Global Vision for Gas

The Pathway towards a Sustainable Energy Future

Roberto D. Brandt

International Gas Union (IGU)

Lima – July 3, 2012
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1. What is IGU?

2. IGU’s Global Vision for Gas

3. Unconventional Gas
IGU is **THE Spokesman for the Gas Industry**

- Worldwide and non-profit organization established in 1931
- Promotes political, technical and economic progress of the gas industry
- Organizes World Gas Conferences every 3 years
- Emphasizes sound environmental performance worldwide
- Increased focus on strategic, policy issues and gas advocacy
- Cooperates with IEA, United Nations, World Bank, IEF and other international organizations
IGU represents 95% of Global Gas Sales

**Latin American & Caribbean Membership**
- Argentina
- Brazil
- Mexico
- Peru
- Trinidad & Tobago
- Venezuela

- 79 Charter Members
- 38 Associate Members
- 11 Affiliated Organisations
Peru won IGU’s Social Gas Award 2012

This is to certify that the IGU

SOCIAL GAS AWARD 2012

has been honoured to

Mr Luis Felipe Fernández Pérez
Peru

for the project
“Vehicle conversion to dual gasoline/CNG from
150 to 100,000 in 5 years in Peru”

25th World Gas Conference, Kuala Lumpur, Malaysia 4-8 June 2012

[Signatures]

Dato’ Dr. Abdul Ra’i bin Hashim
President

Torstein Inderberg
Secretary General
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1. What is IGU?
2. IGU’s Global Vision for Gas
3. Unconventional Gas
IGU’s Global Vision for Gas:
The Pathway towards a Sustainable Energy Future

Published in June 2012

Available on http://www.igu.org
## Natural Gas: Addressing the World’s Challenges

### Key Global Challenges

<table>
<thead>
<tr>
<th>Population Growth &amp; Resource Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Development &amp; Employment</td>
</tr>
<tr>
<td>Energy Poverty &amp; Public Health</td>
</tr>
<tr>
<td>Air Quality &amp; Climate Change</td>
</tr>
<tr>
<td>Mobility</td>
</tr>
<tr>
<td>Affordability</td>
</tr>
</tbody>
</table>

### Role of Natural Gas

- Newly Recognised Abundant Resource Base
  - conventional, deepwater & unconventional
  - Industrial Feedstock
  - Employment Creation
- Combat indoor pollution & urban smog
- Negligible SOx, particulates
- Low levels of NOx and CO₂
- LNG for trucks and shipping
- CNG and/or electric vehicles for cars
- CCGTs as lowest cost low carbon technology
IGU’s Global Vision for Gas

Natural gas is very well-suited to meet these challenges

- **Availability:** Abundant & growing resource base
- **Affordability and strong cost competitiveness**
- **Acceptability:** Low carbon option
- **Efficiency, especially for power generation**
- **Reliability & adaptability:** Proven technologies
Natural Gas: Resource Availability

What is the Global Availability of Natural Gas?
Global Natural Gas Recoverable Resources vs Demand
(Trillion Cubic Meters)

- Cumulative Historic Production: 93
- Proven Reserves: 187
- Conventional Potential: 217
- Unconventional Potential: 385
- Global Natural Gas Potential: 789

Chart does not include:
- Biogas
- Natural Gas Hydrates

Annual Demand Growth at 1%: 3.5%
The task to meet future global energy needs whilst at the same time addressing air quality and climate change concerns is challenging.
IGU’s Pathway Trajectory: Global Emissions Reductions, by Abatement Method

- **Base Case**
- **Reducing Demand**
- **Coal to Gas Substitution**
- **Oil to Gas Substitution**
- **Transport Oil Substitution**
- **Renewables and Nuclear**
- **Biogas**
- **Carbon Capture**
- **Pathway**

CO₂ Emissions (billion tons)

- Reductions from Greater Gas Use
- Reductions from Other Technologies
- Reductions from Both Greater Gas Use and Other Technologies
IGU’s Pathway Trajectory: Global Emissions Reductions, by Consumer Sector
IGU’s Pathway Trajectory: Global Emissions Reductions, by Region
As today, power generation will be the largest consumer sector by 2050.
IGU’s Pathway Trajectory: Implications for Gas Market Share of Primary Energy

- **1990**: 90% Solid Waste and Biomass, 20% Primary Electricity
- **2010**: 80% Solid Waste and Biomass, 20% Primary Electricity
- **2035 Base Pathway Case**: 70% Solid Waste and Biomass, 30% Primary Electricity
- **2035**: 60% Solid Waste and Biomass, 40% Primary Electricity
- **2050 Base Pathway Case**: 50% Solid Waste and Biomass, 50% Primary Electricity
- **2050**: 40% Solid Waste and Biomass, 60% Primary Electricity

Significant regional differences in energy market sizes and gas penetration by country.

Policy will be particularly important in the areas where the greatest reductions in emissions are projected:

- Demand reduction & energy efficiency
- Coal to gas substitution
- Carbon capture
Latin America & Caribbean: Main Challenges for the Growth of the Natural Gas Industry

<table>
<thead>
<tr>
<th>Regions / Countries</th>
<th>Major Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Integrated domestic markets</td>
<td>• Competition against other energy sources&lt;br&gt;• Acceptability of market economics and long-term pricing policies&lt;br&gt;• Marketing of associated gas&lt;br&gt;• Infrastructure expansion&lt;br&gt;• Diversity of national energy policies / Regional integration</td>
</tr>
<tr>
<td>Argentina</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td></td>
</tr>
<tr>
<td>B. Emerging markets</td>
<td>• Internal market development</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td></td>
</tr>
<tr>
<td>Uruguay</td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td></td>
</tr>
<tr>
<td>C. Predominantly exporters</td>
<td>• Ability to attract investment&lt;br&gt;• Ability to retain external market share</td>
</tr>
<tr>
<td>Bolivia</td>
<td></td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td></td>
</tr>
</tbody>
</table>
The ‘Global Vision for Gas’ lays out a clear pathway towards a sustainable energy future.

There is a strong need for a portfolio approach in energy, combining:
- Reductions in energy use
- Enhanced energy efficiency
- Expanded use of zero carbon technologies
- Greater resort to clean-burning natural gas

Policymakers need to recognize the critical role that natural gas has to play alongside other low carbon options, and facilitate the appropriate policy enablers as befits each region, based on its particular circumstances.
1. What is IGU?

2. IGU´s Global Vision for Gas

3. Unconventional Gas
Proved World Natural Gas Reserves, by Region - 2011 (%)

Total: $208,4 \times 10^{12}$ m$^3$

(7360,9 Tcf)

References: (1) Excludes Mexico (included in Latin America & Caribbean).

Reserves life index (RLI) of 63 years, with 49% concentrated in Russia, Iran and Qatar.

World Natural Gas Production, by Region - 2011 (%)

Total: 3,3 x 10^{12} \text{ m}^3 
(115,7 Tcf)

USA represents 20% of the world’s total, with 60% of its production coming from unconventional gas. The latter has considerably impacted international Liquefied Natural Gas (LNG) trade and flows.


References: (1) Excludes Mexico (included in Latin America & Caribbean).
Classification and Potential of Existing Gas Resources

Most advanced unconventional gas technologies: Shale gas, Coal-bed methane (CBM) and Tight-sands.

Source: Ziff Energy Group, Canada.
Comparison of Unconventional Gas Resources vs. “Conventional” Gas Reserves

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Volume $10^{12}$ m$^3$</th>
<th>Volume Tcf</th>
<th>Order of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Conventional&quot; Natural Gas</td>
<td>208,4</td>
<td>7360,9</td>
<td>1,0</td>
</tr>
<tr>
<td>Tight-sand gas</td>
<td>209,7</td>
<td>7405,6</td>
<td>1,0</td>
</tr>
<tr>
<td>Coal-bed methane / CBM</td>
<td>256,1</td>
<td>9044,2</td>
<td>1,2</td>
</tr>
<tr>
<td>Shale gas</td>
<td>456,3</td>
<td>16114,2</td>
<td>2,2</td>
</tr>
<tr>
<td>Gas hydrates / Under study</td>
<td>2500</td>
<td>88287,5</td>
<td>12,0</td>
</tr>
</tbody>
</table>

Estimated resources of Shale gas, CBM and Tight-sands more than quadruple the 2011 gas reserves.

Source: R. Brandt, based on Kawata & Fujita, Japan.
Technically Recoverable Shale Gas Resources - 2011

<table>
<thead>
<tr>
<th>REGION / COUNTRY</th>
<th>Tcf</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North America</strong></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>862</td>
</tr>
<tr>
<td>Canada</td>
<td>388</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>187</td>
</tr>
<tr>
<td>France</td>
<td>180</td>
</tr>
<tr>
<td>Norway</td>
<td>83</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>1275</td>
</tr>
<tr>
<td>India</td>
<td>63</td>
</tr>
<tr>
<td>Pakistan</td>
<td>51</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>396</td>
</tr>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>485</td>
</tr>
<tr>
<td>Libya</td>
<td>290</td>
</tr>
<tr>
<td>Algeria</td>
<td>231</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REGION / COUNTRY</th>
<th>Tcf</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Latin America</strong></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>774</td>
</tr>
<tr>
<td>Mexico</td>
<td>681</td>
</tr>
<tr>
<td>Brazil</td>
<td>226</td>
</tr>
<tr>
<td>Chile</td>
<td>64</td>
</tr>
<tr>
<td>Paraguay</td>
<td>62</td>
</tr>
<tr>
<td>Bolivia</td>
<td>48</td>
</tr>
<tr>
<td>Uruguay</td>
<td>21</td>
</tr>
<tr>
<td>Colombia</td>
<td>19</td>
</tr>
<tr>
<td>Venezuela</td>
<td>11</td>
</tr>
</tbody>
</table>

China, USA, Argentina, Mexico and South Africa “rank” among the first 5 of the 32 countries covered by the survey. Moving from Shale gas “resources” to “reserves” will be a major challenge.

Source: US Energy Information Administration (EIA/DOE) / Advanced Resources International (ARI), April 2011.
Comparison of Gas vs. Oil Prices in Developed Markets - 2000/2011 (US$/10^6 BTU)


Reference: BTU: British Thermal Unit.
USA: Break-even Prices for Unconventional Gas 2008/11 (US$/10^6 BTU)

Significant differences in “break-even” prices of unconventional gas reservoirs. Henry Hub volatility!

Global Vision for Gas
The Pathway towards a Sustainable Energy Future
Backup Slides
Roberto D. Brandt
International Gas Union (IGU)
Lima – July 3, 2012
France heads the IGU in the 2012-2015 Triennium
Theme

“Growing together towards a friendly planet”

- Natural Gas is a destination fuel necessary for Sustainable Development
- Natural Gas must be available everywhere (new emerging countries), and its role will grow in Asia and South America
- Continuity and building on the last presidencies actions is key
Strategic Guidelines

“Growing together towards a friendly planet”

- Advocating for the development of natural gas as a destination fuel necessary for Sustainable Development
- Promoting an accurate combination with renewable energies and electricity
- Improving availability of natural gas in new areas and in developing countries
- Attracting and retaining Human Resources for the Future
IGU’s Triennial Work Programme 2012-2015

Strategic Vision

“Growing together towards a friendly planet”

Human Resources for the Future

Natural Gas for a Sustainable Development

Natural Gas Available Everywhere

Combination with Renewables & Electricity
Latin America & Caribbean:  
IGU Charter Members

- **Argentina**
  - Instituto Argentino del Petróleo y del Gas (IAPG)

- **Brazil**
  - ABEGAS - Associação Brasileira das Empresas Distribuidoras de Gás Canalizado

- **Mexico**
  - Asociación Mexicana de Gas Natural, A.C.

- **Peru**
  - PERUPETRO S.A.

- **Trinidad and Tobago**
  - The National Gas Company of Trinidad and Tobago Limited

- **Venezuela**
  - Petróleos de Venezuela S.A. (PDVSA)
Latin America: IGU Associate Members

- Instituto Brasileiro de Petróleo, Gás e Biocombustíveis
- Petróleo Brasileiro S.A. – Petrobras
- TBG - Transportadora Brasileira Gasoduto Bolivia-Brazil S/A
Global Gas Vision: Base Case Outlook

The model builds up energy demand both ‘bottom-up’ by key industrial sector, and on a regional basis.

Outlook for Real GDP Growth by Region, 2010–50

<table>
<thead>
<tr>
<th>Region</th>
<th>Real GDP Growth (2010–50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>3.4%</td>
</tr>
<tr>
<td>Africa</td>
<td>4.0%</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>4.4%</td>
</tr>
<tr>
<td>Commonwealth of Independent States</td>
<td>3.0%</td>
</tr>
<tr>
<td>Europe</td>
<td>1.9%</td>
</tr>
<tr>
<td>Latin America</td>
<td>4.3%</td>
</tr>
<tr>
<td>Middle East</td>
<td>3.7%</td>
</tr>
<tr>
<td>North America</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

Outlook for Population by Region

- CIS
- Middle East
- North America
- Latin America
- Europe
- Africa
- Asia Pacific

Population (billions)
Global Gas Vision: Air Quality and Climate Change

Natural gas is a clean-burning and low carbon fuel

The emissions of NOx from natural gas are typically 63 percent less than from oil and at least 60 percent less than for coal. The emissions of SOx from natural gas are almost negligible, and so are particulates.

In terms of carbon dioxide, natural gas typically has 40 percent less carbon content than coal, and 25 percent less carbon content than oil.
Global Gas Vision: Carbon Capture

To achieve even further reductions in emissions, it will be necessary either to rely exclusively on non-fossil fuel options, or to deploy carbon capture technologies widely in addition to the non-fossil fuel options.

Natural gas CCS is likely to have two significant cost advantages over coal CCS:

- The Capex (investment) cost for gas will be lower.
- The cost of CO\textsubscript{2} transportation and storage (T&S) will be lower.
IGU’s Pathway for Natural Gas Development

The ‘Global Vision for Gas’ lays out a clear pathway towards a sustainable energy future

- Improved air quality and public health
- Affordable energy
- Available resources
- Sharply reduced greenhouse gas emissions
Carbon emissions are expected to grow significantly in Latin America

Oil is dominant

The substitution of oil, largely in the transport sector, is a key part of bringing emissions down.
Global Gas Vision: Economic Impact

- Gas prices remain broadly at today’s levels in 2050.
- The lowest cost form of new base load power generation today is generally gas-fired CCGTs in the OECD.
- The gas industry is a major generator of employment across the globe.
In the pathway to a sustainable energy future, natural gas is more than a bridge, it is a destination fuel!
## Unconventional Gas Resources, by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Shale gas</th>
<th>Coal-bed methane / CBM</th>
<th>Tight-sand gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$10^{12}$ m$^3$</td>
<td>Tcf</td>
<td>$10^{12}$ m$^3$</td>
</tr>
<tr>
<td>North America</td>
<td>108,8</td>
<td>3842,3</td>
<td>85,4</td>
</tr>
<tr>
<td>Former Soviet Union</td>
<td>17,8</td>
<td>628,6</td>
<td>112,0</td>
</tr>
<tr>
<td>Central Asia and China</td>
<td>99,9</td>
<td>3528,0</td>
<td>34,4</td>
</tr>
<tr>
<td>Asia Pacific (OECD)</td>
<td>65,5</td>
<td>2313,1</td>
<td>13,3</td>
</tr>
<tr>
<td><strong>Latin America &amp; Caribbean</strong></td>
<td><strong>59,9</strong></td>
<td><strong>2115,4</strong></td>
<td><strong>1,1</strong></td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>72,2</td>
<td>2549,7</td>
<td>0,0</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>7,8</td>
<td>275,5</td>
<td>1,1</td>
</tr>
<tr>
<td>Western Europe</td>
<td>14,4</td>
<td>508,5</td>
<td>4,4</td>
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<tr>
<td>Asia Pacific (Other)</td>
<td>8,9</td>
<td>314,3</td>
<td>0,0</td>
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<tr>
<td>Central and Eastern Europe</td>
<td>1,1</td>
<td>38,8</td>
<td>3,3</td>
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<tr>
<td>South Asia</td>
<td>0,0</td>
<td>0,0</td>
<td>1,1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>456,3</strong></td>
<td><strong>16114,2</strong></td>
<td><strong>256,1</strong></td>
</tr>
</tbody>
</table>

Source: R. Brandt, based on Kawata & Fujita, Japan.