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Carbon Footprint of Natural Gas

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

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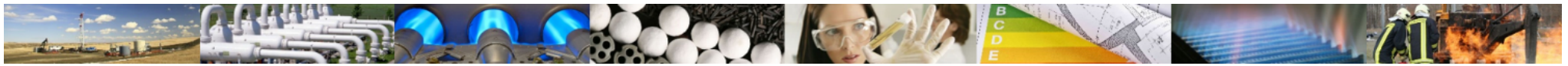
22nd meeting of the EU-Russia Gas Advisory Council's

Vienna, 14th February 2017



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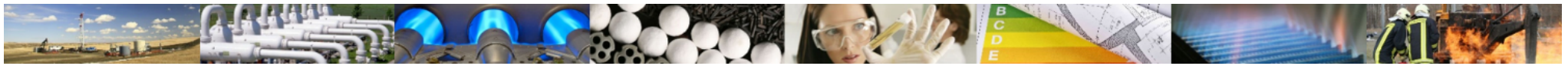
MODELLING, ASSUMPTIONS AND DATA

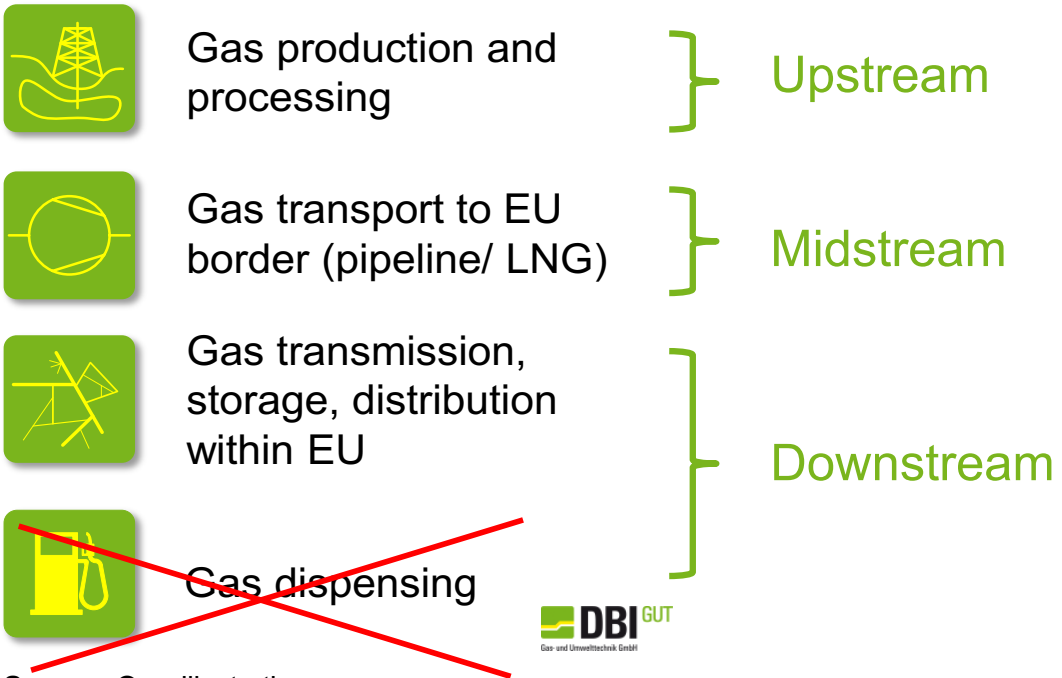
Overview of data sources and data availability



- The analysis focuses on the region Central EU (as defined in EXERGIA) considering the same system boundaries as EXERGIA but without dispensing

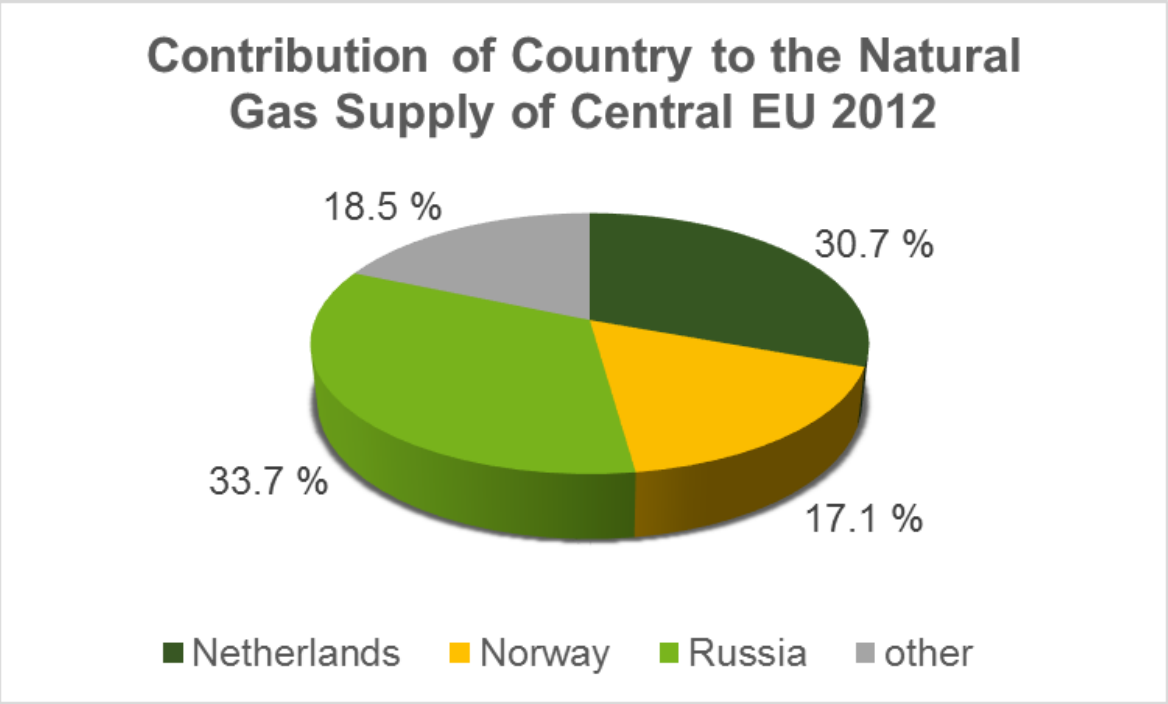
- Model used for calculating the Carbon Footprint: GHGenius Version 4.03 (same as in EXERGIA report)

- Updated best available data is used



Source: Own illustration

- Share of natural gas delivered to Central EU indicate three major suppliers that have a major impact on the Carbon Footprint calculation



Source: Own illustration based on IEA Data

- For these countries updated best available data were collected

GHG Modelling and Data Collection
Overview of data sources and availability

Source: Eigene Darstellung

Explanation of symbols

Production & processing | Transport to Central EU border | Transmission, storage, distribution within Central EU

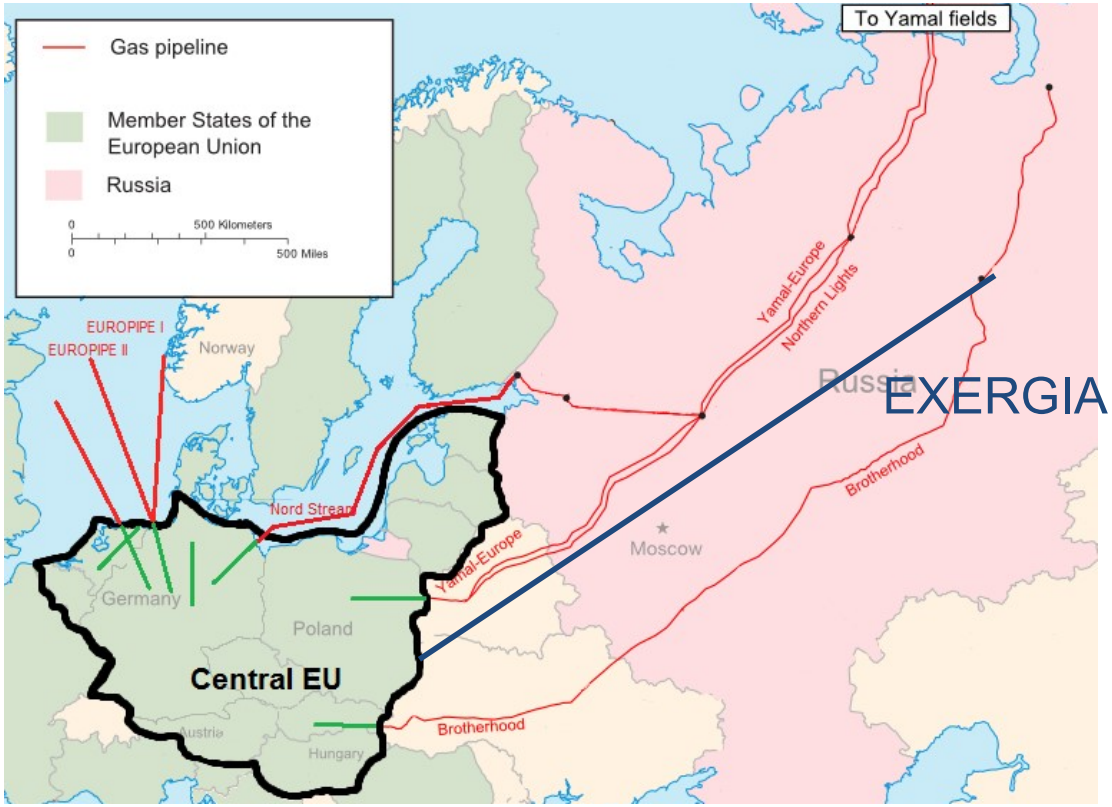
Explanation of colours

Updated best available (also other sources) data used

Improved data from the same data sources as EXERGIA used*

* For detailed explanation, refer to report

- Changes in the modelling approach:
  - EXERGIA used one generic pipeline for transport of Russian gas to EU Central
  - The current study applies a more realistic approach with three Russian corridors → reflection of different pipeline distances, losses and transport energies



Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png

- Changes in the modelling approach:
  - Market shares of different producers in Central EU are remodelled with latest (2016) IEA data for 2012 and a new set up for 2013 – 2015
    - A new approach was developed that considers the consumed gas as a mix of gas imports + indigenious production
    - This is an approximation but the real consumption mix is not known and it is presumed that the effect on the Carbon Footprint is negligible
  - EXERGIA used the National Inventory Reports (NIR) from 2014 for 2012, the current study uses the most current NIR from 2016 for 2012/13/14 (some methodological changes within the NIR)

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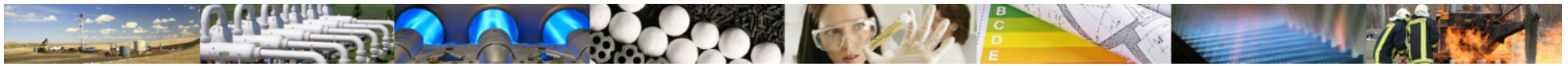
Results for Carbon Footprint of natural gas consumed in Central EU



Carbon Footprint of Natural Gas consumed in Central EU

General aspects

- Updated best available data for Germany, The Netherlands, Norway, Russia used within GHGenius
- IPCC AR4 GWP_{100} values (e.g. 25 for CH_4) are applied for all years[1]
- The Carbon Footprint for 2012 to 2014 was calculated[2]
- „Dispensing“ was not considered due to the marginal share of this utilization path

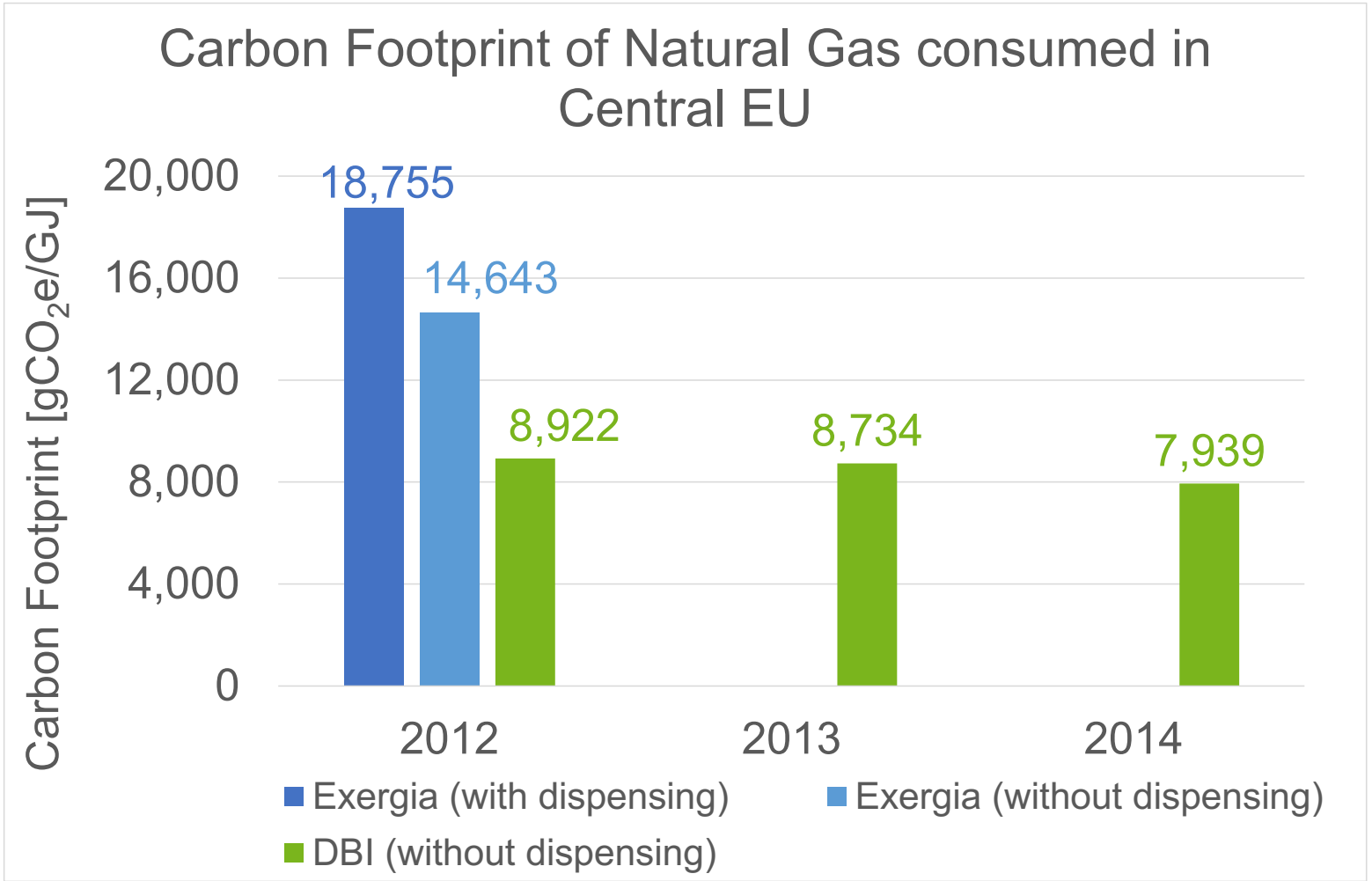
Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png

[1] Chosen due to comparability to EXERGIA-Report and because values are adopted by the Conference of the Parties 24/CP.19 on its 19th session and implemented in National Inventories.

[2] 2014 was the most current year where all data were available. For 2015, e.g. the National Inventory Reports are not available, yet.

Carbon Footprint of Natural Gas consumed in Central EU

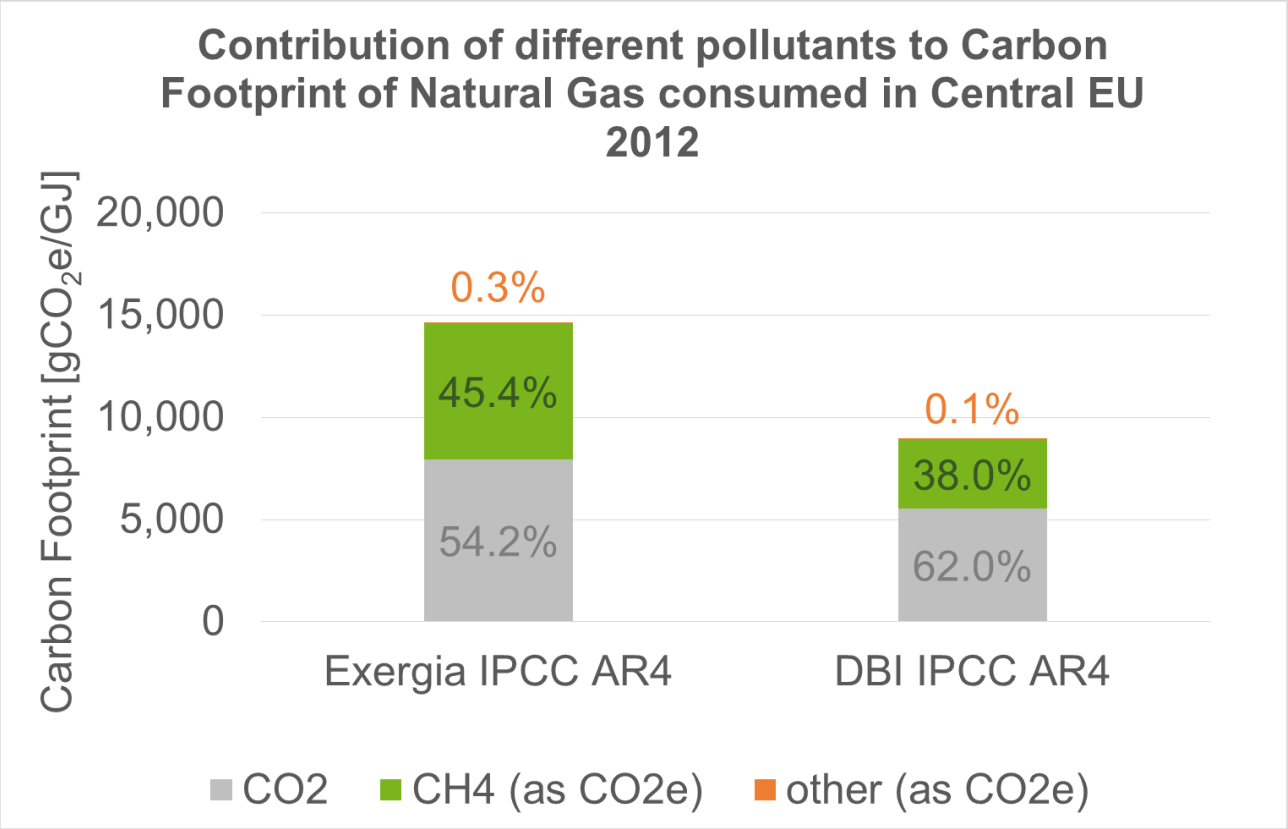
Result comparison



Carbon Footprint of Natural Gas consumed in Central EU

Result evaluation

- According to the new calculation, methane contributes less than 40 % to the Carbon Footprint of natural gas consumed in Central EU in 2012



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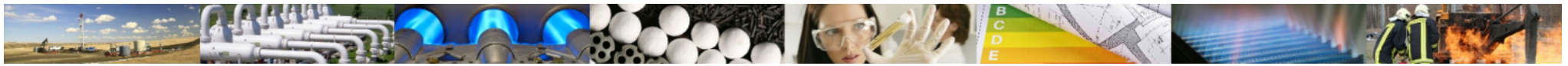
Results for streams which deliver natural gas to Central EU

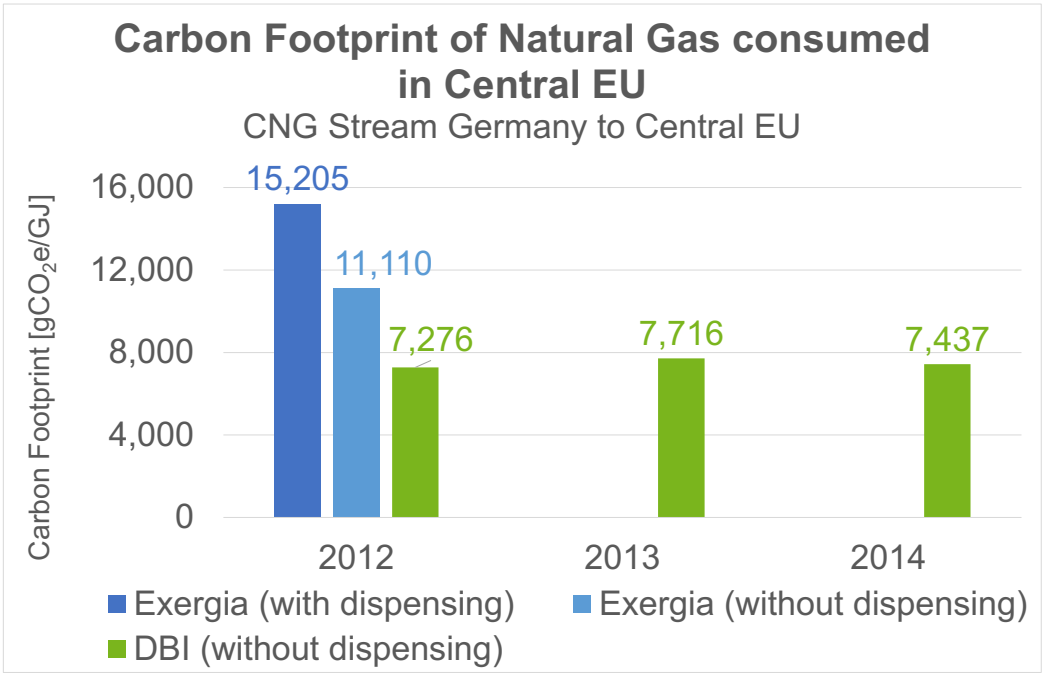


Carbon Footprint of Natural Gas consumed in Central EU

Results stream Germany to Central EU

- With the updated data and recalculations done the Carbon Footprint for the German stream is: 7,276 gCO_2e/GJ in 2012
- For Germany, data from BVEG, from the German TSOs and the NIR was used
  - Deviation due to updates of values for transmission and the distribution grid*

Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png



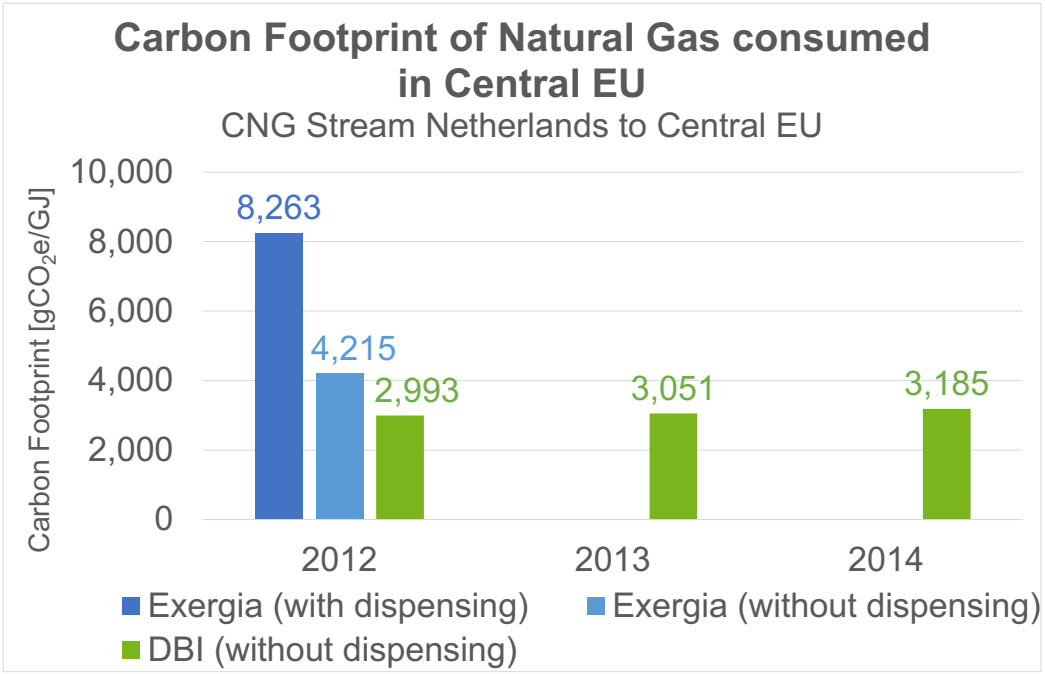
* Updated emission factors show lower emissions of the distribution grid

Carbon Footprint of Natural Gas consumed in Central EU

Results stream The Netherlands to Central EU

- With the updated data and recalculations done the Carbon Footprint for the Dutch stream is:
  2,993 gCO_2e/GJ in 2012
  - Deviation due to updates of values for methane emissions of the distribution grid (due to a change in NIR*)

Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png



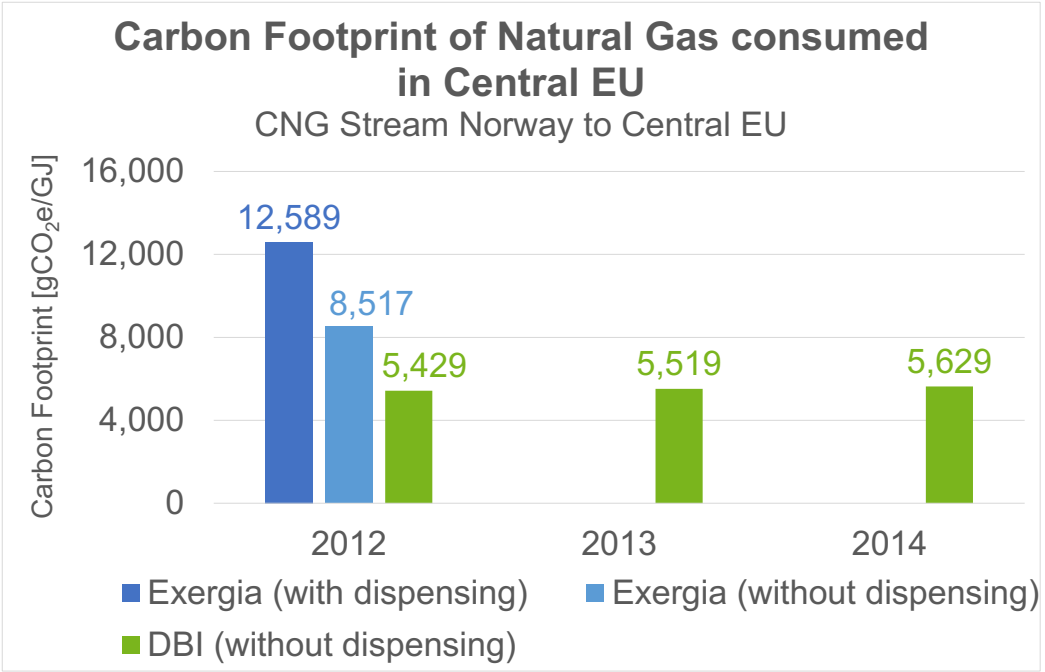
* Updated emission factors show lower emissions of the distribution grid

Carbon Footprint of Natural Gas consumed in Central EU

Results stream Norway to Central EU

- With the updated data and recalculations done the Carbon Footprint for the Norwegian stream is 5,429 gCO_2e/GJ in 2012
  - Deviation mainly due to updates of values for correction of transport energy

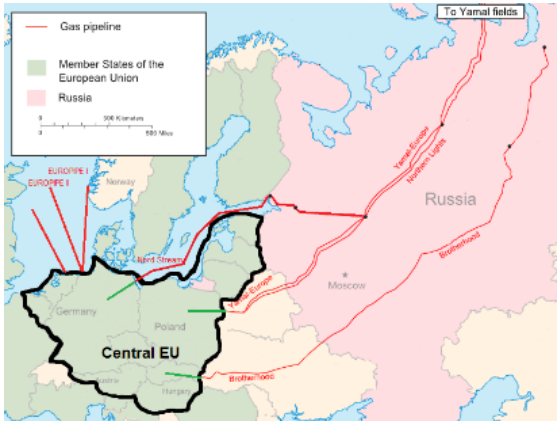
Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png



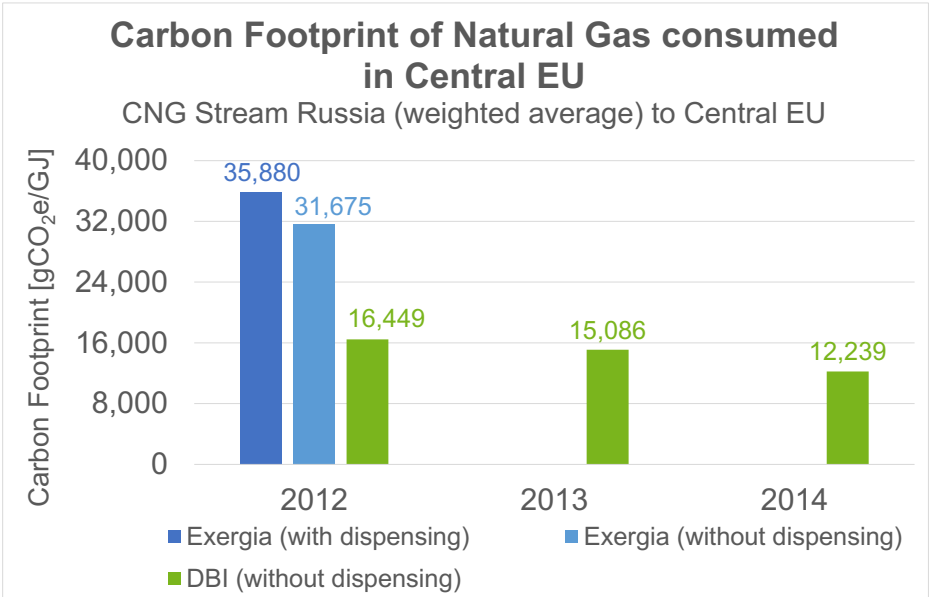
Carbon Footprint of Natural Gas consumed in Central EU

Results Stream Russia to Central EU

- With the updated data and recalculations done the Carbon Footprint is:
  16,449 gCO_2e/GJ in 2012
  - Deviation mainly due to updates of values for energy consumption/ methane emissions
  - The Carbon Footprint decreases over time, because of implemented efficiency measures and upgrading to best available technology for existing infrastructure



Source: Own illustration DBI based on https://de.wikipedia.org/wiki/Datei:Major_russian_gas_pipelines_to_europe.png



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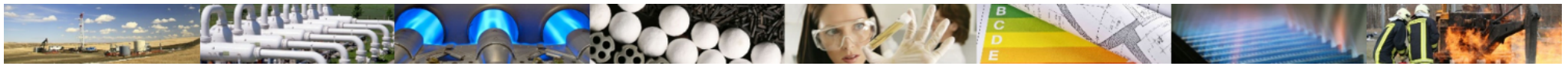
SUMMARY, COMPARISON, OUTLOOK



SUMMARY, COMPARISON, OUTLOOK

	Carbon Footprint of Natural Gas consumed in Central EU [gCO_2e/GJ]		
Year	**2012**		
Source	**EXERGIA**	**DBI**	**Deviation**
Gas transmission, storage and distribution within EU	2,804	1,760	**-37.2%**
Gas transportation to EU border	8,287	4,822	**-41.8%**
Gas production	3,352	2,105	**-37.2%**
CO2, H2S removed from NG (Gas processing)	201	235	**16.9%**
Total	**14,644**	**8,922**	**-39.1%**

SUMMARY, COMPARISON, OUTLOOK

- Up-to-date best available data for upstream and midstream (pipeline streams only) and downstream (without dispensing) for Germany, The Netherlands, Norway and Russia were collected to provide a more realistic view on the natural gas infrastructure
- As a result, the calculated Carbon Footprint of natural gas consumed in Central EU decreases about 39% compared to the value in the EXERGIA-Study
- As a second step, NGVA Europe has initiated a project which will include the data for the countries mentioned above and aims to update further data (values for the entire EU, LNG, the power mix etc.)
- Considering the available results, the authors recommend to initiate an update of the existing ME-values on an European level
- Activities to improve the database are underway (e.g. http://www.gerg.eu/ , http://www.marcogaz.org/)

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Thank you for your attention!

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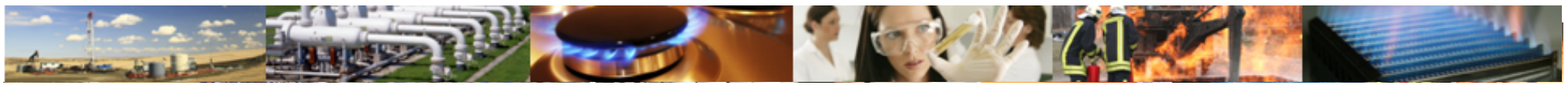
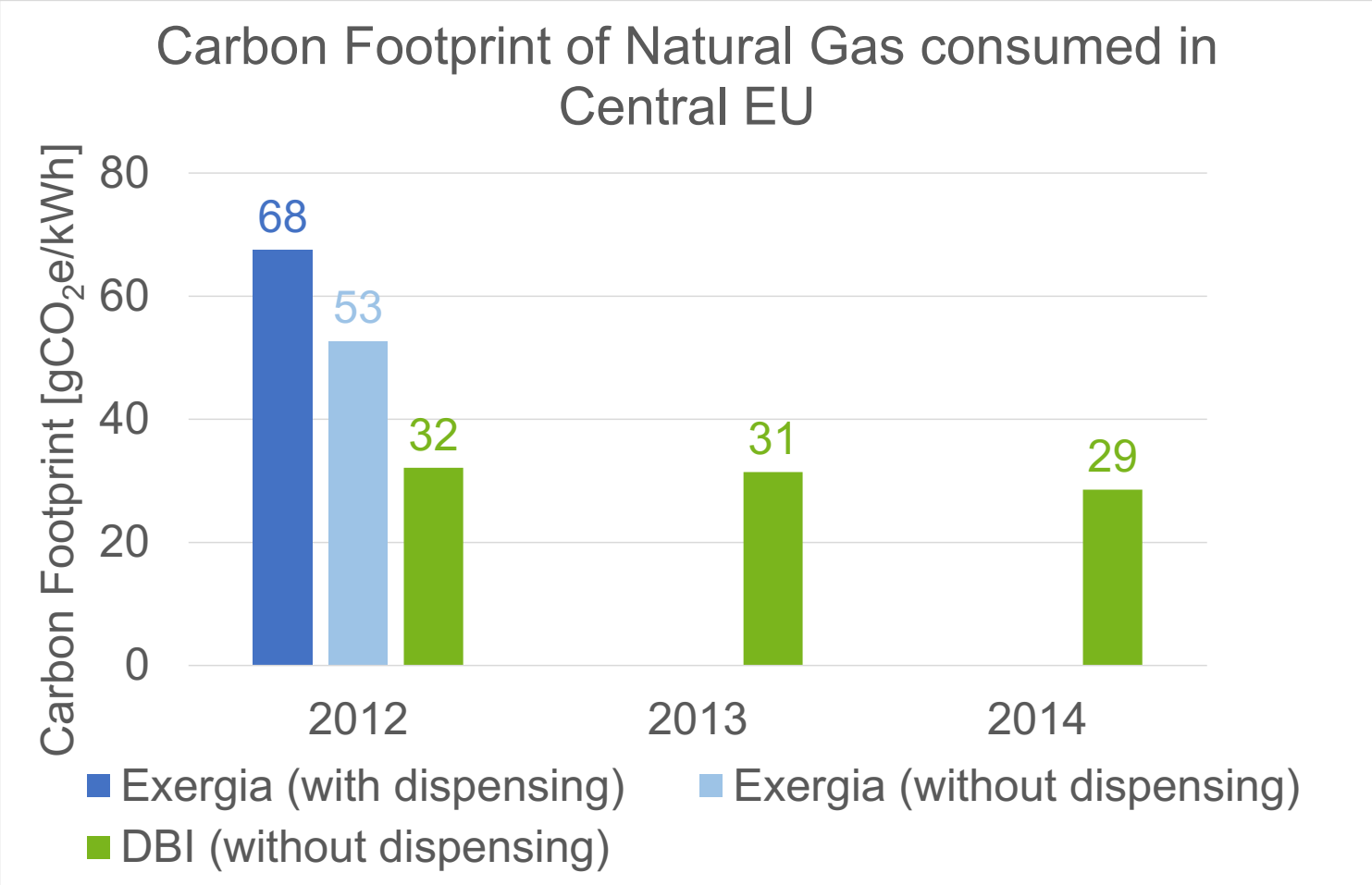


Carbon Footprint of Natural Gas consumed in Central EU

Result comparison – units converted

- The results can also be expressed in gCO_2e/kWh



ISSUES IDENTIFIED WITHIN GHGENIUS AND EXERGIA-REPORT (EXERPT)

- Major impact on the final results
  - Data source:
    - NIR 2014 uses default values instead of actual values for Russian methane losses
    - Rather high transmission energy of Russia is verified with outdated data
- Medium impact on the final results
  - Manual errors:
    - Norwegian transport energy (0.00003 J/J·km entered instead of 0.00001 J/J·km)
- Minor impact on the final results
  - Manual errors:
    - Dutch gas lost production (0.003 % entered instead of 0.03 %)
  - Methodological approach:
    - German gas lost production related to consumption instead of production
  - …