Middle East Shale: Potential and Implications

EAGE Workshop
Jordan, September 2013
Middle East shale – overlooked, but important

“Middle East [was] not addressed by the current study. This was primarily because there [are] significant quantities of conventional natural gas reserves” (EIA 2011)

“Shale gas is neither plentiful nor cheap” – Qatar Petroleum (2010)
Middle East Shale: Key points

• Most attention to date has focussed on impact of North American shale gas/oil on the Middle East

• But MENA shale raises important questions:
  – Does MENA have shale oil/gas resources? Where and how much?
  – Does the region need to develop its shale oil and gas?
  – Can the region develop shale resources technically & economically?
  – What are the challenges to be overcome?
Global Shale Impact
US shale boom – North Dakota (Bakken) overtakes smallest 2 OPEC members
Global gas resources

- Shale means a huge jump in global resources
- Detailed assessment of Middle East unconventional gas not publicly available
- MENA’s dominance in conventional gas challenged by unconventional gas

Shale gas can reshape gas trade flows

- White: satellite imagery of lights = energy demand
- Purple → Red: global gas basins, in increasing size of resources (USGS)
- Yellow: main current and future export routes for Middle East gas

Significant shale gas potential

Less LNG demand in Europe?

Lower Chinese (and Indian?) LNG imports

North American shale-to-LNG

North African shale gas to Europe

More intra-MENA gas trade?

Australian shale-to-LNG

New conventional gas
MENA shale resources
Early Silurian: Qusaiba, Mudawarra

Source: Afifi (2004)
Middle Jurassic: Sargelu, Naokelekan

Source: Ziegler (2001)
Late Jurassic: Jubaila-Hanifa

Source: Ziegler (2001)
Early-Middle Cretaceous: Garau/Sulaiy; Kazhdumi

Source: Ziegler (2001)
Palaeogene: Pabdeh, Aaliji

Source: Ziegler (2001)
Abu Dhabi examples: Diyab, Shilaif

- **Diyab (Late Jurassic)**
- **Well B1 tested 1000 bpd from natural fractures**

- **Shilaif (Mid-Cretaceous)**
- **31 billion bbl generated, most not migrated out of source rock**

**Source**: Ahmed K. Taher (2010)
<table>
<thead>
<tr>
<th>Country</th>
<th>Shale</th>
<th>Age</th>
<th>TOC %</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>Athel Silicilyte</td>
<td>Infracambrian-Cambrian</td>
<td>4-7</td>
<td>50-1500</td>
</tr>
<tr>
<td>Regional</td>
<td>Qusaiba</td>
<td>Silurian</td>
<td>4-12</td>
<td>20-70</td>
</tr>
<tr>
<td>Jordan, Iraq</td>
<td>Mudawwara</td>
<td>Silurian</td>
<td>4-7</td>
<td>50-1500</td>
</tr>
<tr>
<td>Turkey</td>
<td>Dadas</td>
<td>Silurian</td>
<td>2-8</td>
<td>30-61</td>
</tr>
<tr>
<td>Iraq</td>
<td>Chia Gara</td>
<td>Jurassic</td>
<td>2.5-7.5</td>
<td>30-300</td>
</tr>
<tr>
<td>Iraq, Iraq, Kuwait</td>
<td>Nahr Umr</td>
<td>Cretaceous</td>
<td>0.4-14</td>
<td>150-220</td>
</tr>
<tr>
<td>Iran, Iraq</td>
<td>Pabdeh</td>
<td>Palaeocene</td>
<td>3-7.5</td>
<td>150-220</td>
</tr>
<tr>
<td>USA</td>
<td>Barnett</td>
<td>Carboniferous</td>
<td>4.5</td>
<td>90</td>
</tr>
<tr>
<td>USA/Canada</td>
<td>Bakken</td>
<td>Devonian-Carboniferous</td>
<td>10-20</td>
<td>46</td>
</tr>
</tbody>
</table>

- Middle Eastern shales often deep (4000+ m) – but comparable to Haynesville
- Likely many are high liquids; carbonate rich (easier to fracture)
Numerous different Gulf unconventional gas plays

- Gulf unconventional plays varied, potentially large
- Sour and contaminated gas (CO$_2$, H$_2$S, nitrogen)
- Tight gas (sands & carbonates)
- Shale gas, condensate and oil
- Deep and ultra-deep
- Mixed resources (e.g. deep, tight and sour)

- Also: Egypt, Tunisia, Algeria

Source: PacWest; Manaar research
MENA gas: Shale resources significant locally and globally

Sources: BP, USGS, EIA, Petrenel, Baker Hughes, Manaar research
Middle East need for shale
Does Middle East need to produce shale oil?

- OPEC itself sees only slow growth in call for its crude
- Forecasts a slowly-falling market share from 34% today to 32% by 2015-35
- Competition for new supplies from Iraq, Iran, Libya, etc
- However shale oil can be important for non-OPEC producers
  - Oman, Egypt, Tunisia, etc
  - Algeria?
  - Associated liquids - Kuwait

Source: OPEC Bulletin & World Oil Outlook
Does Middle East need to produce shale gas?

Source: Fattouh & Stern, eds. (2010)
Long-term global gas export balance

- Middle East and Africa are the two major exporting regions
- Asia is the major importing region
- Russia supplies Europe
- Big change is the emergence of North American gas exports after 2015
- However, total Middle East gas exports do not grow much and it falls behind Africa
Abu Dhabi: gas supply squeezed to 2016
Oman: needs unconventional gas to maintain LNG exports
Gas policy motivations vary by country

- **Bring gas to domestic consumers**
  - Yemen
  - Iraq
  - Libya

- **Save domestic oil for export**
  - Kuwait
  - Syria
  - Saudi Arabia

- **Grow domestic gas to sustain exports**
  - Egypt
  - Iran
  - Oman

- **Limit dependence on gas imports**
  - Qatar
  - UAE - Northern Emirates
  - Jordan
  - Morocco
  - Tunisia
  - Dubai

Bubble size indicates market size
Implications of soaring MENA gas demand

- Need for improved efficiency and end to gas flaring
- Challenges to gas-based industrialisation & job creation
- Need for new gas exploration & development
- Power cuts and unrest
Challenges to overcome
## MENA unconventional gas SWOT analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strong existing transportation networks and infrastructure</td>
<td>• More expensive to produce than conventional gas</td>
</tr>
<tr>
<td>• Numerous organic-rich shale/carbonate horizons</td>
<td>• Gas prices not high enough to support high costs</td>
</tr>
<tr>
<td>• Carbonate-rich shales (easy to fracture)</td>
<td>• Water scarcity</td>
</tr>
<tr>
<td>• Preferential pricing for shale gas (Oman)</td>
<td>• Lack of drilling and exploration resources in North Africa at present as well as skilled labour</td>
</tr>
<tr>
<td>• Incentives for exploration and development (Algeria new Petroleum Laws)</td>
<td>• Only 3 dominant pumpers in the MENA: Schlumberger, Baker Hughes and Halliburton</td>
</tr>
<tr>
<td>• Fast-growing, gas-short domestic markets</td>
<td>• Deep reservoirs</td>
</tr>
<tr>
<td></td>
<td>• Uneven distribution of gas reserves between countries</td>
</tr>
<tr>
<td></td>
<td>• Traditional mindset of NOCs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adequate resources of shale gas and tight gas</td>
<td>• Insufficient increases in gas prices</td>
</tr>
<tr>
<td>• Gain to export in thriving gas industry</td>
<td>• Lack of adaptation of fiscal regimes</td>
</tr>
<tr>
<td>• Local market conditions - gas shortage countries have potential for long term gas supply contracts</td>
<td>• Environmental opposition in Egypt and Tunisia</td>
</tr>
<tr>
<td>• Many unexplored reserves in North Africa and Iraq</td>
<td>• Political instability, particularly in North Africa</td>
</tr>
<tr>
<td>• Saline-water &amp; non-water fracs such as CO₂ and LPG to alleviate water shortages</td>
<td>• Competition from exports from US, East Africa, East Mediterranean</td>
</tr>
</tbody>
</table>
Gas prices have to rise to support shale gas development

US shale break-even prices (source: Antero)

Iran target: ~$6
Bahrain current: $2.25
Saudi Arabia current: $0.75
Gas pricing reform slowly materialising

Source: Manaar research
Unconventional gas still competitive

- Alternative generation (solar, nuclear, coal CCS) is cheaper than LNG or oil.
- However, high-cost domestic gas (e.g. unconventional) at ~$8/MMBtu is still competitive against alternatives.

Source: Manaar research

23/07/2015
MENA frac capacity not insignificant today, but well behind China, Russia

Source: PacWest Consulting Partners; Manaar research
MENA to see fast growth in frac capacity, but still small in global terms

Source: PacWest Consulting Partners; Manaar research
Conclusions

• Shale oil and gas present both challenge and opportunity to MENA
• MENA likely to have large shale oil & gas resources, spread across many countries
• Less immediate need for shale oil given market constraints
  • But could be important in non-OPEC, second-tier producers
• Shale gas potentially important in meeting regional gas demand
  • Relevant to almost every country
• Barriers to development
  • Mainly: commercial terms, low gas prices
  • Also: water, service companies, deep reservoirs
• Region gearing up to activity: Jordan, Saudi Arabia, Oman, Algeria, Abu Dhabi, etc
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