Natural gas

Agnieszka KOSCIELNIAK
Statistician, Energy Statistics Section

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Overview

• Background

• Key concepts
  - What is natural gas?
  - What are the main flows?

• Common reporting problems

• Final remarks
Background
Natural gas - Introduction

• First recorded use of natural gas for energy purposes:
  - Circa 500 B.C. the Chinese discovered the potential to use to seeping natural gas from rock fissures,
  - using crude bamboo pipelines to transport the gas,
  - where it was used to boil sea water, separating the salt and making it palatable. (source: http://naturalgas.org/overview/history/)

• Leap forward a couple of millennia, in the XIX Century, natural gas started being exploited commercially, starting in the US
  - (although the UK had already an established industry of manufactured gas from coal)
Examples

Colliery gas as a source for generating electricity at the Appin Tower coal mines in New South Wales, Australia.
World gas demand steadily increased over last 25 years and is expected to further rise over next two decades.

Natural gas perspective

- The cleanest (or less polluting) fossil fuel, plentiful and dynamic fuel
- Recent increase in trade (LNG), and price volatility
Share of natural gas in TES 2015

Key concepts

What is natural gas?
What are the main flows?
Natural gas – definition

• A mixture of gaseous hydrocarbons, primarily **methane**, but generally also including ethane, propane and higher hydrocarbons [...] and some non-combustible gases. (SIEC)

Associated gas
- Natural gas found in underground reservoirs/fields producing both liquid and gaseous hydrocarbons

Non-associated gas
- Natural gas found in underground reservoirs/fields producing only gaseous hydrocarbons.

Colliery/coal seam/shale gas
- Methane recovered from coal mines (colliery gas), or from coal seam (coal seam gas), and shale gas.
Marketable natural gas

- Natural gas is not a chemically unique product.
- Some quantities are vented/flared/reinjected during production.
- Only after processing becomes marketable.
- Separation removes or reduces others hydrocarbons to acceptable marketable levels, but methane dominate the mix.
- Liquid hydrocarbons produced in association with natural gas are referred to as Natural Gas Liquids (NGL). NGLs removed in the process are distributed separately.
Liquified natural gas (LNG)

- Natural gas may be liquefied to simplify storage and transportation.
- When natural gas is liquefied it is called liquified natural gas (LNG).
Natural gas flows

Supply

Production

Exports
Stock build
Intern. Bunkers

Transformation
Energy own use
Losses
Final consumption

Imports
Stock draw
Stock draw
Natural gas flows – supply

Extraction of non-associated gas

Extraction of associated gas

Separation

Inert gases, NGLs, Sulphur, Other impurities

Flaring, venting, re-injection

Colliery gas, coal seam gas, shale gas

Production

Imports

Exports

Stock draw

Stock build

International bunkers

Total energy supply
Natural gas flows – energy industries

Transfers

Transformation
- Electricity plants
- Combined Heat and Power (CHP) plants
- Heat plants
- Gas-to-liquids (GTL) plants
- Other transformations

Own use by energy industries
- Oil and gas extraction
- Gasworks
- Blast furnaces
- Oil refineries
- Liquefaction/regasification plants (LNG)
- Electricity, heat and CHP plants
- Other own use

Losses
Natural gas flows – transformation

Natural gas

Transformation to power
- Electricity/heat plants
- Electricity
- Heat

Other transformations
- Coke ovens
- Coke oven gas
- Blast furnaces
- Blast furnace gas
- Other recovered gases
- Gas works
- Gas-works gas
- Gas coke
- Gas-to-liquids plants
- Oil products
Natural gas flows – final consumption

Final energy consumption

Manufacturing, construction and non-fuel mining industry

- Iron and steel
- Chemical and petrochemical
- Other manufacturing
- Construction
- Non-fuel mineral industry

Transport

- Road
- Domestics navigation
- Pipeline transport
- Others

Other

- Households
- Agriculture, forestry, fishing
- Commerce and public services
- Not elsewhere specified (other)

Non-energy consumption
<table>
<thead>
<tr>
<th>Item number</th>
<th>Data item</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Production</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Of which: Associated gas</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Of which: Non-associated gas</td>
</tr>
<tr>
<td>3.1.3</td>
<td>Of which: Colliery and Coal Seam Gas</td>
</tr>
<tr>
<td>3.2</td>
<td>Production from other sources</td>
</tr>
<tr>
<td>3.3</td>
<td>Extraction losses</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Of which: gas flared</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Of which: gas vented</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Of which: gas re-injected</td>
</tr>
<tr>
<td>3.4</td>
<td>Gas flared (except during extraction)</td>
</tr>
<tr>
<td>3.5</td>
<td>Gas vented (except during extraction)</td>
</tr>
</tbody>
</table>
### Additional data items – production, storage

<table>
<thead>
<tr>
<th>Item number</th>
<th>Data item</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Peak output</td>
</tr>
<tr>
<td>6.2</td>
<td>Gas storage facility – Name</td>
</tr>
<tr>
<td>6.3</td>
<td>Gas storage facility – Type of storage</td>
</tr>
<tr>
<td>6.4</td>
<td>Gas storage facility – Working capacity</td>
</tr>
</tbody>
</table>
Additional data items – reserves

| Class A: Commercially recoverable resources |
| Class B: Potentially commercially recoverable resources |
| Class C: Non-commercial and other known deposits |

<table>
<thead>
<tr>
<th>Item number</th>
<th>Data item</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>Opening stocks of mineral and energy resources (by type of resources and by type of characteristics)</td>
</tr>
<tr>
<td>8.2</td>
<td>Closing stocks of mineral and energy resources (by type of resources and by type of characteristics)</td>
</tr>
</tbody>
</table>
Measurement units

- Gaseous fuels are generally measured in Volume (e.g. m$^3$) and energy units (e.g. Joules)
  - Preferred reporting: energy units
  - If volume units are used, calorific values should be provided

- Volume measures generally based on 2 reference conditions:
  - Normal conditions: measured at 0°C Celsius and at a pressure of 760 mm Hg
  - Standard conditions: measured at 15°C Celsius and at a pressure of 760 mm Hg

Recommended **standard conditions**, particularly if NCVs not known or not provided
Table A2.5: Conversion equivalents between Standard cubic metres (m³) and Normal cubic metres (m³)

<table>
<thead>
<tr>
<th>From:</th>
<th>To</th>
<th>Standard m³</th>
<th>Normal m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard m³</td>
<td></td>
<td>1</td>
<td>0.948</td>
</tr>
<tr>
<td>Normal m³</td>
<td></td>
<td>1.055</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Standard cubic metre (m³) refers to standard measurement conditions at 15°C and 760 mm Hg. Normal cubic metre (m³) refers to normal measurement conditions at 0°C and 760 mm Hg.
### LNG and natural gas units

**Table A2.6: Conversion equivalents between LNG and Natural Gas units**

<table>
<thead>
<tr>
<th>From</th>
<th>To:</th>
<th>Metric Tons of LNG</th>
<th>m(^3) of LNG</th>
<th>Standard m(^3) (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metric Tons of LNG</td>
<td>1</td>
<td>2.2</td>
<td>1360</td>
<td></td>
</tr>
<tr>
<td>m(^3) of LNG</td>
<td>0.45</td>
<td>1</td>
<td>615</td>
<td></td>
</tr>
<tr>
<td>Standard m(^3)</td>
<td>7.35*10(^{-4})</td>
<td>1.626*10(^{-3})</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

(a) 1 Standard m\(^3\) = 40 MJ.

- These conversion tables are default conversion tables.
- Actual conversion factors may vary according to the composition of the natural gas in question.
Common reporting problems
Common reporting problems

- Sometimes data are reported in tons (of LNG).
  - Hard to make the conversion into Terajoules

- Calorific values are missing when data are reported in volume (cubic metres, cubic feet)
  - Conversion using default NCVs adds inaccuracy to figures

- Flaring and venting – often not reported

- Production reported includes quantities that should be excluded:
  - Such as re-injection, flaring, venting, shrinkage, inert matter

- Imports and exports (border crossing, not change in ownership)
Common reporting problems

• Input into electricity and heat plants reported as final consumption
  - Particularly for autoproducers
  - Transformation vs final consumption

• Energy use vs non-energy use
  - Purpose of use (energy or feedstock) has to be inquired
  - Special attention to industries that can produce “non-energy products” from natural gas: fertilizers, plastics, etc
  - Feedstock for methanol can be a problem, depending on whether the methanol is used for energy or non-energy purposes

• Consumption in transport by pipelines is not reported
  - Instead this is reported as oil and gas industry
**UN Energy Statistics Questionnaire**

- Arranged by product and then flow
- Structure is constant across products (with a few exceptions)
- Questionnaire includes data for last six years for revisions (further revisions always possible)

### Natural Gas (including LNG) (NG); Terajoules (HSO)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG01</td>
<td>Production</td>
</tr>
<tr>
<td>NG02</td>
<td>Receipts from other sources</td>
</tr>
<tr>
<td>NG03</td>
<td>Imports</td>
</tr>
<tr>
<td>NG04</td>
<td>Exports</td>
</tr>
<tr>
<td>NG051</td>
<td>International marine bunkers</td>
</tr>
<tr>
<td>NG052</td>
<td>International aviation bunkers</td>
</tr>
<tr>
<td>NG06</td>
<td>Stock changes</td>
</tr>
<tr>
<td>NGGA</td>
<td>Total energy supply</td>
</tr>
<tr>
<td>NGSD</td>
<td>Statistical differences</td>
</tr>
<tr>
<td>NG08</td>
<td>Transformation</td>
</tr>
<tr>
<td>NG088</td>
<td>Transformation in electricity, CHP and heat plants</td>
</tr>
<tr>
<td>NG082</td>
<td>Gas works</td>
</tr>
<tr>
<td>NG085GL</td>
<td>Gas-to-liquid (GTL) plants</td>
</tr>
<tr>
<td>NG09</td>
<td>Energy industries own use</td>
</tr>
<tr>
<td>NG101</td>
<td>Losses</td>
</tr>
<tr>
<td>NG10A</td>
<td>Final consumption</td>
</tr>
<tr>
<td>NG11</td>
<td>Non-energy uses</td>
</tr>
<tr>
<td>NG12</td>
<td>Final energy consumption</td>
</tr>
<tr>
<td>NG121</td>
<td>Manufacturing, construction and non-fuel mining industry</td>
</tr>
<tr>
<td>NG1211</td>
<td>Iron and steel</td>
</tr>
<tr>
<td>NG1213</td>
<td>Chemical and petrochemical</td>
</tr>
<tr>
<td>NG1214</td>
<td>Other manuf., const. and non-fuel min. ind.</td>
</tr>
<tr>
<td>NG122</td>
<td>Transport</td>
</tr>
<tr>
<td>NG123</td>
<td>Other</td>
</tr>
<tr>
<td>NG1231</td>
<td>Households</td>
</tr>
<tr>
<td>NG1232</td>
<td>Agriculture, forestry and fishing</td>
</tr>
<tr>
<td>NG1235</td>
<td>Commerce and public services</td>
</tr>
<tr>
<td>NG1234</td>
<td>Not elsewhere specified (other)</td>
</tr>
<tr>
<td>NG019</td>
<td>Memo: Gross Production</td>
</tr>
<tr>
<td>NG103</td>
<td>Re-injected</td>
</tr>
<tr>
<td>NG105</td>
<td>Extraction loss/shrinkage</td>
</tr>
<tr>
<td>NG104</td>
<td>Flared and vented</td>
</tr>
</tbody>
</table>
Final remarks
Final remarks

- Natural gas production = marketable production
  - Reinjection, flaring, venting excluded...
    - but important for emission estimates (to be provided separately)
  - After removal of NGLs, impurities, etc.
  - Includes own use in gas fields
    - natural gas used for energy purpose to extract natural gas or aid operations
  - Includes own use in liquefaction (LNG) and regasification plants
    - Even if the former are located at the wellhead
    - Or the latter located at import sites
Final remarks

- Non-energy purposes to be properly recorded
  - use as feedstocks to produce “non-energy products” such as plastics and fertilizers

- Data to be provided preferably in TJ (energy content)
  - Otherwise GCVs and NCVs to be provided