Carbon Capture, Utilization and Storage

A critical technology for achieving climate targets

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Carbon Capture, Utilization and Storage (CCUS)
CCS in the decarbonization puzzle

*Without CCS, long-term global climate goals may be unobtainable (IPCC AR5)*

Technology area contribution to global cumulative CO$_2$ reductions

Source: International Energy Agency
CCUS Value for the low carbon economy

CCUS is more than reducing emissions

- Achieving climate goals at least cost
- Meeting energy demand growth sustainably
- Decarbonizing Energy Intensive
- Balancing intermittent renewable energies
- Creating and maintaining jobs
- Improving energy security
Breakdown of contributions to global net CO$_2$ emissions in four illustrative model pathways

- “All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector”

- Limiting global warming to 1.5°C would require CDR on the order of 100-1000 GtCO2 over the 21st century
CCUS is proven and ready for deployment at scale

18 large scale facilities in operation, 5 in construction, and 3 in advanced planning

Source: Global CCS Institute
Today, CCUS is off track for meeting the objectives of the Paris Agreement

Mechanisms to incentivize CCUS investment are the market barriers

The costs of CCUS will fall with deployment, R&D and economies of scale

CCUS scale of ambitions

- 2017: 37 Mtpa
- 2030: 850 Mtpa
CCUS need Policy stability

Momentum is picking up for commercializing CCUS, but accelerated deployment is critically needed

Adapted from 2016 IEA 20 years of Carbon Capture and Storage
CCUS need investment

USD Billion since 2006


CCUS need policy parity with other clean energy technologies
CCUS in government initiatives

**Mission Innovation**
- **Carbon Capture Challenge**
  - 21 Members
  - Netherlands, Denmark, Finland, Indonesia, Sweden, Australia, Canada, China, European Commission, France, Germany, India, Italy, Japan, Korea, Mexico, Norway, Saudi Arabia, United Arab Emirates, United Kingdom, United States

**Research & Development**
- Denmark, Finland, Indonesia, Sweden

**Policy & Technical Projects**
- 26 Members
  - Czech Republic, Greece, New Zealand, Poland, Romania, Serbia

**Deployment**
- Brazil, Russia, South Africa
- 25 Members
  - Chile, Spain

**Carbon Capture Challenge**
- 21 Members
Carbon Sequestration Leadership Forum

- **2003**
  - Established in 2003
  - Comprised of 26 members
  - Focused on the development of improved, cost effective CCUS
  - Make technologies broadly available internationally
  - Facilitate the development and deployment of CCUS technologies via collaborative efforts

- **2005**
  - Saudi Arabia joined CSLF

- **2015**
  - Saudi Arabia Host 5th CSLF Ministerial Meeting

- **2018**
  - 18 large projects in operation and 5 in construction
  - More than double the number of operational projects since 2010
  - Capturing 37 million tons of CO$_2$/year
# Clean Energy Ministerial

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2009</td>
<td>Established in 2009</td>
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<td>26 Participating Governments</td>
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<td>Annual Ministerial Meeting</td>
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<td>Public-Private Engagement</td>
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<td></td>
<td>Advance Clean Energy portfolio through deployment and campaign and strong collaboration between public and private sectors</td>
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<td>2015</td>
<td>Saudi Arabia joined CEM</td>
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<td>2017</td>
<td>CCUS recognized in CEM8</td>
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<td>2018</td>
<td>CEM9 Expands the spectrum of clean energy technologies to include CCUS</td>
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<td>Create a sustained platform for the private sector, governments, and the investment community.</td>
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<td>Identify near and longer-term investment opportunities.</td>
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<td>Disseminate CCUS policy, regulatory, and investment best practices</td>
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## Mission Innovation

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| 2015 | • Launched in 2015  
|      | • 24 Participating Governments  
|      | • Double governmental and/or state-directed clean energy R&D investment over five years  
|      | • Accelerate public and private global clean energy innovation |
| 2016 | • 7 Innovation Challenges Created Including CCUS  
| 2017 | • Held an international CCUS experts workshop  
|      | • Established current state of technology in CCUS  
|      | • Created an international consensus on the most critical scientific challenges on CCUS  
|      | • Established internationally agreed Priority Research Directions (PRDs) |
| 2018 | • Issued a comprehensive report on “Accelerating Breakthrough Innovation in Carbon Capture, Utilization, and Storage”  
|      | • $103 million funding to address the PRDs |
Oil and Gas Climate Initiative

• OGCI is a voluntary, CEO-led Oil and Gas industry initiative which aims to catalyze meaningful actions on climate change through collaboration and engagement
  
  – 13 member companies for now, IOCs and NOCs, representing around 30% of the world O&G production
  
  – Close to 20% of global primary energy consumption

• OGCI Fund

$1+B over 10 years

50% in mitigating carbon dioxide
CCUS Capabilities in GCC
Large scale CCUS Plants in GCC

Uthmaniyah CO2-EOR
- By Saudi Aramco
- 800,000 tons of CO₂ per year
- CO₂ used for Enhance Oil Recovery (EOR)

Jubail CO2 to Chemicals
- By Saudi Basic Industries Corporation (SABIC)
- 500,000 tons of CO₂ per year
- CO₂ used to produce methanol and urea

Al Reyadah CCUS
- By ADNOC & Emirates Steel
- 800,000 tons of CO₂ per year
- CO₂ used for Enhance Oil Recovery (EOR)
- World's first iron and steel project to apply CCS at large scale
Concluding Remarks

- CCUS is not an option, it is a critical technology for achieving global climate objectives
- CCUS technology is ready and face no technical barriers for deployment
  - CCUS can reduce CO$_2$ emissions in power, industry, heat and transport
- Effective and stable market mechanisms are needed urgently
- Collaboration between all stakeholders (government, industry, and finance) is key
- Saudi Arabia is playing a leading role in advancing CCUS