



ESCWA

United Nations Economic and Social Commission for Western Asia

# Carbon Capture, Utilization and Storage in ESCWA Member States: Enhancing the Sustainability of the Energy System in a Carbon Constrained Development Context

SESSION 1: CARBON CAPTURE, UTILIZATION AND STORAGE  
(CCUS) AND ENHANCED HYDROCARBON RECOVERY (EHR) –  
POLICIES AND TRENDS IN THE REGION

El Habib El Andaloussi (ESCWA, Chief, SDPD/ Energy Section)

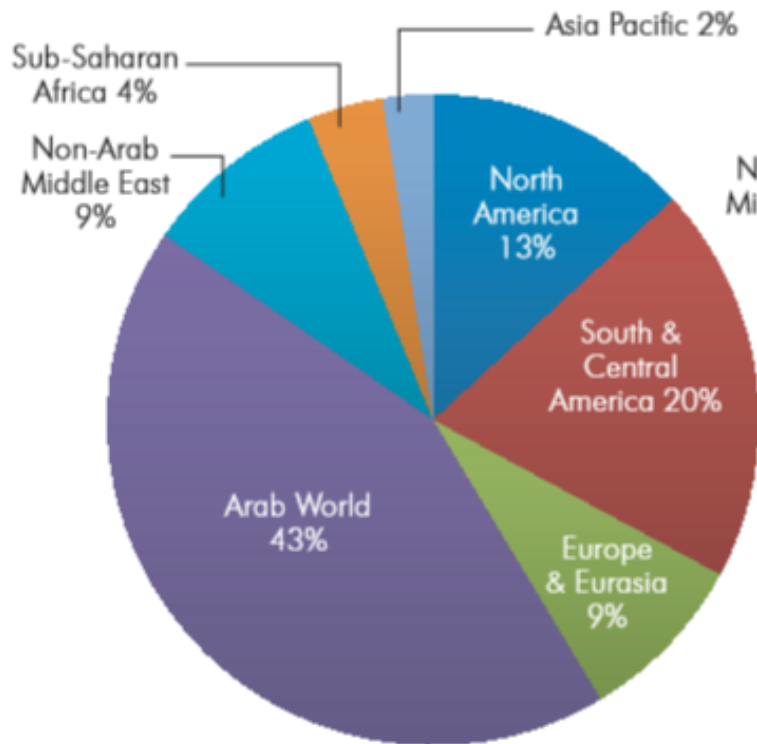
November 6<sup>th</sup>, 2013



# Proven Oil Reserves and Oil Production in the Arab Countries (2011)

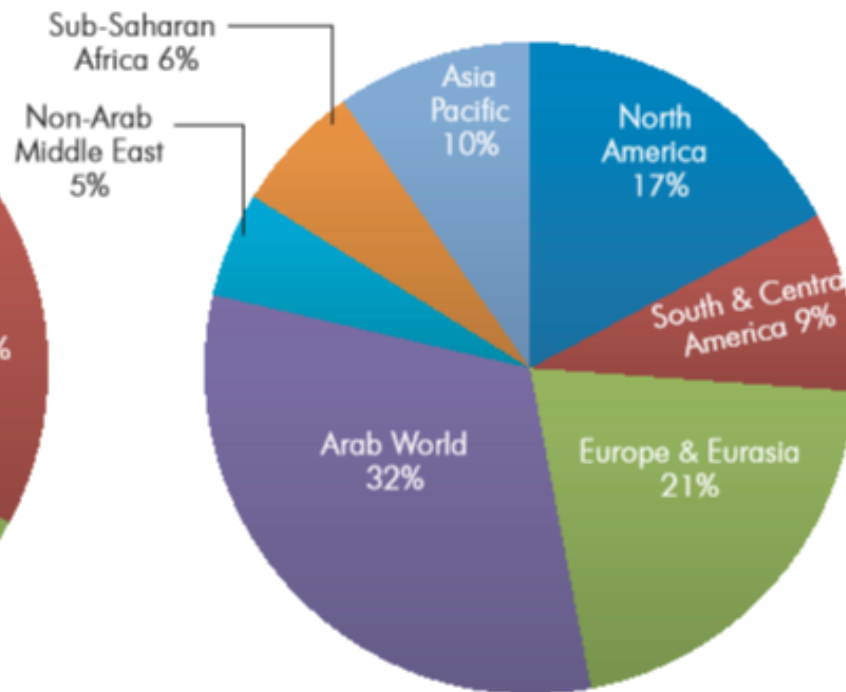


**Reserves by Region, end-2011**



**GCC 30%  
of World Oil  
Reserves**

**Production by Region, 2011**



**GCC 27%  
of World Oil  
Production**

# 10 Arab countries leading Oil and/or Gas Production and Exports



	Countries	Oil Prod (M bd)	Oil reserves (bbl)		
1	S. Arabia	11.153	265.4	TOP-10	OPEC
2	UAE *	3.096	97.8	TOP-10	OPEC
3	Kuwait	2.682	101.5	TOP-10	OPEC
4	Iraq	2.635	143.1	TOP-10	OPEC
5	Qatar *	1.638	24.7		OPEC
6	Algeria *	1.884	12.2		OPEC
7	Egypt *	0.706	4.3		
8	Oman *	0.889	5.5		
9	Libya *	0.502	47.1		OPEC
10	Yemen *	0.163	2.7		
	<b>GCC co.</b>	<b>19.505</b>	<b>495.0</b>		
	<b>Arab co.</b>	<b>26.262</b>	<b>713.6</b>		
	<b>WORLD</b>	<b>83.576</b>	<b>1652.6</b>		

Source: EIA (2012)

*\* Gas exports countries by LNG and Pipelines*

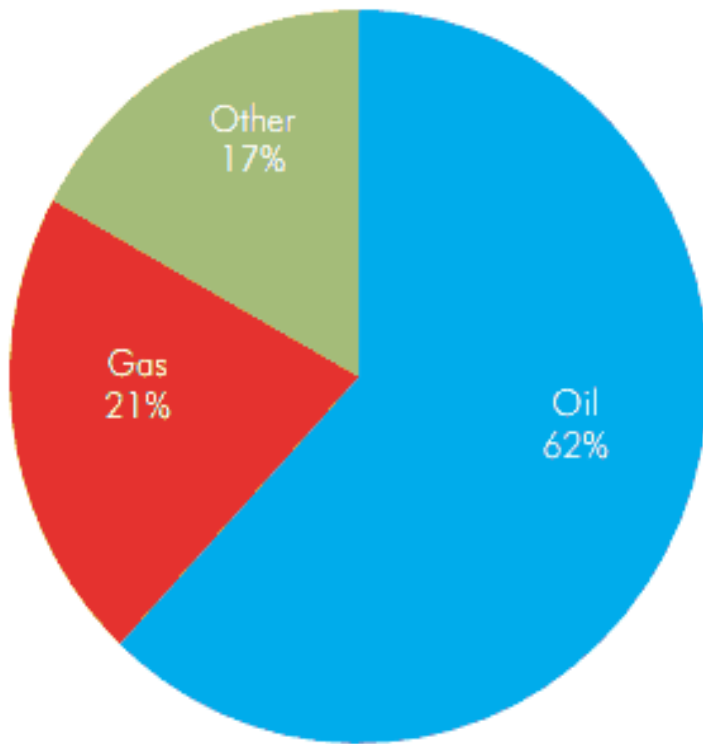
Arab 32% of World Oil Prod.  
GCC 23% of World Oil Prod.

Arab 16-20% of World Gas Prod.  
GCC 11% of World Gas Prod.

# Arab Primary Energy Supply 1971 VS. 2010

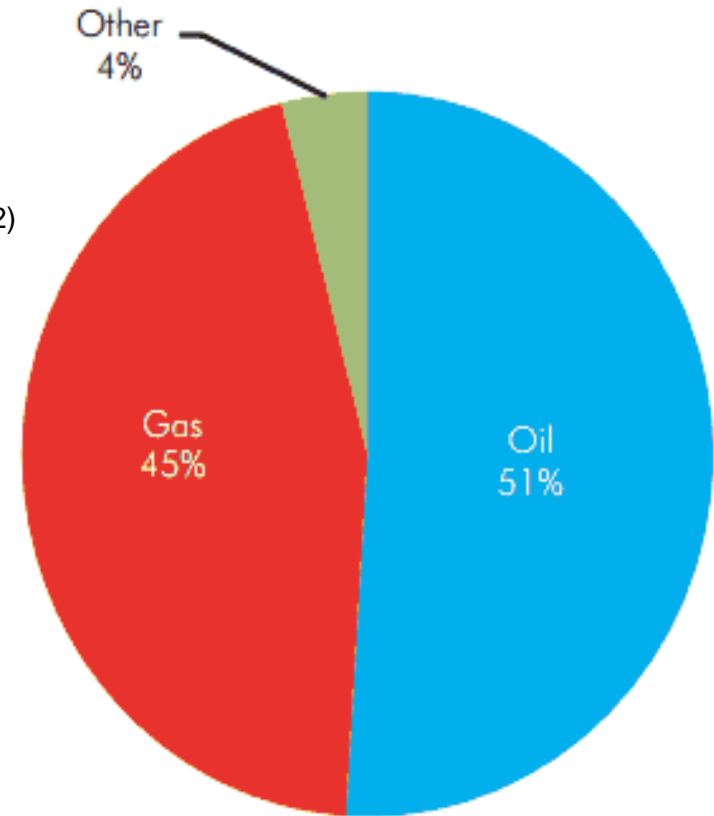


**1971**



**50.6 Mtoe**

**2010**



**569.6 Mtoe**

Source: EIA (2012)

**Energy demand increased 11 folds in the last 40 years**

**Oil and gas share in energy mix increased from 83% to 96%**

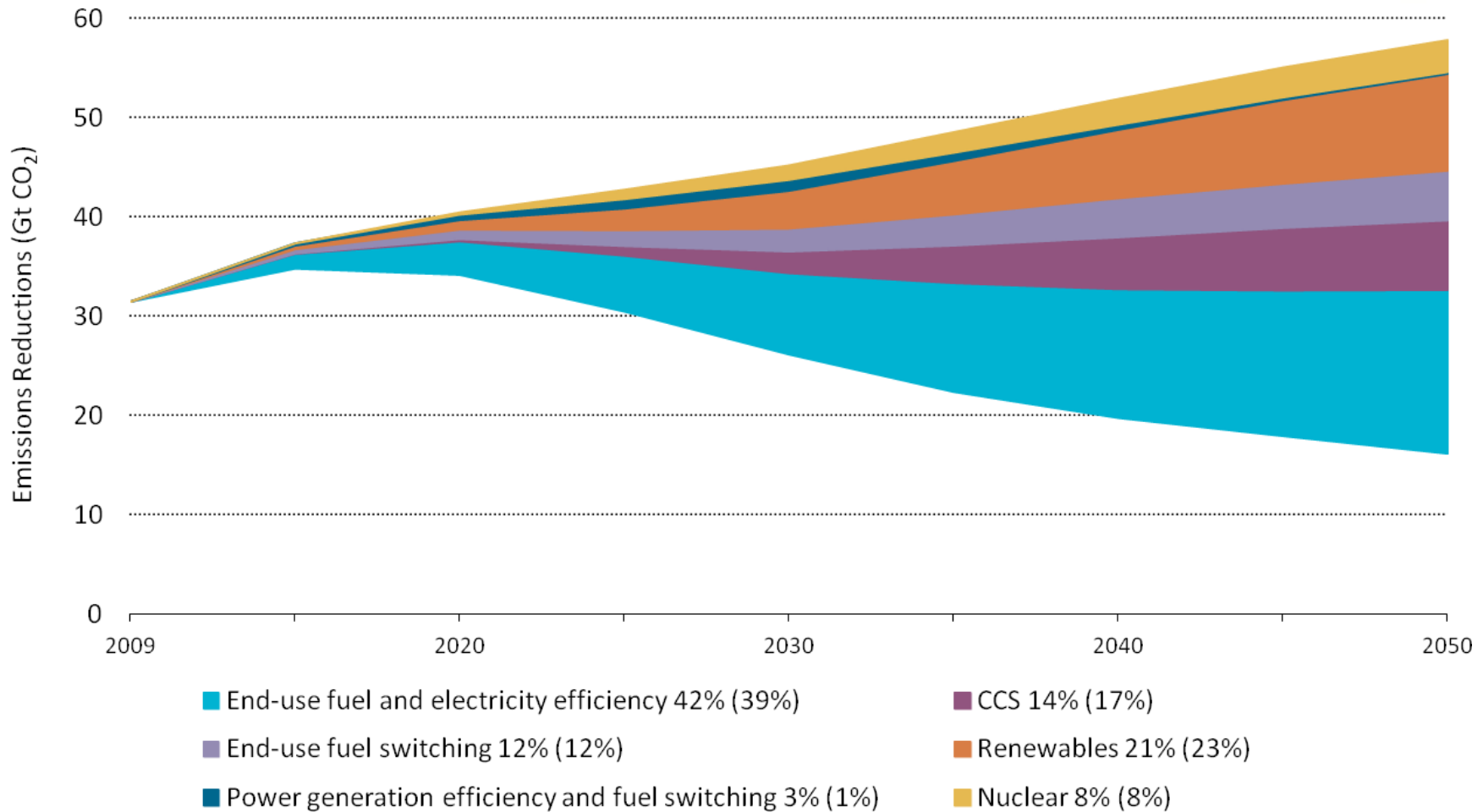
# Sectorial CO<sub>2</sub> Emissions from Fossil Fuel Combustion of the Arab countries in Million Tonnes of CO<sub>2</sub>



Arab Country	National Communication Report	Year of Inventory Calculation	Emissions from Fossil Fuel Combustion (Mt CO <sub>2e</sub> )	Percentage of Total Emissions (%)
<b>Egypt</b>	Second NC, 2010	2000	116.30	60.2
<b>Morocco</b>	Second NC, 2010	2000	32.29	50.9
<b>Sudan</b>	First NC, 2003	1995	16.70	18.7
<b>Tunisia</b>	Initial NC, 2001	1994	15.25	65.3
<b>Bahrain</b>	Second NC, 2012	2000	17.25	77.1
<b>Jordan</b>	Second NC, 2009	2000	14.91	74.0
<b>Lebanon</b>	Second NC, 2011	2000	13.85	74.86
<b>KSA</b>	Second NC, 2010	2000	237.55	92.10
<b>Syria</b>	Initial NC, 2010	2005	58.35	74.00
<b>UAE</b>	Second NC, 2010	2000	116.11	89.60

**From 1990 to 2010 fossil fuel CO<sub>2</sub> emissions increased 247% in the Arab Region**

# CCS indispensable to meeting 2DS targets



**Energy Efficiency + Renewable+ CCS**



# Up-scaling Energy Efficiency in the Residential and Services Sectors



*For more information, please contact:*

## A Focus on Existing Building Stock

ESCWA research shows that the residential and services sectors represent an important part of the total consumption of energy in the Middle East and North Africa region, with a share of

### One of the Aims of the Project

Reinforce the sustainability of energy supply by improving EE of the residential and services sectors, thus reducing the energy bill for both end users and states and **mitigating the impact of climate change.**

# Renewable Energy in Arab countries



- ✓ The RE in the Arab region has evolved rapidly in recent years with a diverse range of countries announcing projects and policies.
- ✓ As of April 2013, 64 projects (13 in GCC), totaling almost 6 GW (0.8 GW in GCC) of new RE capacity were in the pipeline – a 4 fold increase over existing capacity.
- ✓ 16 of the 22 Arab countries had enacted at least one RE enabling policy, such as feed-in tariffs, fiscal incentives, and public financing, and 20 countries now have policy targets, up from 5 in 2007.
- ✓ New investment in the Arab countries totaled 1.9 b\$ in 2012, a 6 fold increase compared to 2004.
- ✓ Saudi Arabia, UAE, Egypt, Morocco and Tunisia, in particular, have developed policy frameworks to stimulate local manufacturing and innovation.
- ✓ The Arab countries RE market is far from having reached its full potential. Today we notice promising signs of development through pipeline projects and increasing political commitments.



# RE projects in Arab countries



Installed Capacity in the Pipeline (MW) (number of projects)						
	Solar	Wind	Biomass & Waste	Geothermal	Small Hydro	TOTAL
Algeria	175 (5)	20 (2)				195 (7)
Bahrain			25 (1)			25 (1)
Egypt	106 (2)	1,070 (5)			32 (1)	1,208 (8)
Libya		610 (5)				610 (5)
Oman	407 (2)					407 (2)
Saudi Arabia	125 (4)					125 (4)
Syria		290 (3)				290 (3)
UAE	113.8 (3)	30 (1)	101 (2)			244.8 (6)
Yemen		60 (1)				60 (1)
<b>Total NOEC</b>	<b>926.8 (16)</b>	<b>2,080 (17)</b>	<b>126 (3)</b>	<b>0 (0)</b>	<b>32 (1)</b>	<b>3,164.8 (37)</b>
Djibouti				50 (1)		50 (1)
Jordan	400 (4)	360 (4)				760 (8)
Morocco	172.7 (3)	1,553.07 (12)	1.6 (1)			1,727.37 (16)
Tunisia	5 (1)	100 (1)				105 (2)
<b>Total NOIC</b>	<b>577.7 (8)</b>	<b>2,013.07 (17)</b>	<b>1.6 (1)</b>	<b>50 (1)</b>	<b>0 (0)</b>	<b>2,642.37 (27)</b>
<b>TOTAL</b>	<b>1,504.5 (24)</b>	<b>4,093.07 (34)</b>	<b>127.6 (4)</b>	<b>50 (1)</b>	<b>32 (1)</b>	<b>5,807.17 (64)</b>

Source: Bloomberg New Energy Finance BNEF (2013) dataset, Clean Energy Investment Trends.

*NOEC= Net Oil Export Countries; NOIC= Net Oil Import Countries*

# Advantages of CCS



## **Contributing to GHG reduction**

Reduction of 17% of global GHG reductions by 2050 (IEA)

## **Long term GHG option mitigation**

Allowing continued use of fossil fuel resources and providing time required for switching to lower-carbon technologies

## **Enhancing oil and gas recovery**

CO<sub>2</sub> injection leads to increase the oil extraction to 30-60%, compared with 20-40% using primary/secondary recovery

## **Job Creation**

High potential of creating jobs through CCS activities  
(Carbon Capture and Storage Association, CCSA)

# The International Pathway of CCS



In 2005, CCS was considered as one of possible UNFCCC mitigation options.

In 2009, the campaign of the business sectors was initiated to arise the awareness of CCS as a necessary technology for CO2 emission reductions by 2050.

In 2010, CCS was agreed as a project activity under the CDM by COP16 in Cancun.

In 2011, the CDM rules which include CCS were accepted at COP-17 in Durban.

# CCS in Arab Region



**Arab region has the largest possibility to storing more CO<sub>2</sub> than any other region.**

Large fossil fuel resource

Five Biggest sites having a combined 180 Gt of capacity

Combined storage capacity ranges for the region are estimated at 200-1200 GT for oil and gas field and 50-550 GT for Saline formations (IEA, 2008).

Highest potential incremental recovering from CO<sub>2</sub> EOR (Enhanced Oil Recovery) with additional volumes of oil range for 80-120 billion Barrels (IEA, 2008).

Because of abundance of oil and gas, application of CCS would be limited to storage from fuel transformation and natural gas-fueled power plants.

OPEC funds the development of clean energy technology in particular CCS.

# CCS Projects in Arab Region



	In Salah Project	Carbon Capture and Utilization (CCU) Project
Country	Algeria	Saudi Arabia
Operation Year	2004	Pilot completion set to be achieved by 2016
Operator	BP, Sonatrach and Statoil	Germany's Linde Group
Supporter	US Department of Energy / the EU Directorate of Research	Saudi Basic Industries Corp (SABIC)
Aim	To store 1.2 million tons CO <sub>2</sub> by year; Operational since 2004, more than 3 Mt have been stored. Total of 17 million tons along the project life	At compression and purification about 1,500 tons per day of raw CO <sub>2</sub> produced from two ethylene glycol plants.
Cost	US\$2.7 billion and injection cost, about US\$ 6 per ton CO <sub>2</sub>	Unkown
Specialty	One of the most important industrial-scale CCS initiatives globally. In Salah field produces natural gas (with 10% CO <sub>2</sub> ) which is transported to the EU.	The world's largest plant for capturing and using CO <sub>2</sub> / Gaseous CO <sub>2</sub> used for enhanced methanol "chemical industry" and urea "fertilizer" production



# CCS Projects in Arab Region



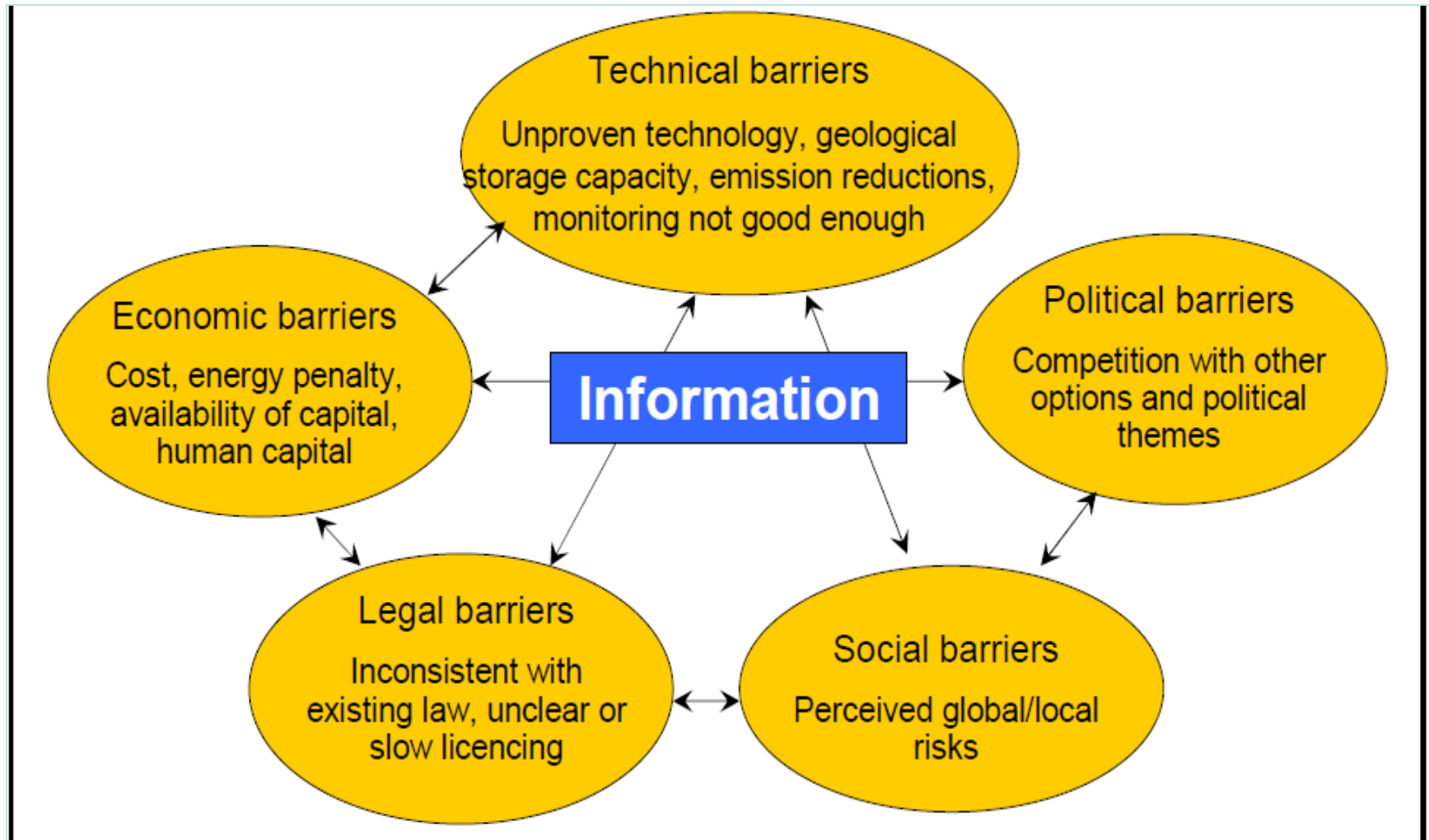
	Masdar Carbon		QAFAC: Carbon dioxide recovery plant
Country	UAE		Qatar
Operation Year	2015	2017	Completion of plant construction will by October 2014
	Status: Feed Study		
Operator	Emirate Steel Industry	Taweelah Asia Power Company (Tapco)/ Emirates Aluminium	Qatar Fuel Additives Company (QAFAC)
Supporter	Abu Dhabi Future Energy Company (Masdar)/ Executive Council/ Abu Dhabi National Oil Company (Adnoc)/ Petroleum Institute and others academic & industrial collaborators		Under license of Mitsubishi Heavy Industries, Japan
Aim	To capture around 800,000 tons per year of CO2	To capture around 2 million tons per year of CO2	500 tons/day of CO 2 will be recovered (Annually, 610,000 tons)
Cost	The project has received bids for a \$200 million pipeline between Mussafah and Taweelah		Unknown
Specialty	Piped via a 50 km pipeline for use in EOR	A 450-km pipeline for use in EOR	One of the world’s largest commercial-scale CO 2 capture facilities.  Carbon dioxide emitted from their methanol plant will be reused.

# CCS R&D in Arab Region



Country	R&D implementing organization
Saudi Arabia	King Abdulaziz City for Science and Technology (KACST), Technology Innovation Center for CCS (KACST-TIC CCS), King Fahd University of Petroleum & Minerals (KFUPM), King Abdullah University of Science and Technology (KAUST), King Abdullah Petroleum Studies and Research Center (KAPSARC)
	<b>Saudi Aramco</b> – working on the first CO <sub>2</sub> -EOR demonstration project in Saudi Arabia. The main objective of the project is to assess the applicability to sequester CO <sub>2</sub> in a mature zone within an oil reservoir.
Qatar	<b>Qatar Carbonates and Carbon Storage Research Centre (QCCSRC)</b> - to help build Qatar's capacity in CCS and cleaner fossil fuels. (In 2008, a \$70 million, 10-year research partnership between Shell, Qatar Petroleum, Imperial College London and the Qatar Science and Technology Park was established) Qatar University's Gas Processing Centre (GPC)
UAE	<b>Masdar Institute</b> - Abu Dhabi National Oil Company (Adnoc), Petroleum Institute. The Emirate of Ras-Al-Khaima

# The Barriers of CCS



# Focus areas for CCS development



## **Upgrading obsolete infrastructure**

Old fossil power plants with capability of energy efficiency and CCS

## **Focusing on incentive mechanism**

To activate financial sources through different phases of CCS projects; industry and governments should play a significant role

## **Increasing number of commercial scale pilot projects of CCS**

## **Increasing R&D activities of CCS**

Because the CCS integrated technology is not yet mature, further research is needed to incorporate all CCS processes (capture, transport and storage).

## **Developing regulatory and legal CCS framework**

To address issues of liability, licensing, leakage, landowner, royalty and citizen's rights

# Thank You

El Habib El Andaloussi

[elandaloussi@un.org](mailto:elandaloussi@un.org)