



Separation Technology Laboratory at Masdar Institute

Dr. Mohammad Abu Zahra

Separation Technology Laboratory

Institute Energy Center (iEnergy)

Masdar Institute of Science and Technology

*Expert Group Meeting on “Carbon Capture, Utilization and Storage
in ESCWA Member States: Enhancing the Sustainability of the Energy
System in a Carbon Constrained Development Context”*

6-7November2013, Masdar Institute – Abu-Dhabi, United Arab Emirates

SEPARATION TECHNOLOGY LABORATORY (STL)

SIEMENS



Massachusetts
Institute of
Technology



CSIRO

Masdar
A MUBADALA COMPANY



RTI
INTERNATIONAL



- **Capture systems development and characterization:**
 - Aqueous and organic based solvents
 - Solid adsorbents
 - Membrane separation processes (selective and MGA)
 - Measurement of physical and thermodynamic properties (e.g. VLE, Kinetics, Cp, enthalpy, volatility)
 - Solvents long-term testing (micro and pilot plant)
- **Capture process concepts development and techno-economic evaluation:**
 - Advanced process concepts (e.g. split flow, inter-cooling, vapor compression)
 - Heat recovery
 - Integration with power plants
 - Process simulation and techno-economic evaluation
- **Environmental impact and waste managements**
 - Chemical and gases emissions
 - Solvent degradation
 - Reclaiming processes

The Major Research Area is the
CO₂ Post-Combustion Capture

- This long term collaboration is aiming to the development of CO₂ post-combustion capture technologies, which suitable for deployment in the gulf region. With major focus on Siemens PostCap technology
- **Supporting Masdar Institute post-combustion capture activities by:**
 - Siemens fellowship program (**Master and PhD students**)
 - R&D projects

SIEMENS

Coordinator

Dr. Mohammad Abu Zahra

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Evaluation of CO₂ Purification Requirements and Techno-Economic Evaluation of Processes for Impurities Deep Removal from the CO₂ Product Stream
Concluded in May 2012

Evaluation of handling approached of solid waste generated from the POSTCAP process considering the regulations in UAE
Concluded in April 2013

Contactors Design for Hybrid Systems for CO₂ Capture
Started in January 2013

Liquid Fuels Evaluation and Characterization
Started in November 2013

DEVELOPMENT OF NEW SORBENTS SYSTEMS FOR CO₂ POST-COMBUSTION CAPTURE

- **Started in September 2011**
- **Duration of 30 months**
- **Objectives:**
 - Development and characterization of amine-based solvents for short term post-combustion capture application
 - Developing CO₂-binding organic sorbents for CO₂ post combustion capture.



Faculty

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BENCH-SCALE DEVELOPMENT OF ADVANCED SOLID SORBENT MATERIAL AND SUITABLE PROCESSES FOR POST-COMBUSTION CO₂ CAPTURE



- **Project Partners:**

University of North Carolina



Pennsylvania State University

Sud-Chemie Inc

Unitel
Technologies



Foster Wheelers USA

- **Kick off in October 2011**

- **Duration of 36 months**

Faculty

Dr. Mohammad Abu Zahra

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- **Overall Objectives:**

- Optimization and production scale-up of advanced MBS materials in fluidizable form and development of associated fluidized-bed process technology.
- Collection of critical process engineering data using single-stage testing equipment to allow for a detailed design of a bench-scale CO₂ capture prototype based on MBS materials.
- Demonstrate technical and economic feasibility of a commercial embodiment of the MBS-based CO₂ capture process



- **Masdar Institute tasks:**

- Techno-Economic Evaluation of the advanced solid material for the natural gas combined cycle power plant case
- Evaluation of scale-up challenges and issues related to the application for NG case
- Sorbent single-stage and bench scale long term testing using flue gas from NGCC power plant

CONCLUDED GRADUATE STUDENTS PROJECTS

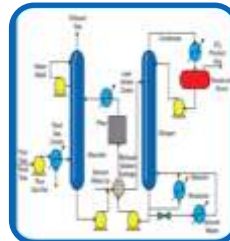
Project	MI Student	Sponsor	Partner	Duration
Evaluation of CO ₂ Purification Requirements and Techno-Economic Evaluation of Processes for Impurities Deep Removal from the CO ₂ Product Stream	Zeina Abbas (ESM)		ESM	2011-2012
Development of New Sorbents Systems for CO ₂ Post-Combustion Capture	Adewale Adeosun (CHE)	Masdar Institute		2011-2013
Evaluation of Handling Approaches of Solid Waste Generated from the CO ₂ Capture Process Considering the Regulations in UAE	Laila Nurrokhmah (ESM)		ESM	2011-2013
Demonstration and Evaluation of an Advanced Solid Sorbent-based CO ₂ Post Combustion Capture Process for Natural Gas Combined Cycle Power Plants	Adel Seif El Nasr (CHE)			2011-2013
Life Cycle Assessment of Natural Gas Combined Cycle Integrated with CO ₂ Post-Combustion Capture Plant using MEA Solvent	Stephen Fedayi (WEE)		WEE	2011-2013

ONGOING GRADUATE STUDENTS PROJECTS

Project	MI Student	Sponsor	Partner	Duration
The Evaluation of the Integrated Natural Gas Combined Cycle Power Plants with CO ₂ Capture	Iman Ustadi (ESM)		University of Edinburgh/ESM	2012-2014
Thermal Degradation of Monoethanolamine for CO ₂ Post Combustion Capture	Hessa Al Shehhi (CHE)		CSIRO	2012-2014
CO ₂ capture novel solvents: Thermodynamics properties measurement and evaluation	Abdurahim Abdulkarim (CHE)	Masdar Institute	 Massachusetts Institute of Technology	2012-2014
CO ₂ Utilization using desalination plants reject brine	Abdallah Dindi (CHE)	Masdar Institute		2012-2014
CO ₂ capture novel solvents: reaction kinetics measurement and modeling	Ahmed Sodiq (CHE)	Masdar Institute	 Massachusetts Institute of Technology	2013-2015
Liquid Fuels Characterizations	Akinola Olanrewaju (CHE)	Masdar Institute		2013-2015

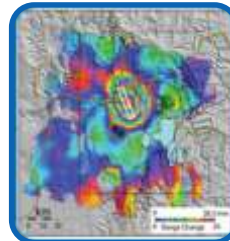
Importance for Abu Dhabi

These activities contribute to the overall vision of Abu Dhabi to reduce GHG emissions. One of the approaches to reduce carbon emission is by the development and deployment of CCS technologies. The current R&D projects will encourage the deployment of CCS technology in UAE. Having the advantage of being an oil producing country, CCS in the UAE will serve to be an excellent candidate to allow for enhanced oil recovery.



CO₂ Capture Technologies

- The development of novel capture systems and processes for post-combustion capture, hydrogen production and chemical looping.
- Multiple projects were established in collaboration with Siemens, MIT, Masdar Carbon and RTI.



CO₂ storage, injection and monitoring

- Study the interactions between the injected CO₂ and the brine saturated rock, geo-chemistry, geo-mechanics, and trapping phenomena during CO₂ storage
- CO₂ monitoring (GPS and INSAR)
- Collaboration with MIT, ADNOC, ADCO and PI



CCS Policies and Regulations

- Optimal CO₂ regulation to Align CCS with EOR and CDM
- Energy Policy and Technology Strategy and scenarios
- Risk analysis, CCS economics and regulations

OTHER ACTIVE UAE PARTNERS

ADCO/
ADNOC

- EOR
- CO₂ Sink

PI

- EOR/Storage
- Capture: Ionic Liquid, Process intensification

UAE Univ.

- Membrane separation
- Solid materials

Emirate Steel,
EMAL, ADWEA,
DEWA

- CO₂ Source

CCS OTHER ACTIVE PARTNERS IN SA

KAUST

- KAUST-Cornell Center for Energy and Sustainability
- Nanoscale hybrid materials technology for high-temperature CO₂ capture (C³)
- Membranes
- Biological CO₂ capture & conversion
- Ionic liquids

KFUPM

- CO₂ Storage and Monitoring
- Ceramic Membranes

King Faisal University

- CO₂ Conversion
- Ionic Liquid

KAPSARC

- Environment and Carbon Management Program

CCS ACTIVE PARTNERS IN QATAR

Qatar Foundation
QATAR National
Research Fund
(QNRF)

- Project development and funding mechanisms

Qatar Petroleum

- EOR/Storage
- CO₂ Sink

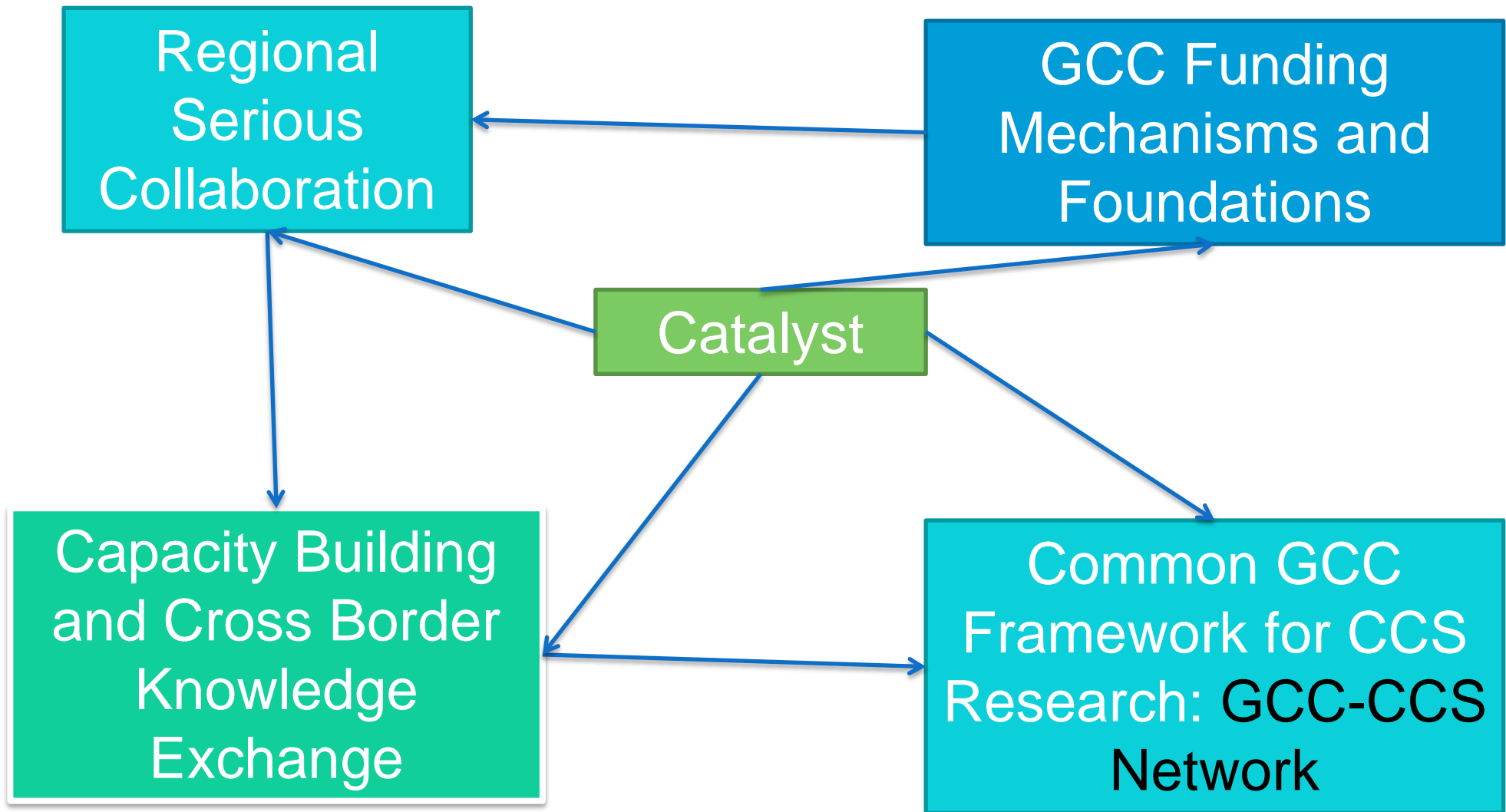
Qatar
University

- Gas processing centre
- CO₂ adsorption
- CO₂ Conversion and Utilization

Qatar Carbonates and
Carbon Storage
Research Centre

- CO₂ Storage
- Imperial college, Shell, QP, QSTP
- Research lab was recently opened

WHAT IS NEEDED!!



THANK YOU