Unlocking the “Age of Gas”

IEA-IEF-OPEC SYMPOSIUM ON GAS AND COAL MARKET OUTLOOKS
October 30, 2014

Markus Becker
Senior Director, Government Affairs & Policy
GE Oil and Gas
What is the “Age of Gas”?

Global gas consumption growth ‘13-’20
Bcm per year

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>175</td>
<td>176</td>
</tr>
<tr>
<td>Asia</td>
<td>131</td>
<td>126</td>
</tr>
<tr>
<td>US-Canada</td>
<td>142</td>
<td>131</td>
</tr>
<tr>
<td>ME</td>
<td>126</td>
<td>126</td>
</tr>
<tr>
<td>Africa</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>Lat. America</td>
<td>56</td>
<td>61</td>
</tr>
<tr>
<td>EU-Eurasia</td>
<td>61</td>
<td>61</td>
</tr>
</tbody>
</table>

Source: GE Age of Gas Outlook update June ’14

Key Benefits

- Competitiveness
- Security - Resilience
- Sustainability

Natural gas has increasing role in global energy mix

www.ge.com/AgeofGas
“Age of gas” scorecard  October 2014

Have signposts toward the “Age of Gas” strengthen or weakened?

**Mega project progress**
Cost control & execution
- Australia & Deep-water inflation

**International connections**
Coordination between states on big LNG and pipelines
- Russia – Ukraine Crisis

**UCR unleashed**
Shale development with technology & sustainable practice
- North America & China progress

**Distributed pathway**
Small scale gas solutions
- Africa & South east Asia, Upstream North America

**Pricing and contracts**
Subsidy management & flexible contracts; new models
- US gas cost remain low, Expanding discussion on new pricing models for Pacific Basin LNG

**Network focus**
Connectivity & investment
- Steady, but no major changes in Gov’t policy or focus that would accelerate NG (eg. EU, US, gas master plans etc.)

Source: GE Oil and Gas Strategic Marketing
# Gas to Power … understanding scale
Large scale feeds thermal…small scale feeds DP and virtual pipeline

## Gas to Power options

<table>
<thead>
<tr>
<th>Large</th>
<th>Int’l Mega Pipeline</th>
<th>BCFD (Bcm / MMTPA)</th>
<th>~GWe (CCGT)</th>
<th>Typical project $B CAPEX</th>
<th>Typical Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LNG Mega</td>
<td>3.5</td>
<td>20</td>
<td>$10-30B</td>
<td>Sovereign ownership state to state deals.</td>
</tr>
<tr>
<td></td>
<td>Regional Pipeline</td>
<td>2.2</td>
<td>12</td>
<td>$1-5B</td>
<td>Long-term commitments on gas and infrastructure</td>
</tr>
<tr>
<td></td>
<td>Floating LNG Regas</td>
<td>1.2</td>
<td>6.5</td>
<td></td>
<td>Mix of state owned &amp; private players</td>
</tr>
<tr>
<td>Mid</td>
<td></td>
<td>(12 / 8.5)</td>
<td></td>
<td></td>
<td>Gas and infrastructure can be separate (tolling)</td>
</tr>
<tr>
<td>Small</td>
<td>Small-scale LNG</td>
<td>MMcfd (DP) 8- 40</td>
<td>~MWe 40- 200</td>
<td>$50 - 300MM</td>
<td>Single entity or small JV partnerships</td>
</tr>
<tr>
<td></td>
<td>CNG in a Box</td>
<td>0.5- 5</td>
<td>2.5- 20</td>
<td></td>
<td>Modular, pre-configured designs</td>
</tr>
</tbody>
</table>

Source: GE Oil & Gas, GE Distributed Power; Bcfd/MMcfd: Billion/Million cubic feet per day; GWe/MWe: Giga-Megawatt equivalent
Strike zone for natural gas

Competitive landscape versus coal …

Key Issues

- Competitive landscape different by region
- Recognize peaking and load following benefits of gas
- Recognize environmental benefits
- Pricing outside the strike zone will limit market growth … particularly in Asia

Recent spot price have been in the “strike zone”

Note: Estimates of high efficiency natural gas are based on 10,000 heat rate, while lower efficiency estimates are based on a 6000 heat rate.
Distributed pathway … small gas-to-power

Oil substitution and energy access are drivers…

Key regions for small gas-to-power

Key metrics:

- % oil generation ‘13 est.
- CAGR elec. dem. ‘14–’20

North America (Upstream, mining & remote)

Caribbean

65%

+3%

LatAm *

14%

+4%

SSA (ex SA)

35%

+5%

GCC

35%

+4%

Indonesia

18%

+9%

Australia- PNG
(mining & remote)

Large growth opportunity with right structures …

* Chile, Argen., Colum., Venz.

Sources: GE Oil and Gas, GE PW Feb ’14 Outlook, IEA
Distributed gas ... rail and small shipping solutions
Cost of small LNG continue to fall ... industrial fleets and power opportunities
NGV ... Railroad opportunities

Global diesel use in Rail ~ 620K bbl/d
US Class 1 diesel use in Rail ~ 240K bbl/d
~ 7% US diesel Demand

Example Integration:
USA Multi model hubs for LNG/CNG

Generation ... Island power examples

<table>
<thead>
<tr>
<th>Indonesia</th>
<th>Gas to Power potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG potential by ’20 *</td>
<td></td>
</tr>
<tr>
<td>2.5 GW</td>
<td></td>
</tr>
<tr>
<td>3.5 MTPA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Caribbean &amp; Cent. America</th>
</tr>
</thead>
<tbody>
<tr>
<td>US LNG/CNG</td>
</tr>
<tr>
<td>Trinidad</td>
</tr>
<tr>
<td>2.7 GW</td>
</tr>
<tr>
<td>3.7 MTPA</td>
</tr>
</tbody>
</table>

* Assumes replacement of 30% installed oil capacity & gas captures 50% recip growth. 3-5 Year potential

Integrating value chain to create comprehensive solution is key

Sources: GE Oil and Gas, GE Distributed Power, IEA 2012, EIA
US Gas demand trajectory uncertain

Power sector use and exports will drive US gas demand

Changes in US Gas Demand ‘14 to ‘25
Billion cubic feet per day

<table>
<thead>
<tr>
<th></th>
<th>‘14</th>
<th>‘15</th>
<th>‘18</th>
<th>‘20</th>
<th>‘25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total US Gas Demand*</td>
<td>72.9</td>
<td>73.5</td>
<td>84.8</td>
<td>~92</td>
<td>~100</td>
</tr>
<tr>
<td>Changes in demand by sector from 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico Exports</td>
<td>0.2</td>
<td>0.7</td>
<td>4.8</td>
<td>0.4</td>
<td>2.5</td>
</tr>
<tr>
<td>LNG Exports</td>
<td>0.9</td>
<td>0.9</td>
<td>2.1</td>
<td>(0.9)</td>
<td>2.1</td>
</tr>
<tr>
<td>Vehicle</td>
<td>0.4</td>
<td>2.9</td>
<td>6.4</td>
<td>1.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Power</td>
<td>(0.5)</td>
<td>2.9</td>
<td>6.4</td>
<td>1.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Industrial</td>
<td>(1.6)</td>
<td>1.0</td>
<td>1.5</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Res/Com</td>
<td>(1.6)</td>
<td>(1.6)</td>
<td>(1.6)</td>
<td>(1.6)</td>
<td>(1.6)</td>
</tr>
</tbody>
</table>

Sources: GE Oil and Gas, Baseline case Aug ‘14. EIA, Excludes Alaska

* Includes Net Exports

Demand side issues

1. LNG exports could be big
   US Gov’t policy and gas prices will dictate how fast

2. Transportation, Industrial sectors are all lining up for lower cost NG

3. Power sector gas demand has biggest growth potential … will be sensitive to price and policy
Lessons from North America

**Upstream**

- Learning by doing …
  - Innovation – exploration
  - Development

Standardization is difficult because each basin/well is different

**Competitive industry structure**

- Fast scale up
- Rapid investment
- Coordination issues & constraints

**Midstream & downstream**

**Integrating infrastructures**

- Gas with renewable energy
- Gas for transportation

**Gas network evolution**

- Developing Phase:
  - Point-to-point
- Growth Phase:
  - Hub-and-spoke
- Mature phase:
  - Multiple Networks

- Pipeline
- LNG
- CNG

Source: GE Global Strategy & Analytics “Age of Gas” 2013

Unleash the innovators … build the networks … to unlock the Age of Gas
Natural gas-fired power share varies by region...

Competition versus coal ... CAPEX vs Fuel contract

**Share of gas fired generation**
2013 estimated

- **Middle East**: 60%
- **Eurasia**: 44%
- **Southeast Asia**: 35%
- **Africa**: 32%
- **North Asia**: 31%
- **North America**: 28%
- **Latin America**: 24%
- **Europe**: 20%
- **India**: 7%
- **China**: 2%

**Levelized cost of electricity LCOE**
US Cents/Kwh - North Asia example

- **Coal ST @ 4.5**: $1,900 KW
- **Coal ST @ 3.5**: $790 KW
- **IGCC**: $1,900 KW
- **CCGT @ $16**: $1,900 KW
- **CCGT @ $14**: $1,900 KW
- **CCGT @ $12**: $1,900 KW
- **CCGT @ $10**: $1,900 KW

- ~800 MW – 36% efficient
- 90% CF
- $1,900 KW
- 30 year asset life
- 15% return
- 60/40 Debt Equity
- No Carbon price

- ~770 MW – 61% efficient
- 90% CF
- $1,900 KW
- 30 year asset life
- 15% return
- 60/40 Debt Equity
- No carbon price

Source: GE Strategy and Analytics 2014.
Note: North Asia includes Japan, Chinese Taipei Korea
Southeast Asia excludes India
LNG industry evolution continues

Global LNG demand
MTPA ‘00 - ‘20

+11% CAGR

105

‘00

220

‘10

360

‘20

Source: GE, CERA

LNG demand growth
MTPA ‘14-‘20

+145

85% in contract or tolling

Europe

35

China

32

India

31

Asia-Pac

23

LA

12

JKT

8

LNG designs evolve

LNG 1st gen

LNG Mega-trains

Brownfield Regas plant Conversions

Next gen onshore LNG

Small-scale LNG

Floating LNG

Feedstock slate growing

✓ Stranded gas (big fields)
✓ Offshore
✓ Sour
✓ Associated
✓ Arctic
✓ Stranded gas (small fields)
✓ CBM
✓ Shale & tight gas

Upside potential

LNG network expanding

LNG% of total traded gas

2012

2012

2012

2012

2012

2012

Importers

Exporters

GE Age of Gas

Europe

China

India

Asia-Pac

LA

JKT

Age 25

Age 42

Age 41%

MTPA '00 - '20

+7-8% CAGR

LNG demand growth
MTPA '14-20

Europe

+145

85% in contract or tolling

MTPA '00 - '20

105

220

360

Source: GE, CERA

Industry poised to grow 60% over next 5-7 years … but will look very different