THE LEBANESE NATURAL GAS POTENTIAL

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OUTLINE

- The regional status
- Available data
- Studies performed and collaboration
- Petroleum systems offshore Lebanon
  - Concept
  - Prospects
  - Volumes
- Markets
  - Local
  - Regional
REGIONAL ACTIVITY
Zohr was a paradigm shift in the exploration cycle

- Carbonate reservoirs are as important as sand reservoirs
AVAILABLE MULTICLIENT DATA

- Spectrum 2D lines (5172 km)
- PGS 2D lines (5000 km)
- GeckoPrakla 2D lines (508 km)
- PGS 3D seismic data (9700 km²)
- Spectrum 3D seismic data (5360 km²)
- NEOS airborne geophysical (6000 km²)
- Onshore 2D lines (100 km)
STUDIES PERFORMED

- Interpretation of the 2D and 3D seismic data 2012 – to present
- Mapping petroleum system elements
- Locating structures capable of holding petroleum -> prospects
STUDIES PERFORMED

- 3D basin modelling 2012 with BeicipFranlab
- Quantify amount of hydrocarbon expelled and trapped
- Locate important areas in the basin for exploration
STUDIES PERFORMED

- Advanced geophysical characterisation studies
- Locate reservoirs of oil and gas
- Reduce uncertainties
- Point to likely drilling targets
STUDIES PERFORMED

- Analysis of the carbonate potential offshore Lebanon following the Zohr discovery
- Assessment of likely discoveries in carbonate reservoirs
- Recent discovery in Onisiforos 1 tcf
STUDIES PERFORMED

- Play Fairway Analysis to rank blocks and areas of exploration
- Ranking from most prospective to least prospective
- Calculate volumes in potential prospects
ACADEMIC PROJECTS

 Memorandum of understanding (MOU):
  ▪ University of Aberdeen (UK): 2 PhD projects proposed

 University Collaboration
  ▪ Imperial College
  ▪ UPMC Paris VI
  ▪ RWTH Aachen
  ▪ Lebanese University
  ▪ NDU Louaize
  ▪ NTNU

 PhD projects
  ▪ Hawie, 2014: stratigraphy of the Levant Basin
  ▪ Ghalayini, 2015: Structures and traps in the Levant Basin
  ▪ Bou Daher, 2015: Source rocks characterisation offshore and onshore
  ▪ Inati, 2017: Crustal structure of the Levant Basin
PETROLEUM SYSTEM OFFSHORE LEBANON
THE CONCEPT OF PETROLEUM SYSTEM

The Conventional Petroleum System

The 5 elements of a petroleum system:
- Source rock
- Reservoir
- Trap
- Seal
- Migration

Seal: Impermeable rock
Reservoir: Permeable rock
Source Rock: Source of oil/gas
Trap: Geometry
THE PETROLEUM SYSTEMS OF LEBANON

- 4 petroleum systems identified
- Consist mainly of gas in the deep Basin
- Liquid oil expected onshore and along the margin
OIL VS GAS IN LEBANON

- Oil is generated at specific depth, in temperature between 60 and 120°C.
- Gas is generated at temperature >120°C.
- Gas is also biogenic, produced by bacteria who degrade the rocks.
MAPPED PROSPECTS OFFSHORE LEBANON
EXPECTED VOLUMES OF GAS

- Example of a structure offshore Lebanon
  - Presence of stacked reservoirs, producing multiple prospects
  - Presence of three units that are likely to produce gas
  - Increases the quantities of gas to be discovered

- Expected volume for the entire structure
  - Maximum: 10 tcf
  - Most likely: 3 tcf
  - 1 tcf = 1 trillion cubic feet = 28 billion m³
EXPECTED VOLUMES OF GAS

- Expected volume for the entire block
  - Maximum: 36 tcf
  - Most likely: 10 tcf
  - 1 tcf = 1 trillion cubic feet = 28 billion m³
ENERGY DEMAND IN LEBANON

98% of the production capacity resides on the coastline

Existing Deir Ammar CCGT (upgraded to 460 MW)
Deir Ammar II (538 MW) NG/HFO under construction - 2018

IPPs (1500 MW) NG

Zouk II (194 MW) NG/HFO

Jieh II (94 MW) NG/HFO

Existing Zahrani CCGT (upgraded to 460 MW)

Tyre Open Cycle PP (70 MW)

Baalbek Open Cycle PP (70 MW)

Additional plants will all have the ability to run on Natural Gas

Ministry of Energy and Water
ENERGY DEMAND IN LEBANON

Power Generation Forecast

- Electricity Demand App. 32 TWh in 2030

Gas Volume Consumption

- Volume of Gas Needed App. 0.26 TCF per year in 2030
REGIONAL MARKETS

- Lebanon holds friendly relations with Syria, Turkey, Cyprus, Egypt, Jordan and the EU.
- Lebanese Natural Gas can easily reach Syria, Jordan and Egypt through the Arab Gas Pipeline.
- Turkey can be reached by an extension of the Arab Gas Pipeline or through a short offshore shallow water pipeline.
- The EU markets can be reached through Turkey.
- Lebanon can tie-in to any regional collaboration passing through Cyprus.
Available data and studies performed at the LPA indicated the presence of large quantities of natural gas offshore Lebanon.

Natural gas can be used in the Lebanese local market.

Export options to neighbouring countries and the EU are also likely.