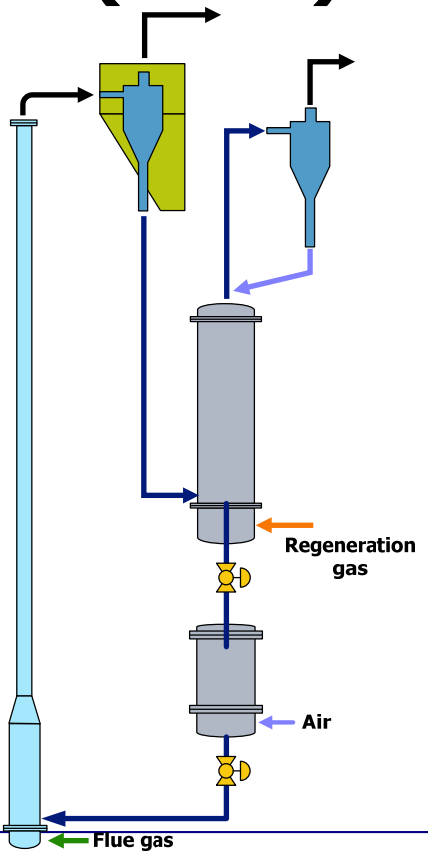
- **Dry sorbent has been developed by Korea Electric Power Research Institute (KEPCO RI)**



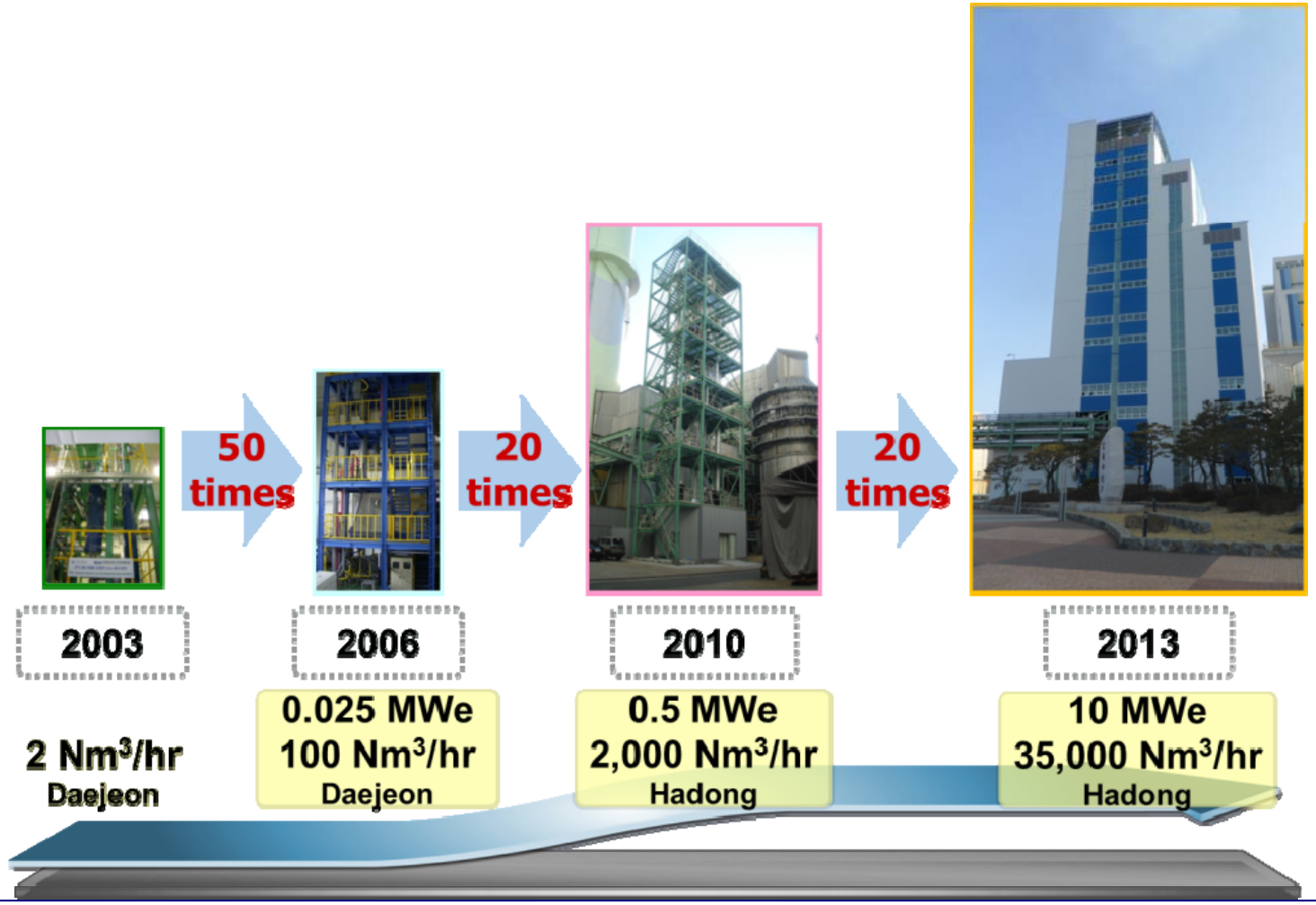
Sorbent name	KEPCO2P2 (by KEPCO RI)
Composition	**35% K_2CO_3 65% supporters**
Mean particle size[㎛]	**~100**
Bulk density [g/㎤]	**~0.9**
ASTM attrition loss [%]	**2 ~ 8**

KIERDRY® Process

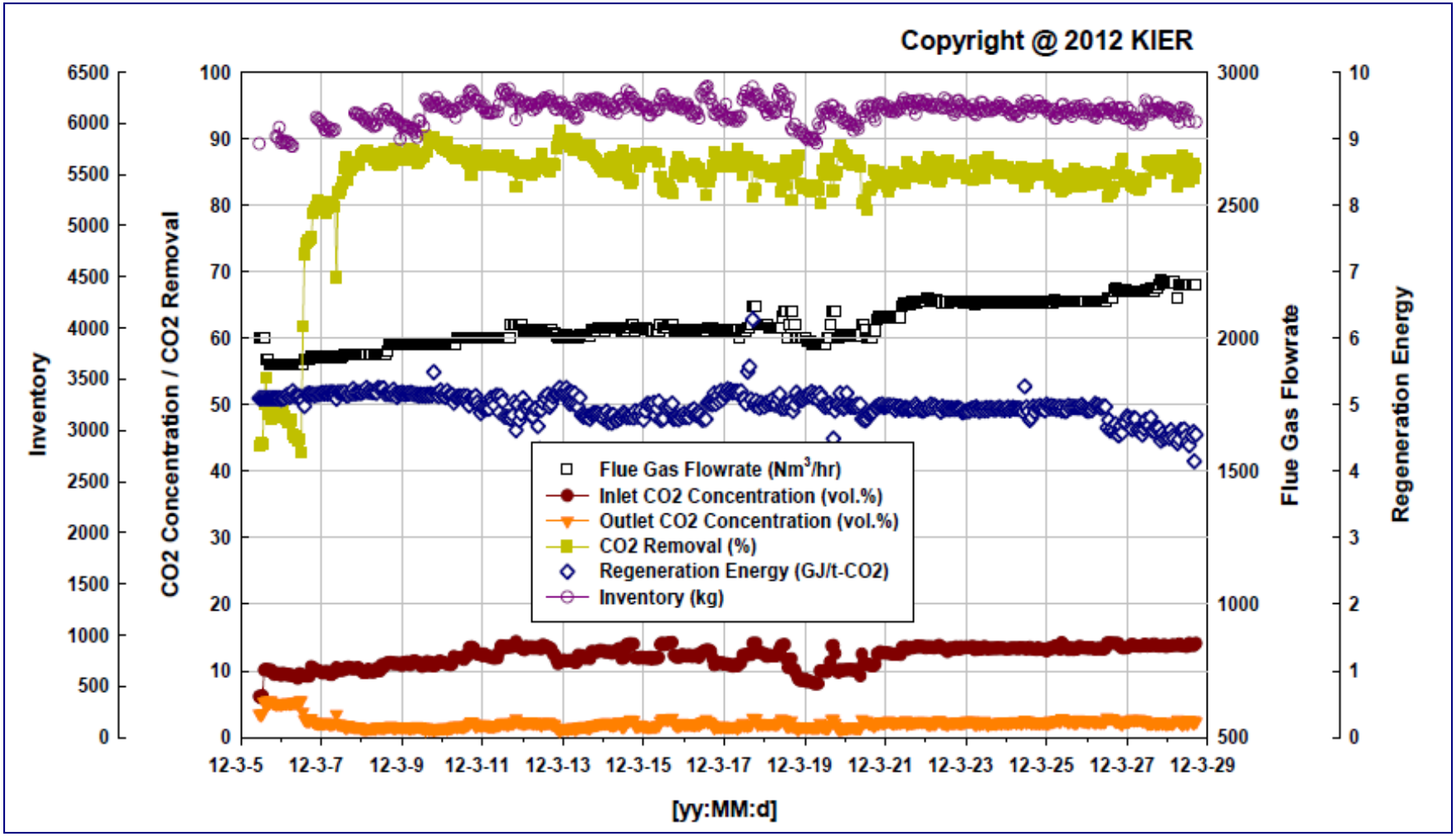
- **Process has been developed by Korea Institute of Energy Research (KIER)**



Process Development History

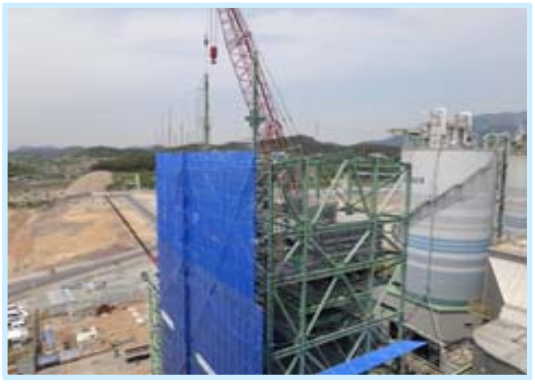


30-day Campaign: 0.5MW test bed



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



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10MW Hadong Dry CO_2 Capture Plant

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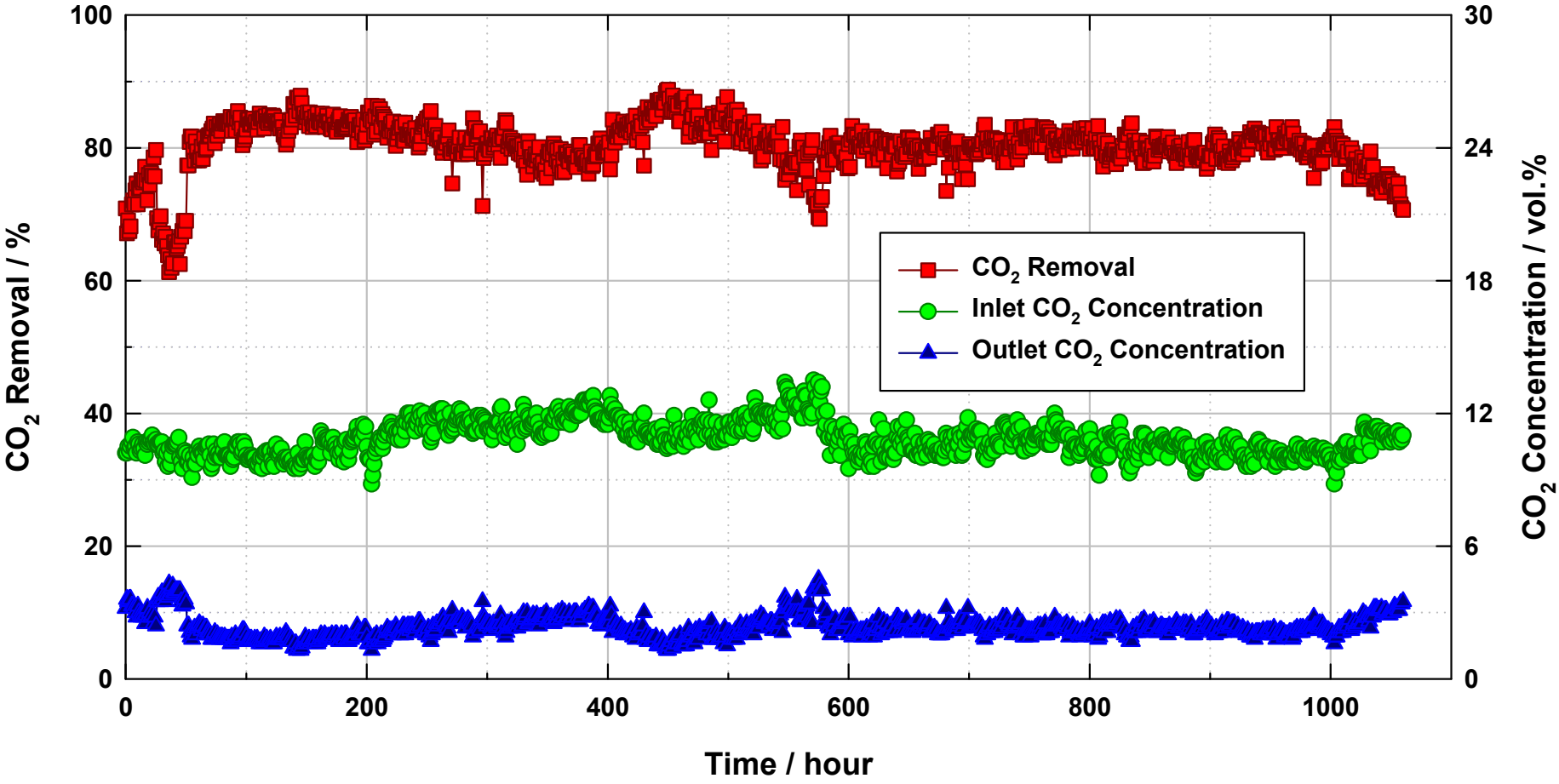
10MW Pilot Plant: Long-term Operation

Pilot Unit – CO_2 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_2/d
- Flue gas: coal-fired boiler
- Sorbent: KEP-CO2P2
- Achievement
  - > 80% CO_2 capture rate
  - 95% CO_2 purity
  - Completed 1000 h continuous operation
- Targets:
  - 20% capital cost reduction
  - 20% cost reduction (<US$ 40/tCO_2
- 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)

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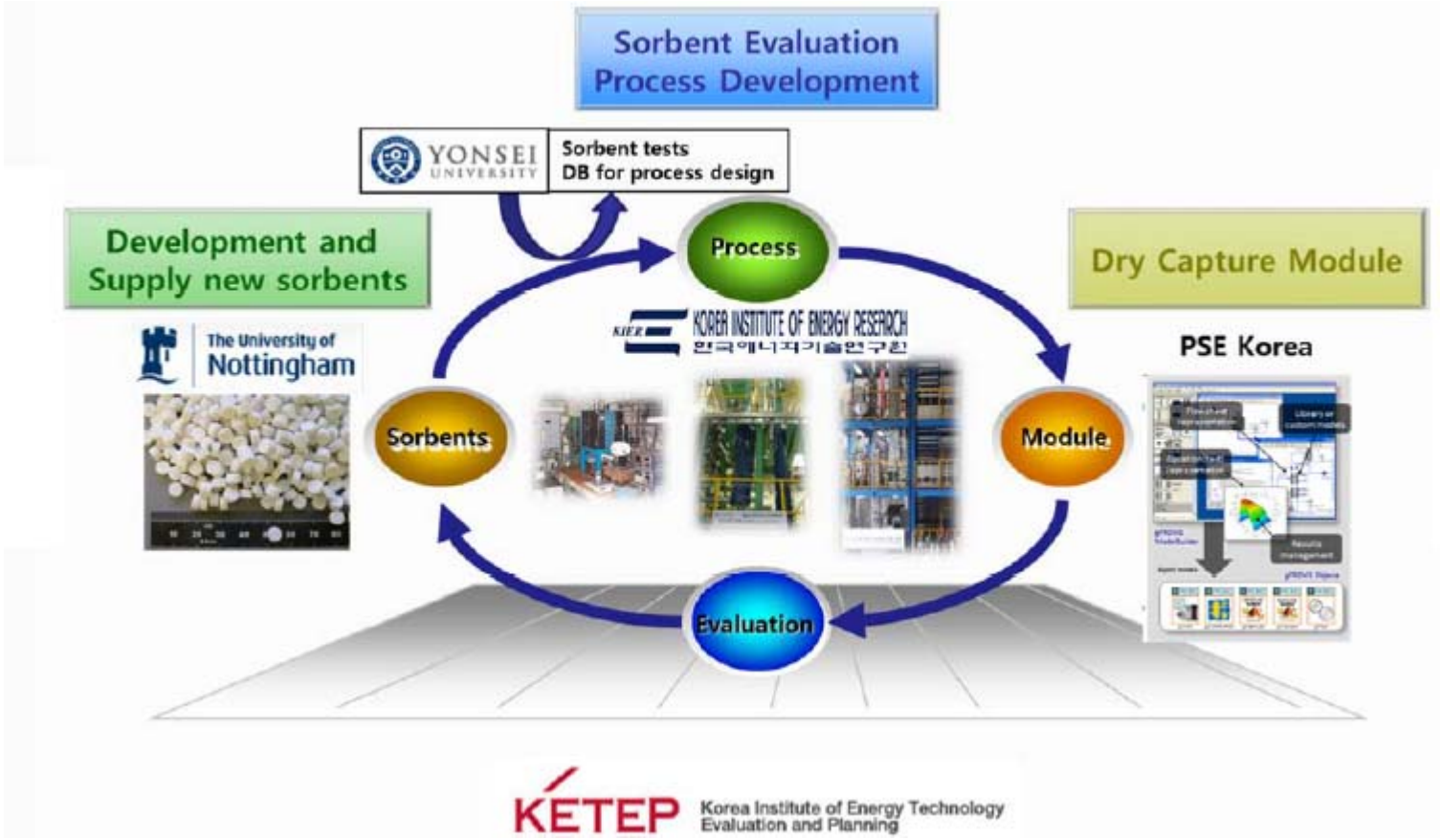
International Collaboration



Vision

- **Lots of sorbents have been developing in the world**

	K_2CO_3	PEI-Silica	K-AC SALT
Heat of Reaction (GJ/tonCO_2)	3	1.5	
Required Regeneration Heat (GJ/tonCO_2)	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 3rd generation technology**

Thank You !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