THE IGU NATURAL GAS LIFE CYCLE PROJECT

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ABSTRACT

The International Gas Union (IGU) started a life-cycle initiative for the natural-gas chain. The aim was to collect and structure industry data on consumptions and emissions along the life cycle of natural gas. This paper describes the results of a project that was carried out over 2005 to initiate this life-cycle inventory.

Costs and environmental impact are important drivers for investigating the natural gas life cycle. Environmental impact will more and more become an important subject in industry policy and strategy. While natural gas is now performing well in terms of environmental profile with respect to other fossil energy sources, continued efforts will be essential to keep this position in a changing market and with other fossil fuels working on their environmental impacts. In order to identify the most attractive options for improvement, further expansion of the life-cycle database is desirable.

One of the important issues in the natural gas chain is the loss of product through fugitive emissions and venting or flaring. Natural gas – methane – has a high global warming impact and therefore product loss and climate impact are closely related. This means that reducing losses leads to improved economic as well as environmental performance.

The focus of the project was on the first part of the life cycle of natural gas, that is, excluding the actual utilization phase as environmental figures for this phase are highly diverse. A question that is also briefly addressed is the potential influence of changing markets and demands on the environmental profile of natural gas.
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1. Background

The International Gas Union’s (IGU) Programme committee A (sustainable development) decided during the Dutch presidency to make a Life Cycle Analysis (LCA) of the entire gas chain. Currently, many sources of life-cycle information on natural gas exist, but they do not follow the same methodology and quality standards and many studies are based on assumptions and estimates as actual industry data are not publicly available. Moreover, not all of global production is covered by existing life cycle studies. A framework database that allows the progressive collection of complete and consistent (industry) data could provide solid backing for several purposes, both internal and external to the IGU.

High quality life-cycle data could be used to show and prove the benefits of natural gas, with respect to alternative energy sources. Alternatively, potential improvement areas along the gas chain might be identified. A continuously updated data base might be used to monitor progress toward sustainability. Regardless of the specific purpose, having reliable – and transparent – life-cycle data at hand will prove essential in political discussions around the world.

2. Global gas and LCA

However, constructing a “life cycle analysis” (LCA) for average global natural gas poses some problems. Global average gas, even if narrowed down to one particular utilization, does not strictly comprise one product system, because many of its unit processes are not connected by a physical flow of energy or material. A cubic meter of gas in Japan, imported as LNG from Indonesia, has absolutely no physical connection to a cubic meter of gas in the Netherlands. Adding (environmental) data for these two gas chains would not yield a result that is in any way qualitatively representative of a real situation. Adding to this is the fact that the two chains – and many others – are very different in their associated environmental impacts, so that the average is also not representative in a quantitative manner.

This means that an ultimate goal of making an LCA of a global average cubic meter of gas is not desirable. Such an aggregation level is simply too high to be meaningful. At a regional scale, LCA results may be more meaningful. The Northern American region (USA, Canada, Mexico) for instance is an almost entirely separate system of production and consumption. Within this region, averaging data over several production and long-distance transport systems would represent a real mixing of the physical gas.

3. Building blocks in de life cycle

Data on emissions and consumption of energy and materials are inventoried per process. This means we have to define all the relevant processes along the life cycle of gas. In figure 1 an overview is given of these building blocks. Two separate “routes” are distinguished as the environmental profiles differ for the gaseous and liquid (LNG) routes.

In this project, no life-cycle impacts are added up, but in figure 2 the average climate impacts are shown per process or building block of the chain.

4. Concluding

The assessment, along with available literature, shows that currently, natural gas is one of the fossil fuels of choice for many applications in terms of environmental impact over the life cycle. From the point of view of continuous improvement, there are several opportunities nonetheless, at several points in the life cycle.

Continuous improvement is an important part of environmental management, but also important to keep natural gas at its good environmental position, as several developments might change the
environmental profile of other fuels favourably with respect to natural gas. These developments are partly market driven, such as a rising share of LNG and gas storage in the global natural gas demand because of higher flexibility. Other developments are of a more technical nature, such as CO$_2$ capture and sequestration.

The exact content of this paper will be coordinated with the content of the official IGU PGC-A presentation of the report.
**Figure 1**

Diagram of natural gas (GAS) and liquefied natural gas (LNG) routes.

- **GAS ROUTE**
  - Exploration
  - Extraction
  - Processing
  - Ethane, propane, butane
  - Storage
  - Pipeline transport
  - Distribution (gas)
  - Residential heating
  - Power generation
  - Transport
  - Hydrogen (vehicle)

- **LNG ROUTE**
  - Exploration
  - Extraction
  - Processing
  - Ethane, propane, butane
  - Storage
  - Pipeline transport
  - Regasification
  - LNG transport
  - Distribution (liquid)

**Figure 2**

Bar chart showing Global Warming Potential (GWP) and GWP of electricity for various stages of the natural gas and liquefied natural gas processes.

- Distribution
- Storage (max)
- Storage (min)
- LNG regasification
- LNG transport
- LNG production
- Transmission
- Processing

Bars illustrate the GWP and GWP (electricity) for each stage.