



# Overview of CCS Activities in Saudi Arabia

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# Engagement

## Research Centers



## Universities



## Companies



# Centers of Excellence



## KACST- Technology Innovation Center on Carbon Capture and Sequestration

### Research Scope:

- **Capture:** Advanced materials for CO<sub>2</sub> Capture and CO<sub>2</sub> bottoming cycle
- **Conversion:** Biological, Photocatalytic, Electrochemical
- **Storage:** Cement and concrete materials

### Research Scope:

- **Capture:** Oxy-fuel, pre and post combustion
- **Storage:** Site selection, leakage, EOR

# R&D Activities



# Key Message

Research and technology development is very important option to address climate change and it should have minimum impact on world economy.

# Environmental Stewardship

Long history of **environmental awareness and protection** by minimizing carbon emissions in hydrocarbon activities, and in energy generation and consumption



Flare Reduction



Energy Conservation

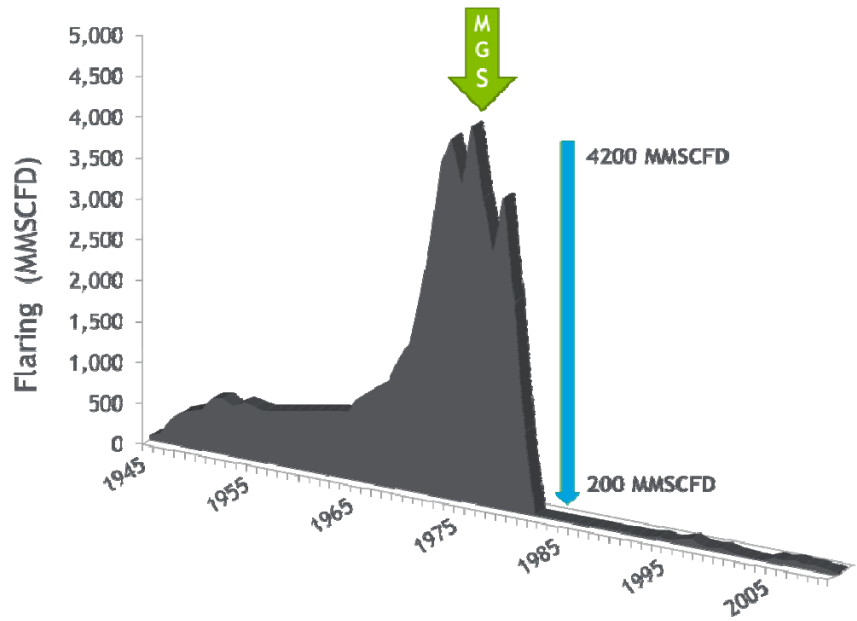


Renewables



Carbon Management

# Flare Mitigation Program



## Master Gas System

- Capture and process gas produced in association with crude oil.
- Utilize the gas as feedstock in many industries to diversify the Kingdom's economy.

# Energy Conservation



المركز السعودي لكفاءة الطاقة  
Saudi Energy Efficiency Center

- Mission: Preserve the national wealth of energy resources, which consequently strengthens development and national economy, and achieves the lowest levels of possible consumption levels in comparison to the general national product and populations
- Target energy sectors: Industry, Buildings and land transportation.



# Renewables

Building a sustainable future for Saudi Arabia by developing a substantial alternative energy capacity

## Research Focus:

- Nuclear - power, medical and industrial fields.
- Renewable Energy - deployment in MENA environments.
- Energy Efficiency - conservation of resources.
- Cross Functional Technology - cut across the programs

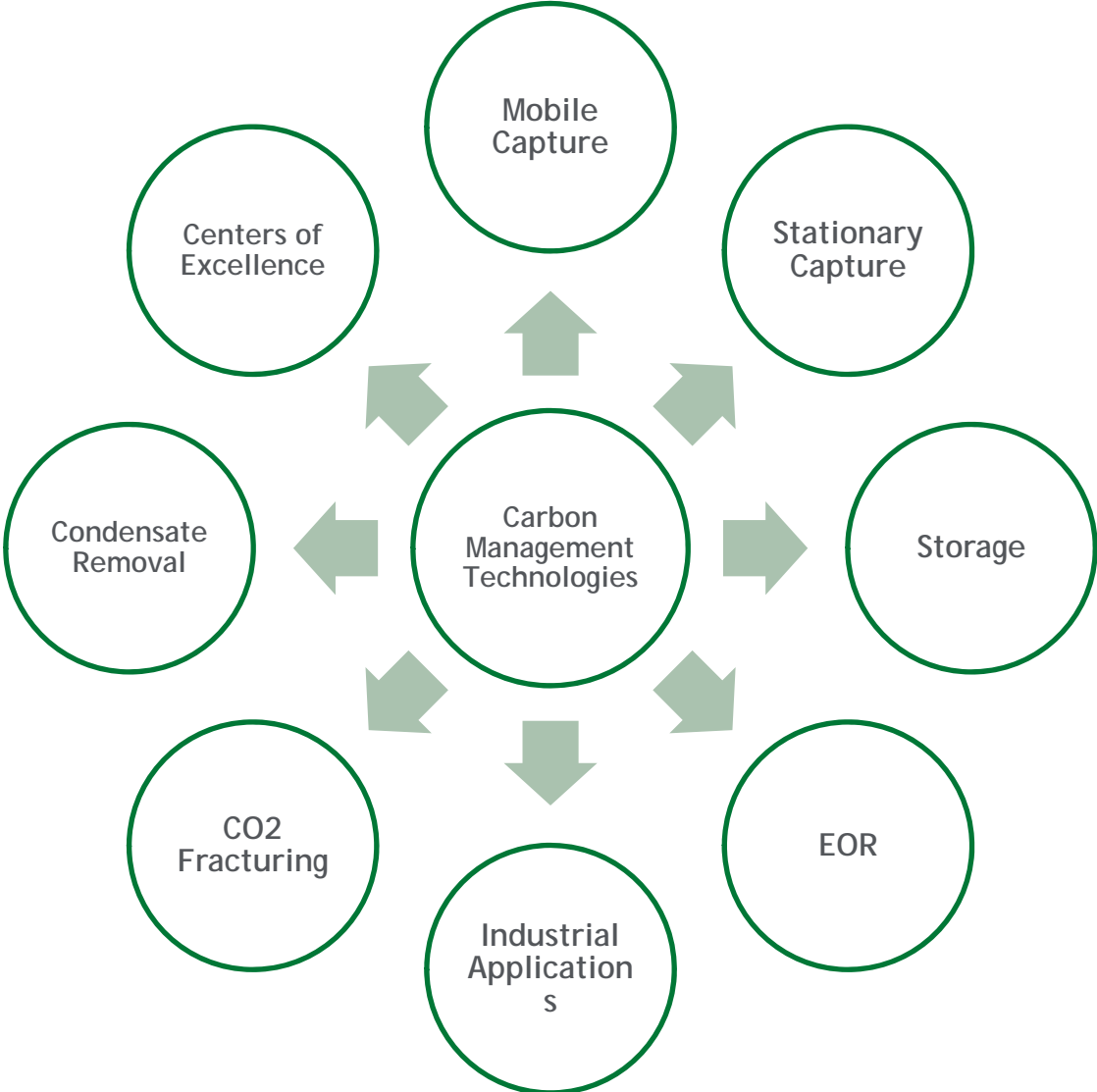


# Renewables

No.	Name	Current Size	Owner	Com. Date
1	<a href="#">Saudi Aramco Solar Car Park</a>	10.5 MW	Saudi Aramco [SA]	2012
2	<a href="#">Princess Noura Bint Abul Rahman University</a>	25 MWth	Princess Noura Bint Abdulrahman University for Women	2012
3	<a href="#">King Abdulaziz International Airport Development Project</a>	5.4 MW	General Authority of Civil Aviation (GACA)	2013
4	<a href="#">KAPSARC project</a>	3.5 MW	Saudi Aramco	2013
5	<a href="#">KAUST Solar Park</a>	2 MW	Saudi Aramco	2010
6	<a href="#">Pilot project</a>	500 kW	Saudi Electricity Company (SEC) and Showa Shell Sekiyu	2011
7	<a href="#">King Abdullah Financial District project</a>	200 kW	KAUST	2012



# Carbon Management



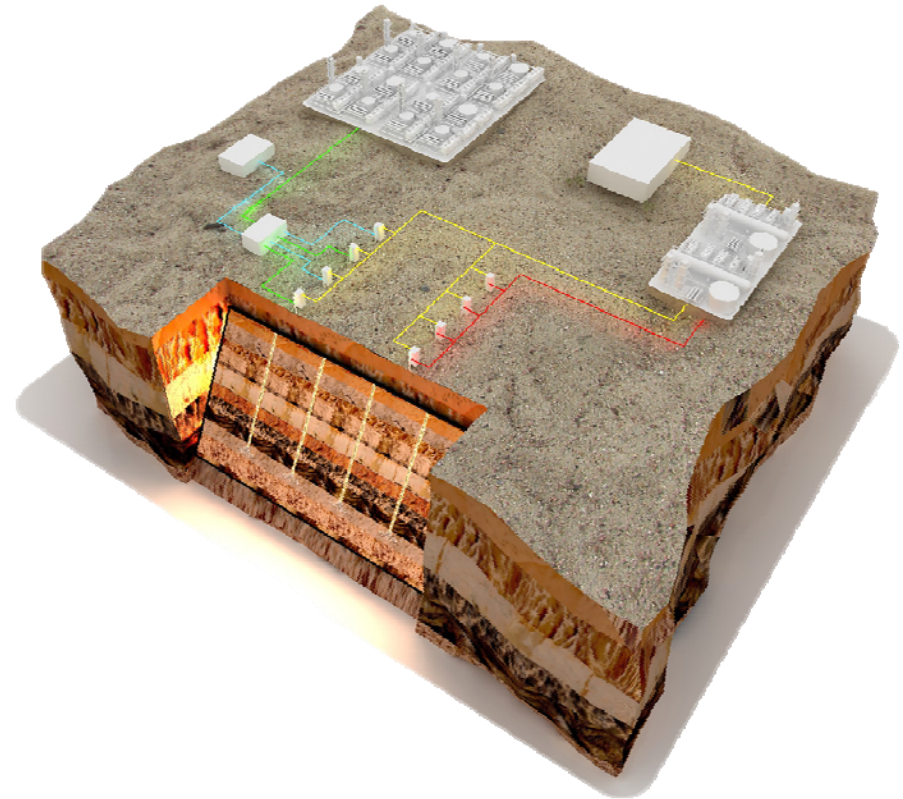
# SABIC Carbon Capture and Utilization



- Designed to compress and purify around 1,500 tonnes per day (500,000 tonnes/year)
- CO<sub>2</sub> is pipelined through the Royal Commission of Jubail to three SABIC-affiliated companies
- Used for enhanced methanol and urea production.

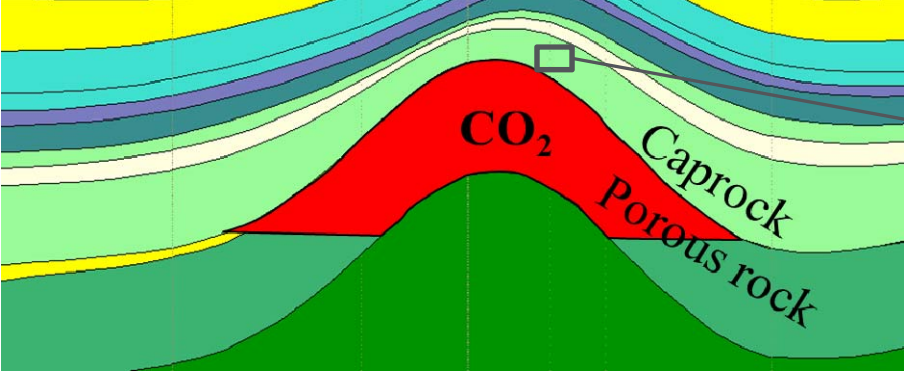
# CO2 EOR

- Demonstrate storage through EOR
- Confirm volume of CO2 sequestered
- Develop and apply innovative CO2 monitoring techniques to assess CO2 sequestered
- Assess impact on oil recovery (EOR)

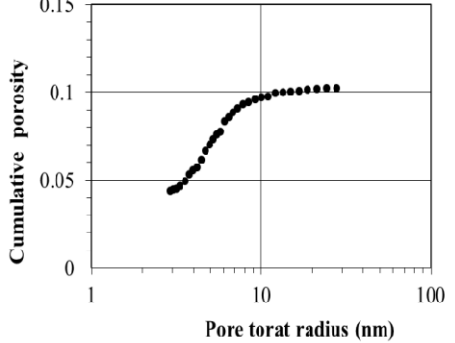


- *CO2 injection: 40 MMscfd*
- *4 inj., 4 prod. And 2 observation*
- *Alternating water/CO2 injection*

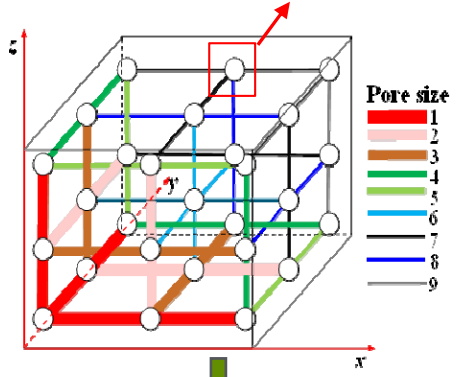
# CO2 Sequestration



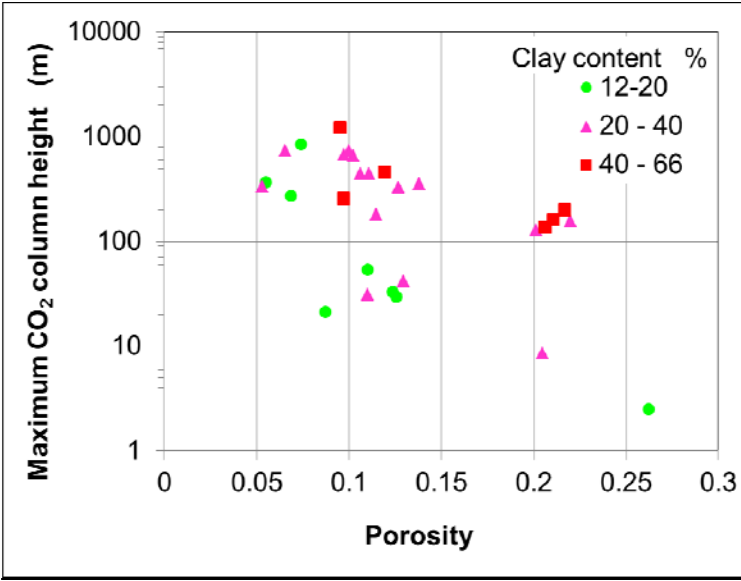
Mercury intrusion data



3D pore network model

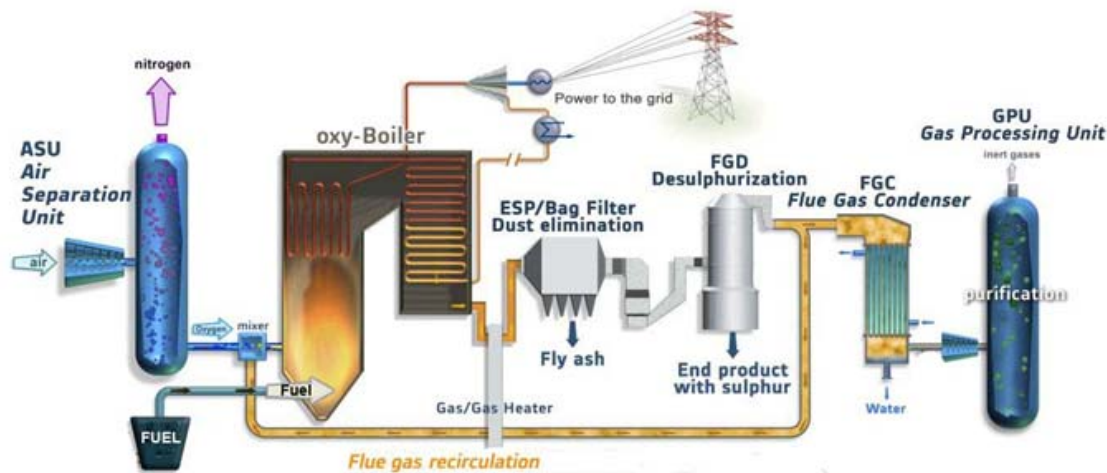


$H_{CO2} = 630m$



# CO2 Capture from Fixed Sources

To bridge the fuel gap for oxy-fuel CO2 capture technology primarily developed for coal & gas



Oxy-combustion demonstrated on 15 MW-th boiler using 1,100 bbl of difficult to burn liquid fuels

# CO2 Capture from Mobile Sources

On-Board CO2 Capture System could capture up to 60% of CO2 from the exhaust gases and store it temporarily on-board

Mid-size truck  
(2011)



Solid Materials  
10% CO2 Capture

Passenger Vehicle  
(2013)



Liquid Materials  
25% CO2 Avoidance



# Industrial Applications (Conversion)

Saudi Arabia investing in CleanTech startups to convert CO<sub>2</sub> in value added products (up to 50% CO<sub>2</sub> in end products)

Waste CO<sub>2</sub> & CO



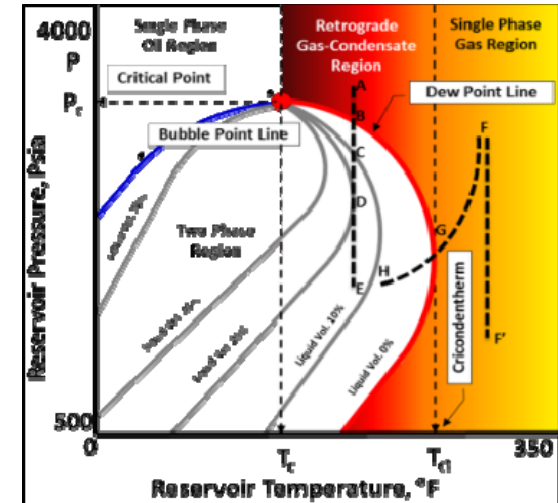
Valuable Chemicals & Materials



# Non-EOR CO2 Utilization Options

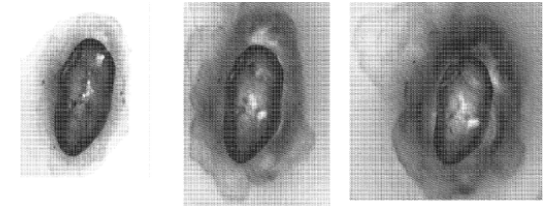
## Condensate Banking Removal in Gas Fields

- Reduction in gas production due to liquid dropout around the wellbore.
- Use supercritical CO2 as solvent to solve dropout challenge



## Waterless Fracturing Based on CO2

- Develop a supercritical CO2 mediated proppants delivery technology for water sensitive formations
- Develop a self-suspending proppant in supercritical CO2



Self-Suspending Proppant in Supercritical CO<sub>2</sub>

# Summary

- Long history of environmental protection reflected in diverse activities
- Technology development and deployment is viable option to address climate change
- Several carbon management technologies developed and being implemented in Saudi Arabia
- Major demonstration projects and prototypes: Saudi Aramco EOR demonstration project, SABIC CCU project, and mobile capture system onboard vehicle.



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