Natural Gas: An abundant, cleaner-burning energy solution
Energy Use Evolves Over Time

Global Demand by Fuel
Quadrillion British Thermal Units (BTU)

Quelle: Smil, Energy Transitions (1800-1960)
Global Energy Demand Per Day
Global Energy Mix

Quadrillion BTUs

Oil 225 2040 0.8%
Gas 200 2010 1.7%
Coal 175 -0.1%
Nuclear 150 2.4%
Biomass 125 0.4%
Solar / Wind / Biofuels 100 5.8%
Hydro / Geo 75 1.8%

Average Growth / Yr
2010 – 2040
1.0%
Benefits of Natural Gas

**Flexible**
High energy content and ease of transport is making gas the fuel of choice.

**Clean**
Natural gas is the cleanest burning fossil fuel.

**Secure**
The world has abundant and easily accessible natural gas resources.

**Revenue Generator**
Growing production provides jobs, tax revenue and personal income.
Remaining Global Gas Resource

Over 200 years coverage at current demand

Quelle: IEA; *Includes Europe Non OECD
Character of the Source Rock

**Conventional reservoir**
- Good permeability due to the pore fabric
- Natural Gas flows to the well due to reservoir pressure

**Unconventional reservoir**
- Pore spaces very small (< 20% of conventional reservoirs)
- Low to hardly any permeability (1/1000 of conventional reservoirs or less)
- Natural gas is not able to flow to the well by itself
- Formations: Tight Gas, **Shale Gas**, Coal bed methane
Hydraulic Fracturing: Aquifer protection

- Aquifers protected by several layers of steel and impermeable cement
- No different from a conventional oil or gas well, or geothermal well

Source: OGP, Total
Natural Gas Spot Price
USA/ Europe/ Asia

**Historic Henry Hub, NBP and JLNG Prices**

- **Henry Hub (€ct/Kwh)**
- **NBP (€ct/Kwh)**
- **JLNG (€ct/Kwh)**

Henry Hub = virtual trading location USA (natural gas pipeline system in Erath, Louisiana)

NBP = National Balancing Point virtual trading location UK

JLNG = Japan Liquefied Natural Gas Import Price

ExxonMobil
Taking on the world’s toughest energy challenges.
US electricity generation growth 2006-2011

Over the past 5 years, natural gas & renewables were the leading sources of incremental electricity generation in the United States

* Graph from IEA Presentation: A Future for Gas by Fatih Birol

ExxonMobil
Taking on the world’s toughest energy challenges.
CO2 emissions in the United States have now fallen by 430 Mt (7.7%) since 2006, the largest reduction of all countries or regions.

* Graph from IEA Presentation: A Future for Gas by Fatih Birol
Oil and Natural Gas imports 2010-2035

Source: IEA World Energy Outlook 2012
### Energy Outlook Germany

#### Primary Energy Consumption

**Millions of tons SKE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil</th>
<th>Natural Gas</th>
<th>Coal</th>
<th>Nuclear</th>
<th>Renewables</th>
<th>Others</th>
<th>External trade balance of electricity</th>
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<tbody>
<tr>
<td>2000</td>
<td>188</td>
<td>102</td>
<td>110</td>
<td>0,4</td>
<td>45</td>
<td>14</td>
<td>-2,1</td>
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<tr>
<td>2010</td>
<td>160</td>
<td>105</td>
<td>105</td>
<td>0,6</td>
<td>52</td>
<td>9</td>
<td>-0,6</td>
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<tr>
<td>2020</td>
<td>159</td>
<td>106</td>
<td>94</td>
<td>1,1</td>
<td>72</td>
<td>49</td>
<td>9</td>
</tr>
<tr>
<td>2030</td>
<td>133</td>
<td>119</td>
<td>72</td>
<td>2,0</td>
<td>81</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>2040</td>
<td>90</td>
<td>122</td>
<td>45</td>
<td>1,6</td>
<td>88</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

**Primary Energy Consumption decreases by 25%**

**Natural Gas will become energy source #1**
Natural Gas Supply Germany 2012

- Norway: 31%
- Russia: 34%
- Netherlands: 19%
- Germany: 12%

About one third of production based on hydraulic fracturing
Potential in Germany

- BGR: up to 22.3 trillion m³ Shale gas
- Cautious approach: ~10% recoverable, meaning:
  
  **0.7 up to 2.3 trillion m³**

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4.3 Schiefergasressourcen

In Deutschland gibt es bislang keine Schiefergasförderung und deshalb auch keine Erfahrungswerte zum technisch gewinnbaren Anteil aus den GIP-Mengen. Produktionsdaten aus den USA zeigen, dass der Gewinnungsfaktor zwischen 10 % und 35 % der GIP-Mengen schwanken kann. Im Sinne einer konservativen Abschätzung wird in dieser Studie von einem technischen Gewinnungsfaktor von 10 % der GIP-Mengen ausgegangen. Entsprechend würde sich die technisch gewinnbare Erdgasmenge auf 0,7 bis 2,3 Bill. m³ belaufen (Tab. 4-2). Diese Menge liegt damit deutlich über Deutschlands konventionellen Erdgasressourcen mit 0,15 Bill. m³ und Erdgasreserven mit 0,146 Bill. m³.
Decades of Experience

- ExxonMobil produces Natural Gas from about 230 wells in Lower Saxony
- So far industry-wide about 300 Fracs in 50 years in Germany
- So far about 800 billions m³ natural gas were produced
- Engineering-know-how: World-record-project Söhlingen Z10 in 1995
50 Years of Hydraulic Fracturing

Number of Fracs in Germany since 1961

about 300 -> 180 executed by ExxonMobil or subsidiaries
Public Perception is Shaped by Images
Dialogue with Communities
Public Information and Dialogueprocess

Process facilitators: Ruth Hammerbacher und Dr. Christoph Ewen

Work group of social actors

- Communities
- Group of residents and interest groups
- Cultural-historical associations (Heimatverbände)
- Water and nature conservation authorities
- Environmental groups
- Water Management, regional and supra-regional
- Agriculture
- Tourist boards
- Trade Associations

Neutral Body of Experts

Scientific Coordinator: Water Conservation/ Ecosystem analysis:
Prof. Dr. Dietrich Borchardt
Helmholtz Centre for Environmental Research

Geology/ Hydrogeology:
Prof. Dr. Martin Sauter
University of Göttingen

Multi-phase flow in the subsurface:
Prof. Dr. Rainer Helmig
University of Stuttgart

Toxicology/Bioanalytical Ecotoxicology:
PD Dr. Rolf Altenburger
Helmholtz Centre for Environmental Research

Environmental Chemistry/ Drinking Water:
Prof. Dr. Fritz Frimmel
Karlsruhe Institute of Technology

Risk Assessment and Water Rights:
Prof. Dr. Alexander Roßnagel
University of Kassel

Human Toxikology:
Prof. Dr. Ulrich Ewers
Institute for Environmental Hygiene and Toxicology

Plant Safety:
Dr. Hans-Joachim Uth
Formerly German Federal Environment Agency

Presentation and discussion of the results

Citizens

Public events

Online dialogue
Recent Studies

**Consensus findings of all four Study:**
- No reason to ban the technology, Definition of excluded areas
- Step-by-Step proceeding with scientific participation
- Continuation of Exploration
- Reassessment of the risks as more data is available

**Adding further data:**
- Plant safety, Wellintegrity,
- Monitoring, Frac-Additives, Frac-Model
- Watermanagement, Disposal, diffused Methane
Summary

• In 2030 Natural Gas will be energy source #1 in Germany

• Domestic Shale Gas has a significant potential

• Local production offers numerous advantages:
  • Provides greater energy security
  • Creates local and national economic benefit
  • Maintains high environmental and safety standards for production
  • No need for transport – saves energy and emissions