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Gas- und Umwelttechnik GmbH

# Management Summary

## Critical Evaluation of Default Values for the GHG emissions of the Natural Gas Supply Chain

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## Critical Evaluation of Default Values for the GHG Emissions of the Natural Gas Supply Chain

The goal of this study was to determine the carbon footprint[1] (CF) of natural gas distributed in Germany and in Central EU[2]. Emissions resulting from the production, processing, transport, storage, and distribution of natural gas were considered. The utilization of the best data available and the transparency of the calculations was of paramount importance to the project.

The project was commissioned and coordinated by Zukunft ERDGAS GmbH and conducted by DBI Gas- und Umwelttechnik GmbH Leipzig.

### Background und Motivation

This project was motivated by a study carried out by the consulting firm EXERGIA on behalf of the European Commission entitled “Study on Actual GHG Data for Diesel, Petrol, Kerosene, and Natural Gas” [1] – hereafter referred to as the EXERGIA study. The EXERGIA study concluded that emissions for the production, processing, transport, storage and distribution of natural gas had been underestimated. However, initial analysis of the EXERGIA study showed that it had, in part, been based on obsolete data. It was assumed that by utilising the latest data considerably improved results for the carbon footprint would be achieved. Consequently, the latest data was researched, checked, and employed for the purposes of this study. In addition, certain sections of the EXERGIA study were not transparent and, as a result, lacked clarity.

### Research Approach

The present study considers the requirements of the life cycle assessment (LCA) as set out by DIN EN ISO 14040 [2] and DIN CEN ISO TS 14067 [3]. It includes the four principle components of a life cycle assessment: goal and scope definition, life cycle inventory analysis, life cycle impact assessment, and interpretation. The study is prepared to achieve ISO conformity through critical review by a third party.

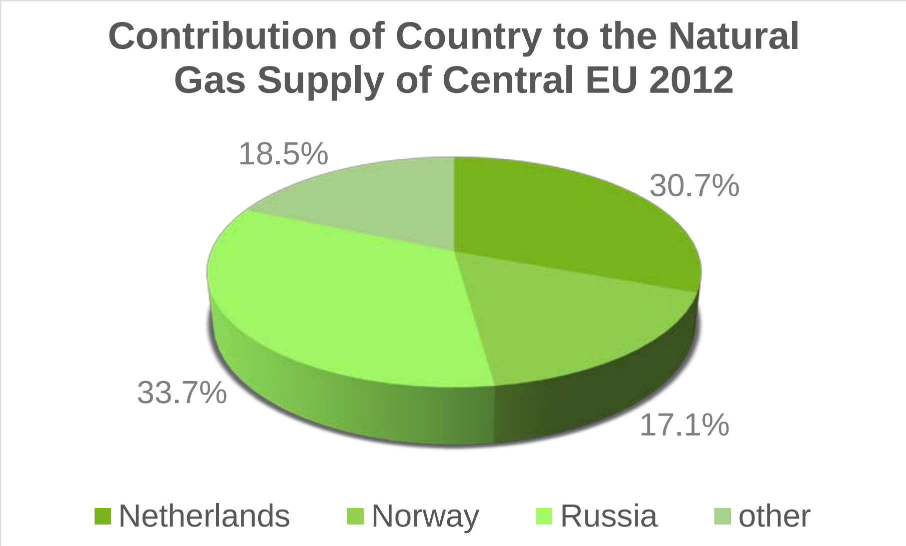
The authors of this study were determined to present all input data and calculations transparently in order to allow for them to be examined by third parties. Furthermore, certain elements of the gas infrastructure were considered more detailed as in the EXERGIA study so as to more accurately illustrate the real infrastructure and its operation.

The research focuses on public available statistical data also uses best available industry data at present from the three main supplier countries for Central EU (the Netherlands, Norway, and Russia, see Figure 1), as well as on Germany: the largest consumer of natural gas in Central EU. The definition of the boundaries of the Central EU region is taken from the EXERGIA study, which divided Europe into four regions: Central Europe, North Europe, Southwest Europe, and Southeast Europe [1, p. 102].

[1] The CF is the “Sum of greenhouse gas emissions (…) in a product system, expressed as $CO_2$ equivalents and based on a life cycle assessment using the single impact category of climate change.” [3, p. 13]

[2] According to Exergia the region “Central EU” comprises: Austria, Belgium, Czech Republic, Estonia, Germany, Hungary, Latvia, Lithuania, Luxemburg, The Netherlands, Poland, Slovakia [1, p. 322].

**Figure 1: Contribution of different countries to the natural gas supply of Central EU in 2012**




Source: Own illustration DBI based on [4]

In order to make the results comparable with the EXERGIA study, the model GHGenius in the version 4.03 was used to determine the carbon footprint - the same version of the model as was used by the EXERGIA study. An inspection and evaluation of the model itself were not within the scope of this study.

Due to the limited time-frame of this study, only data with a notable influence on the final results was reviewed. Certain input data, such as that for LNG, was utilized in the form it was provided in the EXERGIA study by the GHGenius model without any adjustments. Moreover, no adjustments were made to the electricity mixes of the individual countries, or to the greenhouse gas emissions from electricity generation. It can be expected that the further adjustment of this data would lead to a further reduction in the results of the carbon footprint.

As is called for in DIN CEN ISO TS 14067 the global warming potential over a time-span of 100 years ($GWP_{100}$ value) is applied [3, p. 62]. The $GWP_{100}$ utilised in this study are taken from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. This report has been selected as a source for the applied global warming potential values for two reasons in particular. Firstly, it has been fixed as a binding source for the National Inventory Reports since the United Nations Climate Change Conference in Warsaw in 2013 [5] [6, p. 2]. In addition, the carbon footprints calculated by the EXERGIA study were also based on the GWP from the Fourth Assessment Report. This increases the comparability of the results of this study with the results of the EXERGIA study, which has used the same base.

The system boundaries defined in the EXERGIA study were retained. However, the field of fuel dispensing was not considered by this study since only approximately 0.4 % of the natural gas consumed[3] in Europe is used by the transport sector [7]. Instead the study shows a GJ of natural gas, which has been distributed in Central EU or Germany. In order to improve comparability with the results of the EXERGIA study, the results of fuel dispensing from the EXERGIA study were also omitted.

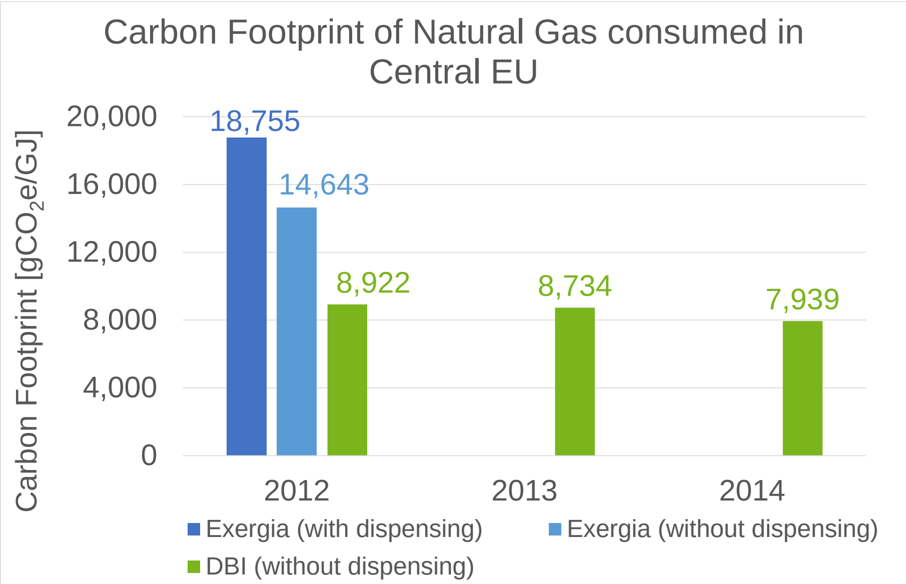
[3] Data from 2014 for the EU-28, Turkey and Switzerland.

## Results

The use of updated best available data and a more accurate portrayal of the infrastructure led to clearly lower carbon footprint results when compared with the results of the EXERGIA study. The carbon footprint for natural gas distributed in Central EU was calculated at 8,922 gCO2e/GJ (cf. EXERGIA: 14,643 gCO2e/GJ) in 2012 and at 7,939 $gCO_2e/GJ$ in 2014 (Figure 1).

The greatest influence in the results comes from the use of updated best available data for gas transport to the borders of Central EU. However, clearly lower results were also obtained in the areas of transport, storage, and distribution within Central EU. This can be attributed, among other factors, to new measurements and the resulting update of the NIR for the gas distribution network in the Netherlands, which now reports considerably lower methane emissions than before.

**Figure 1: Carbon Footprint of Natural Gas Distributed in Central EU**

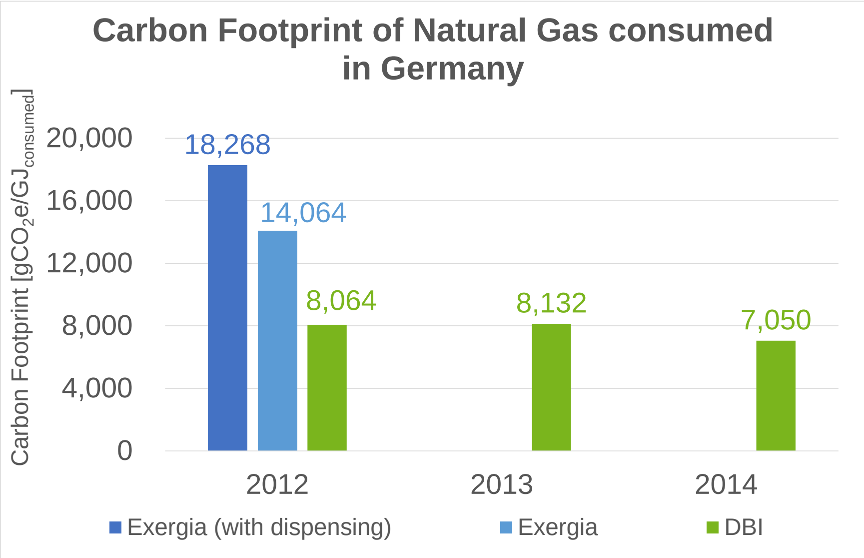



Source: Own illustration DBI based on EXERGIA and updated best available data

For the system "Natural Gas Distributed in Germany" a carbon footprint of 8,064 $gCO_2e/GJ$ for the year 2012 (compared to EXERGIA: 14,064 $gCO_2e/GJ$) and 7,050 $gCO_2e/GJ$ for the year 2014 (Figure 2) was calculated.

The reduction of the result for this system is mainly caused by updated input data for gas transport to the border of Germany, but also by updated data for gas transmission and distribution within Germany.

**Figure 2: Carbon Footprint of Natural Gas Distributed in Germany (including adjusted lengths)**




Source: Own illustration DBI based on EXERGIA and updated best available data

It is likely that the results of the carbon footprint would decrease further if further input data were updated. This can be seen by the fact that the difference between the results of the EXERGIA study and this study are significantly higher for the natural gas distributed in Germany than for the system "Natural Gas distributed in Central EU". For Germany, almost all input data for the calculation of the CF of natural gas has been adapted. For natural gas distributed in Central EU further countries are relevant, for which data could not be evaluated in the timeframe of this study.

## Conclusions and Perspectives

The updated input data chosen for the determination of the carbon footprint of natural gas distributed in Central EU led to a substantial decrease in the carbon footprint values compared to the EXERGIA study. A carbon footprint of 8,922 gCO2e/GJ was determined for the year 2012 (compared to the EXERGIA value of 14,643 gCO2e/GJ), and 7,939 gCO2e/GJ for 2014. Only the input data for pipeline gas from Germany, the Netherlands, Norway, and Russia was updated.

The evaluation of fuel dispensing (not considered in this study due to its limited relevance to the research objectives) will be addressed in a separate project, which will consider the whole of Europe. As part of the cooperation with this project, coordinated by the NGVA and conducted by Thinkstep, the data collected as part of this study will be made available for further evaluation. It is expected that this further evaluation within the NGVA/Thinkstep project will lead to a further decrease of the calculated CF.

It can be concluded that the public availability and transparency of data have a strong influence on the outcomes of study results. The availability of this data can, therefore, be seen to have a direct influence on decision-making at a European level since it cannot always be assumed that representatives of the natural gas industry are part of studies (as for example the EXERGIA study) conducted to estimate the carbon footprint.

Therefore the following recommendations are made:

- Immediate distribution of the results of this study so as to ensure that the results of the EXERGIA study, which are currently available at the European Commission, can be updated. Moreover, this study, along with the expected results of the NGVA/Thinkstep study, shall lead to a general review of data and research methods in this field incorporating the natural gas industry.
- In the medium and long-term it is necessary to substantially review and improve the data basis for the input data used in the calculation of the carbon footprint. It is important that the ever-increasing transparency practice within the industry continues on its current course. This improved communication is important so as to correctly quantify and record the measures currently being undertaken by the industry (e.g. the application of new technologies and new materials for pipeline construction) to reduce emissions. These measures have already resulted in a considerable reduction in emissions, from approximately 8 % for the total volume of natural gas produced in the mid-1980s, to approximately 2 % by the early 2010s [8, p. 91].

These measures are considered essential both for the short-term reaction to the current situation, and for the long-term strategic positioning of the industry.

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