

# Role of Government R&D Project in CO<sub>2</sub> Reduction Technology Development:

## **Case of 21C Frontier CDRS Project in Korea**

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# OUTLINE

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## **Introducing Korean Government Programs on CO<sub>2</sub> Reduction Technology R&D**

**1. Government R&D Programs on Energy**

**2. CDRS R&D Center and its R&D Program**

**3. New and Renewable Energy (NRE) R&D**

# CDRS Project ?

## ❖ PREVIEW

- Carbon Dioxide Reduction and Sequestration R&D Project
- 10-year project (2002 – 2011)
- Total 100M USD (\$75 M from gov, \$25 M from industry)

## ❖ TARGET (2012)

- CO<sub>2</sub> Reduction of 9 million TC per year (5%)
- Economic Effect of 1.2 billion USD per year (incl. indirect)
- Technology Level up to top 10 in the world
- Joining Global Research Network on CO<sub>2</sub> Reduction

# I. Government R&D Programs on Energy

## ❖ MOCIE (Ministry of Commerce, Industry and Energy)

### ● Energy R&D Program

- Since 1988, Total 36.2 million USD in 2004
- Energy Conservation Technology Program (21.2 mil USD)
- Clean Energy Technology Program (7.2 mil USD)
- energy Resource Development (7.8 mil USD)
- Direct Economic Effects estimated bigger than 80 times of government funding (1988-2003)

### ● New and Renewable Energy (NRE) R&D Program

- Since 2004 (2004-2012)
- Focus on Wind, Solar PV and Fuel Cell/Hydrogen, 210 million USD (2004-2008) for three R&D Centers, Biggest single R&D Program in Korea

# I. Government R&D Programs on Energy

## ❖ MOST (Ministry of Science and Technology)

- 21 C Frontier R&D Center Program (since 2000)
  - Focus on technology development for industry
  - 15 centers so far, 75 million USD per center(10 year)
  - Two energy-related projects :  
**CDRS** , Hydrogen technology

- Nuclear Technology R&D Program (Since 1980's)
  - New Program for Hydrogen via Nuclear Tech (2005)

## ❖ MOE (Ministry of Environment)

- G7 Program (since 1998)
  - Clean Energy Technology Project
  - Focuses on Clean Coal Technology and High-efficiency Engine

# I. Government R&D Programs on Energy - Trends

## ❖ Two Themes of Government R&D for Carbon Dioxide Reduction

- Energy Saving & Efficiency Improvement (70%)
- New and Renewable Energy Development (30%)

## ❖ TRENDS

- Focusing more on New and Renewable Energy Technology than Energy Saving/Efficiency Improvement Techs
  - Establish new NRE Division in MOCIE (2004)
- Minimizing Impacts on Industry
- Using more Market Incentives (Demand-Pull)
- Technology Export ! (CDM)

## II. CDRS - CO<sub>2</sub> Reduction & Sequestration R&D Center - Intro

### ❖ MOST's 21C FRONTIER R&D PROGRAM

- 10-Year (2002-2011), 3-Phases (3+3+4)
- Center Director Organizes & Evaluates Research Teams
- Matching Fund from Industry Required :  
Among Total 100M USD, 25 M from industry (will increase)

### ❖ CDRS

- 4 Major Topics, 33 Research Teams, 297 researchers
  - Topics Selected by Energy-Intensive Industries and Gov.
- 10% teams will be Expelled after 1st phase
- 70% will enter Markets in 2nd phase, 30% in 3rd
- Policy Development Team included

## II. CDRS – Targets and Goals

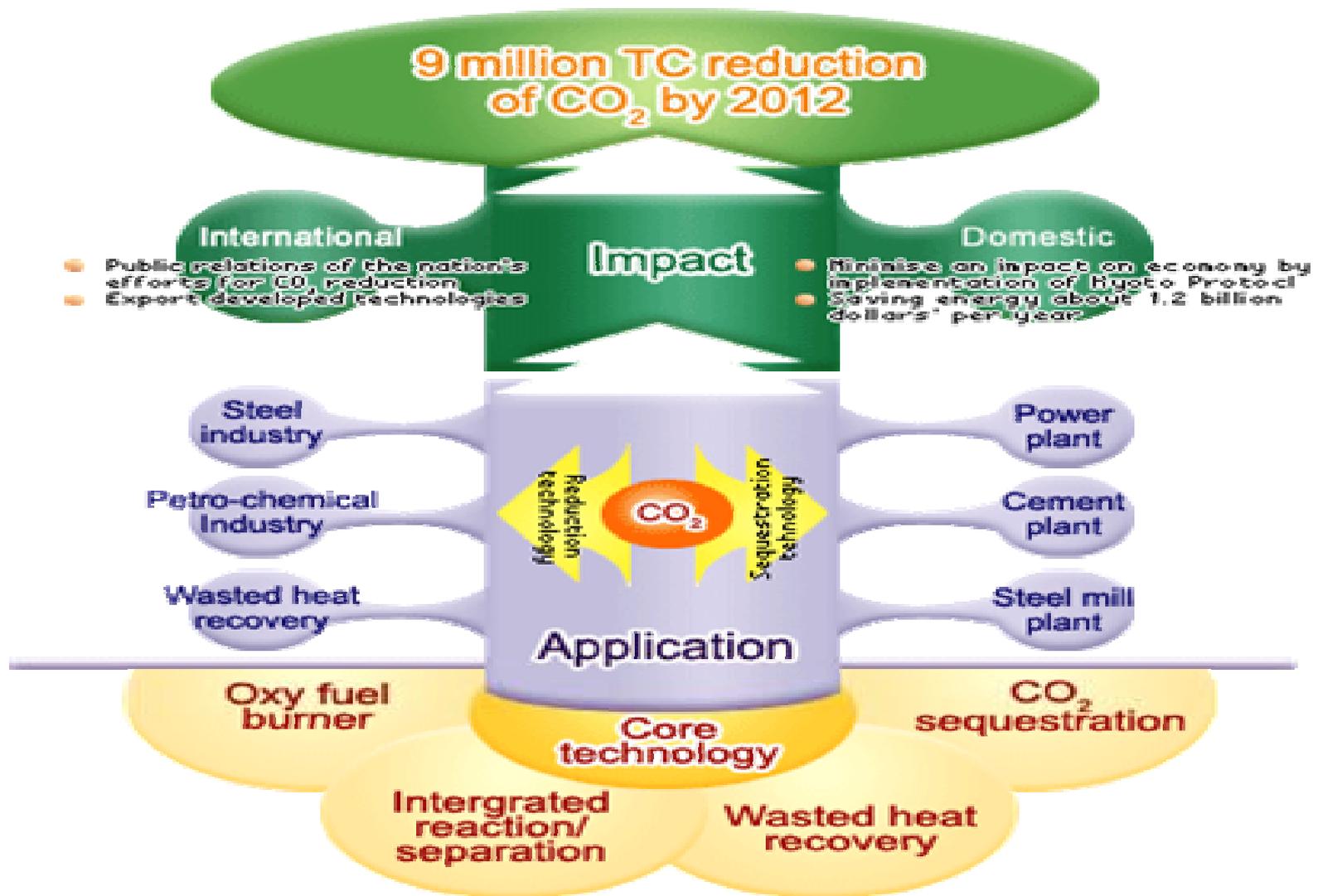
### ❖ R&D PROGRAM TARGET (2012)

- CO<sub>2</sub> Reduction of 9 million TC per year
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### ❖ TECHNOLOGY DEVELOPMENT GOAL

- 5% Reduction of total CO<sub>2</sub> Emission by 2012
- 30% Energy Efficiency Improvement for Energy-Intensive Industries like Petrochemical, Chemical and Steel
- Low Cost (10 USD/TC) Conversion Technology

## II. Final Targets of CDRS R&D Center



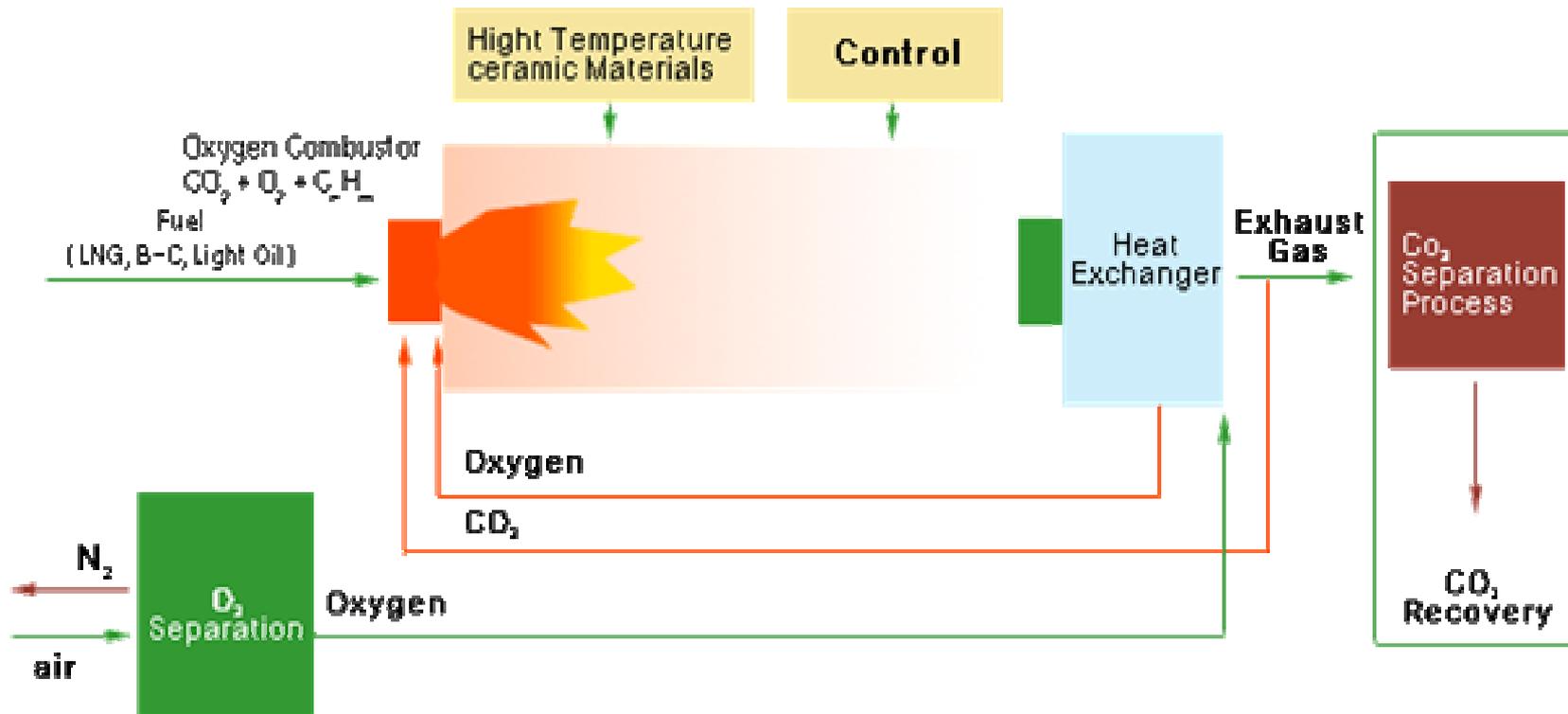
## II. CDRS – Research Topics

### ❖ 4 Major Research Topics :

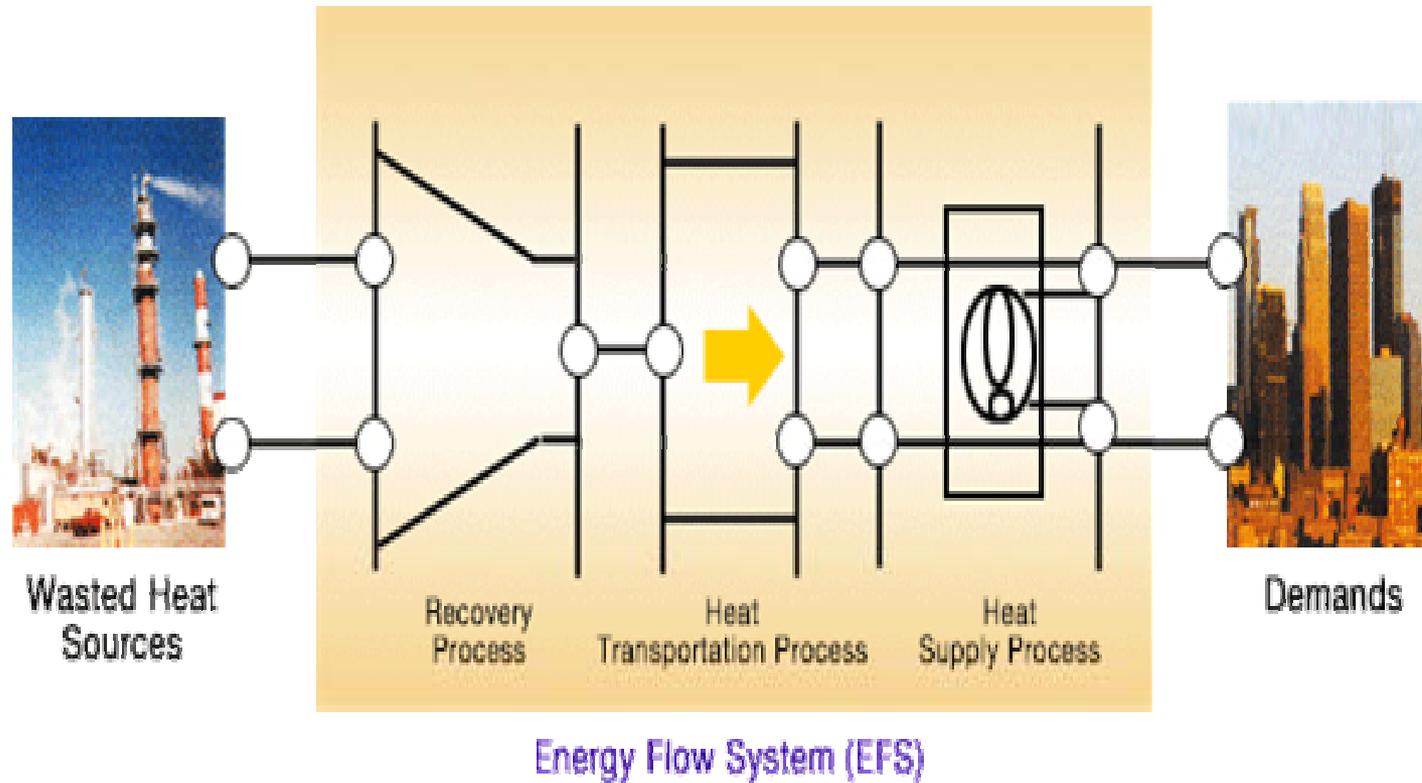
3 Reductions & 1 Sequestration (33 sub-topic research teams)

- 1. Oxy-Fuel Combustion System : 2M TC reduction
  - Steel Industry, system oriented
- 2. Wasted Heat-Recovery System : 4M TC reduction
  - Residential/Commercial Heating, system oriented
- 3. Integrated Reaction/Separation Process : 3M TC
  - Petrochemical Process, individual process
- 4. Sequestration : Separation/Sequestration/Conversion
  - Basic Research Stage

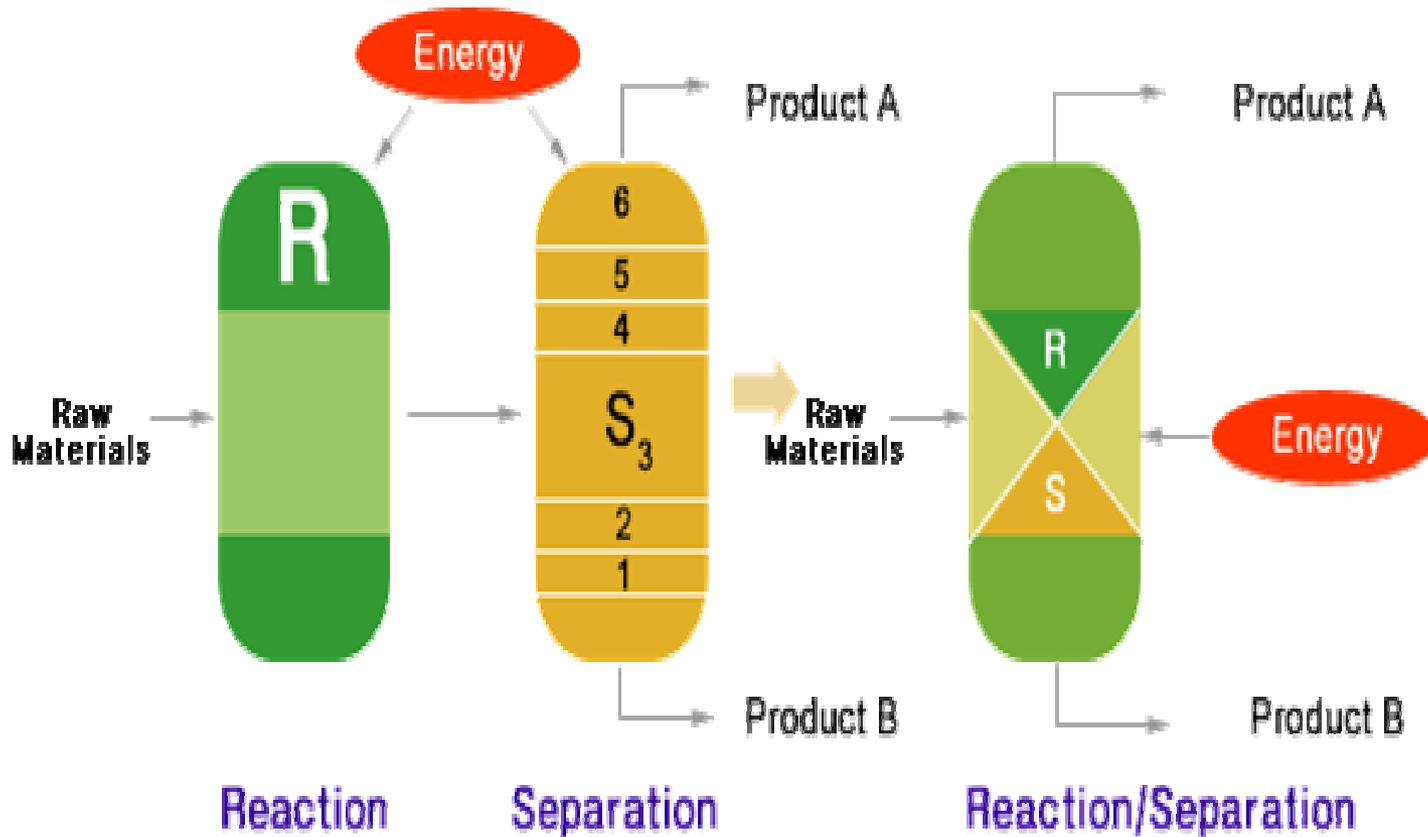
## II. Target System for Oxy-Fuel Combustion Topic



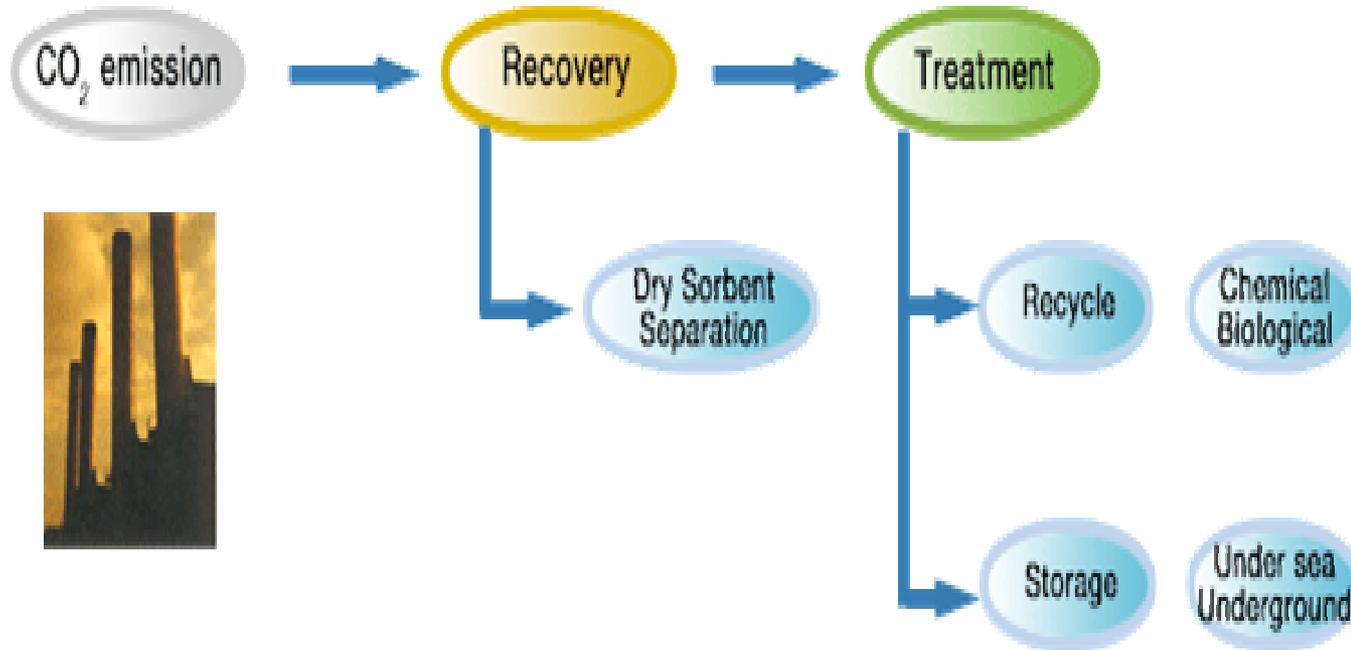
## II. Target System for Wasted Heat Recovery Topic



## II. Research Flow of Integrated Reaction/Separation Topic



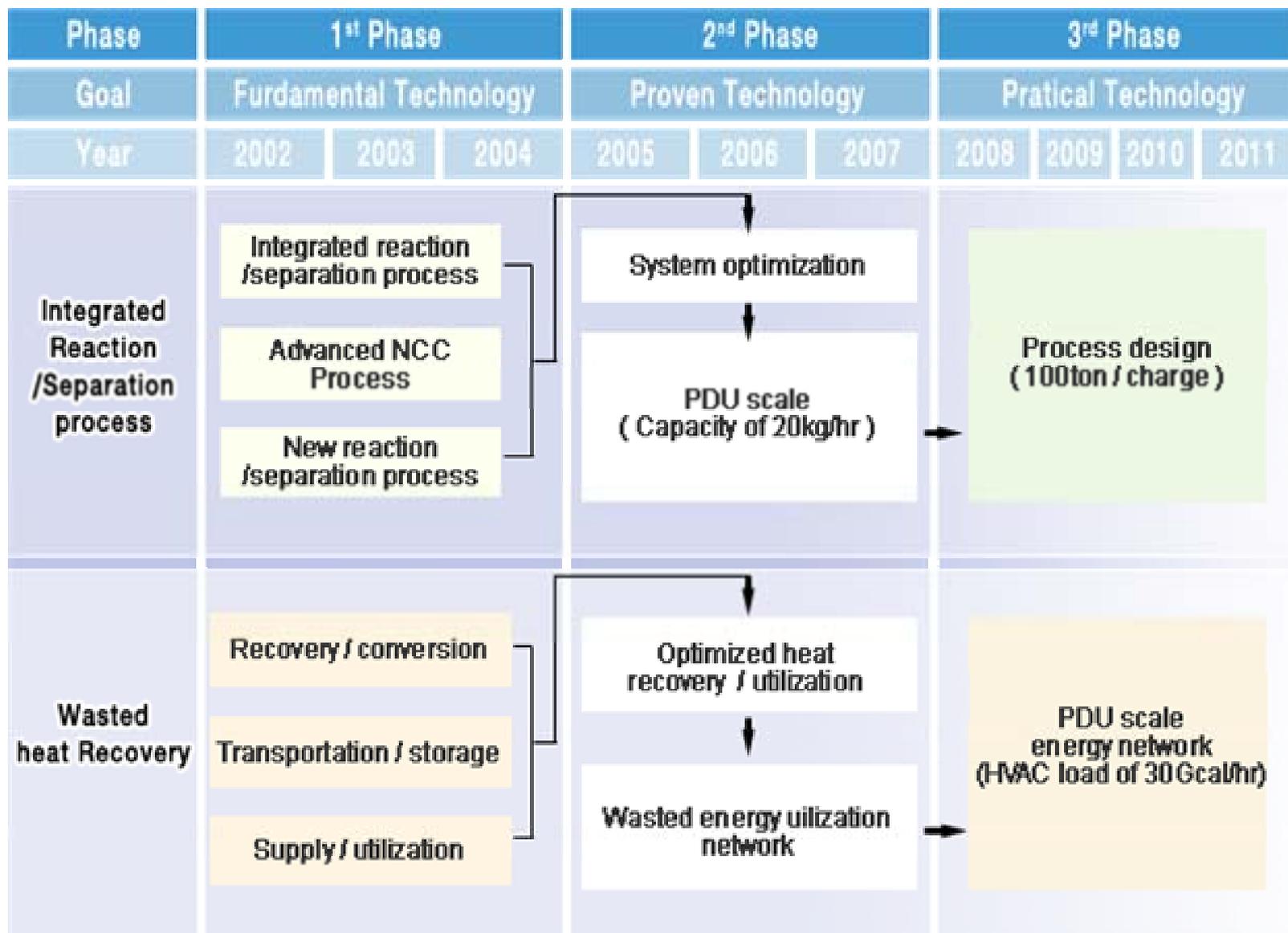
## II. Research Flow of CO<sub>2</sub> Sequestration Topic



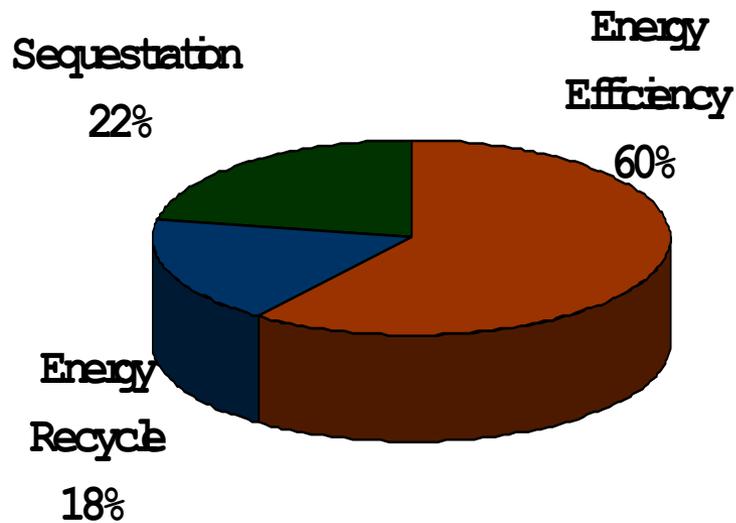
## II. Technology Roadmap of CDRS R&D Center

Phase	1 <sup>st</sup> Phase			2 <sup>nd</sup> Phase			3 <sup>rd</sup> Phase			
Goal	Fundamental Technology			Proven Technology			Practical Technology			
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Oxy-Fuel Combustion</b>	Low cost O <sub>2</sub> separation			PDU scale ( 3ton/day )			Process development of the capacity of 30 ton/day			
	Analysis and control of oxy-fuel combustion			Combustion system development ( 0.3MW )			Intelligent combustion system ( 2MW )			
	Ceramic materials for high temperature			PDU scale reheat furnace ( 20ton/day )			Intelligent reheat furnace ( 5ton/c charge )			

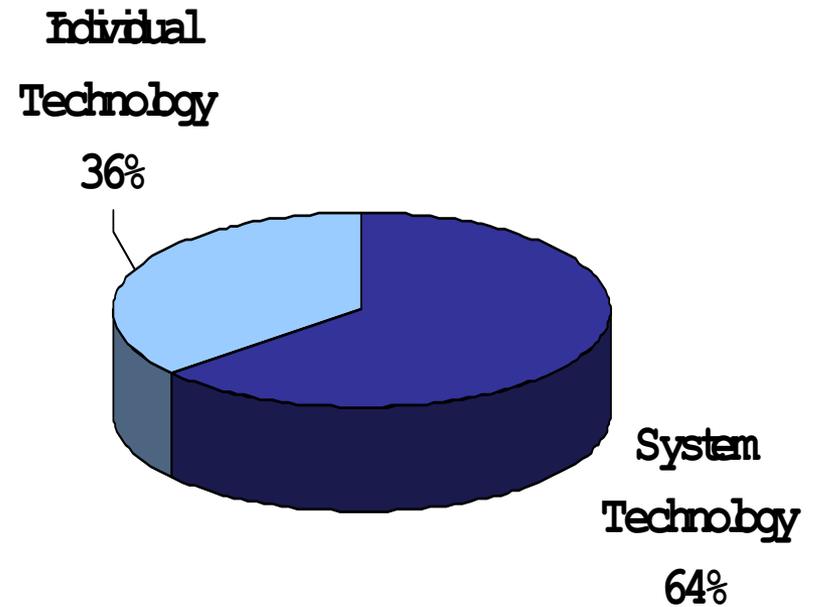
## II. Technology Roadmap of CDRS R&D Center



## II. Types of 33 Sub-Topics (Research Teams)



CO<sub>2</sub> Reduction Methods



Technology Types

## II. CDRS – This Year

### ❖ 1ST PHASE EVALUATION

- Evaluation Criteria & weights set  
via AHP (Analytical Hierarchy Process)
  - 4 major (Technical, Market, Production, and Social)
  - 15 sub, and 58 sub-sub categories
  - Biggest - Social, Lowest-Production
- Technology-Product-Consumer (industry) Diagram
  - Linkages among Tech Producers and Consumers
  - Helps to Keep researches on Target
  - Survey to Proposed Consumer scheduled
- Direct & Indirect Reduction Effects for each team
  - Input-Output Tables used

## II. CDRS – Next Year

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### ❖ 2ND PHASE PREPARATION

- 2nd Phase to start on 2005
  - Eliminated 5 teams on 2004, 3-5 more on 2005
- Management Teams added for Each of 4 Major Topics
- Technology Transfer/Licensing Team will be added
- New and Renewables may be added

### III. NRE Development Program by MOCIE

❖ **Share of NRE in Total Energy Supply: 1.4% in 2002**

- **Economic Impact : Import Substitution of \$520M**
- **CO<sub>2</sub> Reduction of 8.8Mt (TC)**
- **If Large Hydro(0.6%) included, the share would be 2.0%**

Source	Consumption	Share
Solar Thermal	Solar Heating 187,000 Units, Solar Water Heater: 3,000 units	1.2%
Solar PV	12,000 sites: 5,419.	0.2%
Wind	50 units: 8,000.	0.1%
Bio	Liquor and food process: 100 sites	4.0%
Wastes	MSW Incineration & LFG in Major Cities: 500 units	93.5%
Small Hydro	30 sites: 42MW	1.0%

### III. NRE R&D Development by MOCIE

- Development Target
  - Enhancement of Indigenous Technology up to Top 5
  - Solar PV: 3<sup>rd</sup> Place; Fuel Cells: 4<sup>th</sup> Place (2011)
- Supply Target
  - Gov. Investment: 15 billion USD on NRE Facilities (2004-2011)

	2002	2006		2011	
		BaU	Policy	BaU	Policy
<b>Supply (mil TOE)</b>	<b>2.92</b>	<b>4.00</b>	<b>7.73</b>	<b>5.80</b>	<b>13.76</b>
<b>Share (%) (electricity)</b>	<b>1.4 (2.0)</b>	<b>1.7</b>	<b>3.0 (2.4)</b>	<b>2.2</b>	<b>5.0 (7.0)</b>

### III. Government Investment Schedule for NRE Facilities

	2004		2006		2011		Total (04-11)	
	B. Won	Share	B. Won	Share	B. Won	Share	B. Won	Share
<b>Wind</b>	80.0	41.5	210.0	26.1	840.0	10.8	2,620.0	14.7
<b>Solar PV</b>	66.3	34.4	446.3	55.4	4,556.0	58.8	9,990.1	56.0
<b>Fuel Cells</b>	7.2	3.7	24.8	3.1	480.0	6.2	1,492.5	8.4
<b>Small Hydro</b>	11.0	5.7	100.0	12.4	160.0	2.1	803.0	4.5
<b>IGCC</b>	-	-	-	-	709.5	9.2	1,096.5	6.1
<b>OTEC</b>	-	-	2.0	0.2	971.0	12.5	1,643.5	9.2
<b>Bio</b>	28.3	14.7	22.3	2.8	31.8	0.4	186.3	1.0
<b>Total (Mil USD)</b>	192.8 (161.5)	100.0	805.4 (674.9)	100.0	7,748.3 (6,492.8)	100.0	17,831.9 (14,942.5)	100.0

# Summary

## ❖ CDRS - Carbon Dioxide Reduction & Sequestration R&D

- Energy Saving & Efficiency Improvement (60%)  
Energy Recycling (18%) Sequestration (22%)
- 2nd Phase (2005 - 2007) to Enter Markets

## ❖ RECENT TRENDS OF KOREAN GOVERNMENT R&D

**PROGRAMS** ● Focusing more on New and Renewable Energy Technology  
than Energy Saving/Efficiency Improvement Techs

- Minimizing Impacts on Industry
- More Market Incentives (Demand-Pull)
- Requires Technology Export

# Thank You