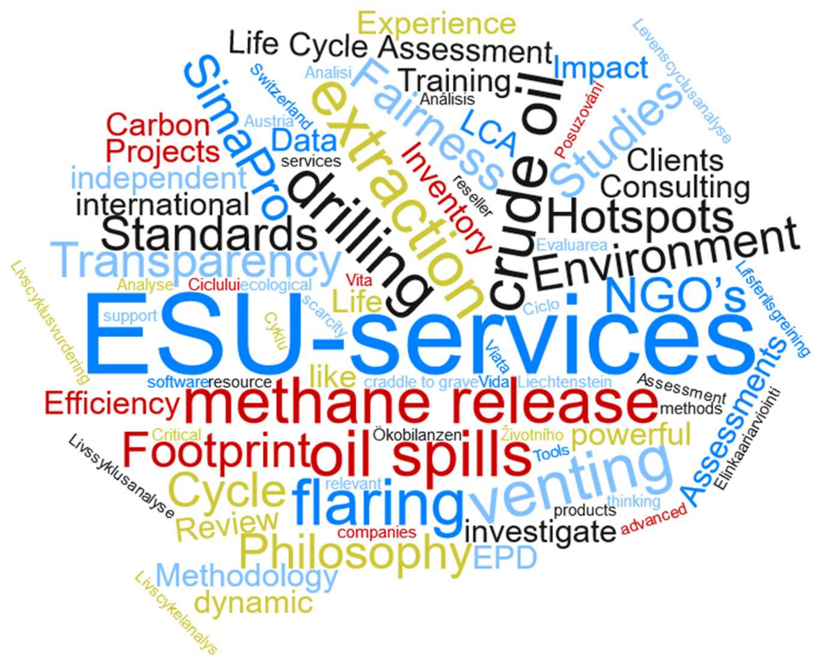
ESU-services

fair consulting in sustainability

2021

Life cycle inventories for long-distance transport and distribution of natural gas



Federal Office for the Environment (FOEN)

Niels Jungbluth Dr. sc. Techn. Dipl. Ing. TU
CEO
ESU-services GmbH
Vorstadt 14
CH-8200 Schaffhausen
T +41 44 940 61 32
F +41 44 940 67 94
www.esu-services.ch
jungbluth@esu-services.ch

ESU-services
fair consulting in sustainability

Life cycle inventories for long-distance transport and distribution of natural gas

Report

Maresa Bussa;Niels Jungbluth;Christoph Meili
ESU-services Ltd.
Vorstadt 14
CH-8200 Schaffhausen
Tel. +41 44 940 61 32
info@esu-services.ch
www.esu-services.ch

Commissioned by the
Federal Office for the Environment (FOEN)

Schaffhausen, 14. July 2021

Imprint

Citation	Maresa Bussa;Niels Jungbluth;Christoph Meili (2021) Life cycle inventories for long-distance transport and distribution of natural gas. ESU-services Ltd. commissioned by the Federal Office for the Environment (FOEN), and the "Verband der Schweizer-ischen Gasindustrie (VSG), Schaffhausen, Switzerland, DOI: 10.13140/RG.2.2.24948.48007, http://esu-services.ch/data/public-lci-reports/
Validation	ifeu – Institut für Energie- und Umweltforschung Heidelberg GmbH Wilckensstraße 3, DE-69120 Heidelberg Phone +49 (0)6 221. 47 67 - 0 www.ifeu.de Coordination: Axel Liebich and Daniel Münter, ifeu@ifeu.de Additional validators: Thomas Fröhlich, Horst Fehrenbach, Sabrina Ludmann
Contractor	ESU-services Ltd., fair consulting in sustainability Vorstadt 14, CH-8200 Schaffhausen www.esu-services.ch Phone 0041 44 940 61 32 info@esu-services.ch
Financing	This report was financed by the Federal Office for the Environment (FOEN), and the "Verband der Schweizerischen Gasindustrie" (VSG).
About us	ESU-services Ltd. has been founded in 1998. Its core objectives are consulting, coaching, training and research in the fields of life cycle assessment (LCA), carbon footprints, water footprint in the sectors energy, civil engineering, basic minerals, chemicals, packaging, telecommunication, food and lifestyles. Fairness, independence and transparency are substantial characteristics of our consulting philosophy. We work issue-related and accomplish our analyses without prejudice. We document our studies and work transparency and comprehensibly. We offer a fair and competent consultation, which makes it for the clients possible to control and continuously improve their environmental performance. The company worked and works for various national and international companies, associations and authorities. In some areas, team members of ESU-services performed pioneering work such as development and operation of web based LCA databases or quantifying environmental impacts of food and lifestyles.
Copyright	All content provided in this report is copyrighted, except when noted otherwise. Such information must not be copied or distributed, in whole or in part, without prior written consent of ESU-services Ltd. or the customer. This report is provided on the website www.esu-services.ch and/or the website of the customer. A provision of this report or of files and information from this report on other websites is not permitted. Any other means of distribution, even in altered forms, require the written consent. Any citation naming ESU-services Ltd. or the authors of this report shall be provided to the authors before publication for verification.
Liability Statement	This report was prepared under contract to the Federal Office for the Environment (FOEN). The contractor bears sole responsibility for the content. Information contained herein have been compiled or arrived from sources believed to be reliable. Nevertheless, the authors or their organizations do not accept liability for any loss or damage arising from the use thereof. Using the given information is strictly your own responsibility.
Version	14.07.21 15:31 https://esuservices-my.sharepoint.com/personal/jungbluth_esuservices_onmicrosoft_com/Documents/ESU-intern/565 LCI oil and gas sector CH BAFU/Bericht/bussa-2021-LCI for the gas distribution-v5.0.docx

Abstract

Natural gas is an important fossil fuel for Switzerland's energy supply. Fossil fuels cause environmental problems, particularly regarding climate change. Frequently, the environmental impacts of gaseous and liquid fuels and their use are compared, considering the upstream process chain.

A prerequisite for such a comparison is the use of current and consistent LCI data. Data on gas production and its transport to Switzerland were last fully updated in 2012.

A screening LCA of old and new life cycle inventory data of gas supply to Switzerland showed that the carbon footprint results of older data on gas production probably underestimate the venting and fugitive emissions by up to 50% compared with current data.

Therefore, in this and two related reports (Meili et al. 2021a, Meili et al. 2021b), data on global oil and natural gas production and the supply of its products to Switzerland and Europe are updated to the reference year 2019.

The natural gas energy system is described from the perspective of the Swiss and European consumer. The natural gas provision chains of the most important countries of origin are considered. The higher impact of the European datasets is caused by differences in the countries of origin and the higher share of LNG imports in the European supply mix. Most relevant from an environmental point of view is the use of energy resources, the emission of greenhouse gasses (especially methane) and the release of main air pollutants and particulate matter.

Contents

Abbreviations

µg	Microgram: 10-9 kg
C/H	Hydrocarbons
CFC	Chlorofluorocarbon
CH	Switzerland
DE	Germany
DIN	Deutsches Institut für Normung e.V.
DVGW	Deutsche Vereinigung des Gas- und Wasserfaches
DZ	Algeria
FR	France
GCV	Gross calorific value
HDPE	High density polyethylene
H-gas	High calorific natural gas
HP	High-pressure
IT	Italy
K	Degree Kelvin
kBq	Kilobecquerel
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory Analysis
LCIA	Life Cycle Impact Assessment
LDPE	Low density polyethylene
L-gas	Low-calorific natural gas
LNG	Liquid Natural Gas
m3	Cubic metre
MWI	Municipal Waste Incinerator
NAC	North African Countries
NCS	Norwegian Continental Shelf
NCV	Net calorific value
NG	Nigeria
NGL	Natural gas liquids: mixture of ethane, propane, butane and pentane
NL	The Netherlands
Nm3	Normal cubic meter
NMVOC	Non-methane volatile organic compounds
NO	Norway
o.e.	Oil equivalent: 1 Nm3 oil = 1 Nm3 o.e., 1'000 Nm3 mnatural gas = 1 Nm3 o.e. resp. 0.84 kg o.e., 1 kg o.e. = 42.3 MJ (NCV).
PAHs	Polycyclic aromatic hydrocarbons
PE	Polyethylene
PJ	Petajoule : 1015 Joule
RER	Europe
RME	Region Middle East
RU	Russian Federation
SDg2	Square of the geometric standard deviation
SVGW	Swiss Association of gas and water (Schweizerischer Verein des Gas- und Wasserfaches)
TJ	Terajoule : 1e12 Joule
UCTE	Union for the Co-ordination of Transmission of Electricity
VOC	Volatile organic compound
VSG	Association of the Swiss gas industry (Verband der Schweizerischen Gasindustrie)

1 Introduction

This document is based on the report for the previous life cycle inventory data for natural gas (Schori et al. 2012). It considers also updates made for the ecoinvent v3 data (Faist-Emmenegger et al. 2015). The approach for the modelling of the life cycle inventory analysis has been simplified in later projects by developing a generic archetype model for the oil and gas production chains (Meili & Jungbluth 2019a, b).

The goal of the report is to report the data as they are investigated with this update for the reference year 2019.

After finalization, data shall be published in UVEK 2021 provided by FOEN. Additionally, the updated life cycle inventory data will be published for free on http://esu-services.ch/data/public-lci-reports.

In general, only subchapters on process steps that are assessed as relevant in the former LCIA results (ecological scarcity 2013) were kept or updated in this report.

If the figures did not change considerably or no new figures were available, the former text was kept for this report to provide this relevant information.

Changes made to ecoinvent v2.0 data and implemented in ecoinvent v3 are NOT part of this report. Content of this document therefore does not reflect the LCI data of ecoinvent v3.

The following chapters analyse the transport and distribution of natural gas for Switzerland and the EU-28 states.

Energy requirements and emissions are inventoried for pipeline and LNG-Transport. Transport routes from the most relevant countries of origin to EU and Switzerland are investigated and supply mixes are calculated based on trade statistics. These data are used to prepare life cycle inventories for pipeline and LNG transport as well as for high- and low-pressure distribution.

2 Market situation for supplies to Switzerland and the European Union

In this study both the average Swiss and the average European Union as in 2019 (EU-28) consumption mix are of interest. The EU-28 mix is labelled in the datasets with the country code "RER". In the framework of the LCA methodology the original country for the natural gas extraction is of interest. Therefore, by using trade and extraction statistics the activities of trading countries are traced back to assess the amount of natural gas extracted for final consumption in Switzerland and the EU-28.

In this study, all natural-gas producing countries which contributed with at least $1.5\%_{vol}$ to the Swiss- or EU-28 supply mix were considered. In addition, the natural gas extraction was also modelled for relevant oil supply countries, as often a combined production is conducted. These selection criteria resulted in 16 countries to be investigated.

Different data sources could be used to estimate the consumption mix in Switzerland and the EU-28. The ideal data source would have to cover the following information (but is not yet available):

- Reference year 2019 with updates available annually

- Detailed information for all producing countries and all European countries (including Switzerland)
- Clear definition how transit countries and temporary storage are handled
- Consistent modelling for crude oil and natural gas
- Differentiation for trade movements by pipeline and ship (crude oil and LNG)
- Detailed regarding import for own consumption and re-exports to other countries
- Full transparency of data sources

The available data sources have advantages and disadvantages, which makes it difficult to find a perfect solution:

- BP-statistics (2020): Published annually and available with 2019 data. Details for trade by pipeline and LNG. Not all countries covered and thus contains a relevant part of "Other European countries".
- Eurostat (2020): Full coverage of all EU-28 countries, but Switzerland does not deliver data for these statistics. Furthermore, the data are not (any longer) complete or not fully specified for reasons of confidentiality. Gas which is temporary stored in a transition country is treated as gas produced in the transition country, which is not suitable for modelling the environmental impacts of supply mixes. Separate statistic for LNG available. Data for 2019 not available at the time of this project.
- IEA statistics (2020a): Full coverage of all European countries including Switzerland. Data for 2019 are available. LNG imports are accounted for separately but without specifying the country of origin. Gas trades are shown for country entry points without any information on the production country.
- VSG calculations[1]: The VSG made own calculations for the gas mix in Switzerland. This is based on single reports or data for the four relevant countries from which imports come to Switzerland. Direct delivery contracts with single countries e.g. the Netherlands are considered, but the exact terms of delivery are confidential. The reference year is only partly 2019. The sources used, include the aggregated pipeline and LNG imports, but a differentiation between the transportation mode is not possible and is not considered in these calculations. No harmonized assumptions were available for other single countries or the EU-28.

The chosen modelling approach is described in the following sub-chapters.

2.1 Switzerland

Data provided by VSG and shown in Tab. 2.1 was used to estimate the share of imports from surrounding countries. Switzerland imports natural gas from Germany (DE), France (FR), Italy (IT), and the Netherlands (NL).

1 Personal communication by Email with Michael Schmid, VSG April-October 2020.

Tab. 2.1 Direct imports to Switzerland from surrounding countries for 2019 according to information by the VSG (Percentage by norm-volume)

	FR	DE	IT	NL
Import to CH	33.1%	61.8%	3.2%	1.9%

As all these countries are net-importing countries (BP 2020), it is assumed that the consumption mix, i.e. imports plus own production, of these countries is exported to Switzerland. The consumption mixes were calculated based on the production and trade statistics provided in BP (2020) and are summarized in Tab. 2.2. The resulting natural gas supply mix for Switzerland and the modelled inventory is shown in Tab. 2.3.

Tab. 2.2 Natural gas consumption mix in the four countries exporting to Switzerland

	Origin of natural gas	DE	FR	NL	IT
		%	%	%	%
1	Russian Federation	50.7%	25.3%	16.6%	28.9%
2	Norway	31.8%	37.3%	52.6%	4.7%
3	Rest of Europe	4.5%	10.4%	13.8%	20.0%
4	Netherlands	8.4%	3.0%	17.0%	0.7%
5	Germany	4.6%	0.0%	0.0%	0.0%
6	Algeria	0.0%	6.0%	0.0%	17.6%
7	Nigeria	0.0%	7.2%	0.0%	0.1%
8	United States	0.0%	5.1%	0.0%	2.3%
9	Qatar	0.0%	3.2%	0.0%	8.9%
10	Egypt	0.0%	0.7%	0.0%	0.7%
11	Libyan Arab Jamahiriya	0.0%	0.0%	0.0%	7.5%
12	Peru	0.0%	0.7%	0.0%	0.0%
13	Trinidad and Tobago	0.0%	0.4%	0.0%	2.1%
14	Italy	0.0%	0.0%	0.0%	6.4%
15	Angola	0.0%	0.6%	0.0%	0.0%
16	Other Africa	0.0%	0.0%	0.0%	0.1%
	Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Tab. 2.3 Natural gas imported to Switzerland in 2019, by origin. Calculation based on direct imports given in Tab. 2.1 and supply mixes of direct exporting countries given in Tab. 2.2. Marked in green: Countries modelled due to their relevance for the Swiss gas supply. Marked in blue: Countries modelled due to their relevance for the Swiss crude oil mix. Marked in orange: Countries modelled due to their relevance for the EU-28 gas supply

	Origin of natural gas transported to Switzerland	**natural gas imported**	**Share for import mix in 2019**	**LCI modelled**
		million m^3	%	%
1	Russian Federation	1393	41.0%	44.6%
2	Norway	1126	33.1%	36.1%
3	Rest of Europe	242	7.1%	0.0%
4	Netherlands	222	6.5%	7.1%
5	Germany	97	2.9%	3.1%
6	Algeria	87	2.6%	2.8%
7	Nigeria	81.6	2.4%	2.6%
8	United States	59.8	1.8%	1.9%
9	Qatar	45	1.3%	1.5%
10	Egypt	8	0.2%	0.0%
11	Libyan Arab Jamahiriya	8	0.2%	0.3%
12	Peru	8	0.2%	0.0%
13	Trinidad and Tobago	7	0.2%	0.0%
14	Italy	7	0.2%	0.0%
15	Angola	7	0.2%	0.0%
	Total	**3400**	**100.0%**	**100.0%**

The swiss natural gas import portfolio provided by VSG (2020) and shown in Fig. 2.1 , can be compared with the Swiss natural gas supply mix calculated for this study. In principle the same approach is used. Some differences in the used data have been identified which can explain the differences in the resulting mix:

- The VSG used partly data for 2018, where this was the most current data made available by national authorities at the time calculating the import portfolio, and partly data from 2019 by single companies in a country
- The VSG did not differentiate between LNG and pipeline imports
- The VSG considered contractual deliveries which show a higher share of gas from extraction in the Netherlands, but the exact terms of these contracts are confidential

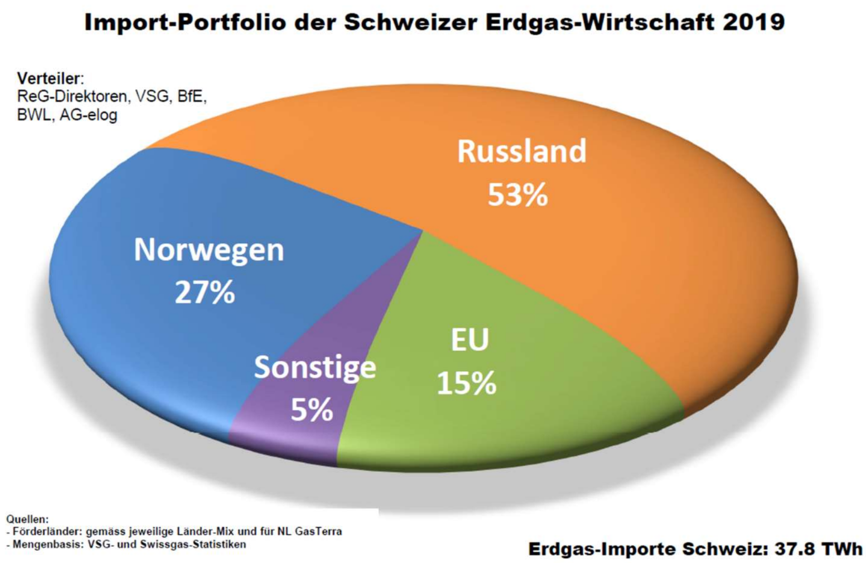


Fig. 2.1 Swiss natural gas import portfolio (VSG 2020)

2.2 European Union

For the European Union natural gas supply mix the production of EU-28 countries as well as their imports from non-EU net exporting countries were considered (BP 2020). Tab. 2.4 shows the natural gas supply mix for the Europe Union and the modelled inventory.

Tab. 2.4 Natural gas imported to the European Union in 2019, by origin (BP 2020).
Marked in green: Countries modelled due to their relevance for the Swiss gas supply.
Marked in blue: Countries modelled due to their relevance for the Swiss crude oil mix.
Marked in orange: Countries modelled due to their relevance for the European gas mix

	Origin of natural gas transported to Europe	natural gas imported	Share for import mix in 2019	LCI modelled
		billion m^3	%	%
1	Russian Federation	174.1	37.1%	39.4%
2	Norway	104.7	22.3%	23.7%
3	United Kingdom	36.1	7.7%	8.2%
4	Algeria	28.2	6.0%	6.4%
5	Qatar	27.1	5.8%	6.1%
6	Netherlands	25.6	5.5%	5.8%
7	United States	15.7	3.3%	3.5%
8	Nigeria	12.1	2.6%	2.7%
9	Romania	8.8	1.9%	2.0%
10	Rest of Europe	6.7	1.4%	0.0%
11	Trinidad and Tobago	5.4	1.2%	0.0%
12	Libyan Arab Jamahiriya	4.9	1.1%	1.1%
13	Germany	4.9	1.0%	1.1%
14	Italy	4.2	0.9%	0.0%
15	Poland	3.6	0.8%	0.0%
16	Denmark	2.9	0.6%	0.0%
17	Peru	1.5	0.3%	0.0%
18	Egypt	1.1	0.2%	0.0%
19	Angola	1.1	0.2%	0.0%
	Total	**469.1**	**100.0%**	**100.0%**

2.3 Share of pipeline and LNG transports

To model the natural gas supply (prior to its distribution within Europe and Switzerland), the share of liquefied natural gas (LNG) in the supply mixes was assessed based on the BP statistics (2020). The share of LNG of the gas supplied to the European Union was 20 % in 2019. For Switzerland, LNG makes about 13 % of the Swiss supply mix. Tab. 2.5 shows the share of pipeline and LNG-imports to the European Union and Switzerland, as modelled under the assumptions stated in chapter 2.1, for the analysed production countries.

Tab. 2.5 Mode of transport for natural gas supplies to Europe (BP 2020)

Origin of natural gas transported to Europe	**EU-28**		**CH**	
	Transport via pipeline	**Transport via LNG-tanker**	**Transport via pipeline**	**Transport via LNG-tanker**
Russian Federation	90%	10%	91%	9%
Norway	95%	5%	97%	3%
Netherlands	100%	0%	100%	0%
Algeria	58%	42%	17%	83%
Germany	100%	0%	100%	0%
Nigeria	0%	100%	0%	100%
Libyan Arab Jamahiriya	100%	0%	100%	0%
United States	0%	100%	0%	100%
United Kingdom	100%	0%	0%	0%
Qatar	0%	100%	0%	100%
Romania	100%	0%	0%	0%
Total imports	**80%**	**20%**	**87%**	**13%**

3 Properties of natural gas consumed

An overview with updated numbers of the composition of raw natural gas is provided in the accompanying report on crude oil and natural gas extraction (Meili et al. 2021a).

The quality of natural gas fed into the European gas network corresponds to the natural gas composition at the point of final consumption in Switzerland and the European Union. As for the raw gas, the composition of natural gas after processing depends on its origin (Schori et al. 2012). As available information on natural gas composition after processing is rather old (Schori et al. 2012) and not available for all countries of origin considered, a generic natural gas composition based on Swiss data is used for this study (see Tab. 3.1) (SWISSGAS 2019). The assumption for the mercury content is based on Schori et al. 2012.

Tab. 3.1 Generic gas composition used for this study (SWISSGAS 2019; Schori et al. 2012)

Substance	Unit	Value	Source
Methane, fossil	kg/m³	0.6629	Swissgas 2019
Ethane	kg/m³	0.0549	Swissgas 2019
Propane	kg/m³	0.0124	Swissgas 2019
Butane	kg/m³	0.0064	Swissgas 2019
NMVOC, non-methane volatile organic compounds	kg/m³	0.0005	Swissgas 2019
Carbon dioxide, fossil	kg/m³	0.0229	Swissgas 2019
Mercury	kg/m³	1.00E-08	Schori 2012
Gross CV	MJ/m³	41.1	Swissgas 2019
Net CV	MJ/m³	37.2	Swissgas 2019
Density	kg/m³	0.76	Schori 2012

4 Life cycle inventory of long-distance transport

4.1 Overview

This chapter focuses on the long-distance transport from the countries of origin to Switzerland and the EU-28. Important parameters are the Swiss and EU-28 supply mixes, the transport modes, and the transport distances from the different origins to Switzerland and the EU-28 countries, respectively.

Natural gas is mainly transported by long-distance pipelines with compressor stations driven by gas turbines as described in Subchapter 4.2. The transport by ship as LNG (liquefied natural gas) has become increasingly important in recent years and the process chain is described in Subchapter 4.3. The supply mixes at a specific destination are described in Subchapter 4.4. The well-established natural gas grid and the seasonal storage capacity in Europe allows to respond to demand peaks and to dispatch natural gas from different origins. It is included in the inventory of the long-distance transport to a specific destination and is described in Section 4.4.1.

Information about exported volumes and receiving European countries is taken from (BP 2020). Where different pipelines route from the production to the receiving country exist, a weighted average transport distance was calculated. Where available, the different routes were weighted by actual flow rates, otherwise the pipeline capacities were used. For the reference transport distance to RER-region the transport distances individual receiving countries are weighted by the import volumes given in BP 2020. The average transport distance from Russia is based on Schuller et al. 2017 and Müller-Syring et al. 2016 as these studies present figures from direct communication with Gazprom. The Transmission Capacity Map of ENTSOG[2] is used together with online sources[3] to estimate the pipeline distances for other countries of origin. Tab. 4.1 shows the distances for the pipeline import for the non-EU production countries.

[2] www.entsog.eu/maps#
[3] www.wikipedia.org, www.maps.google.com

Tab. 4.1 Transport distances from country of origin to EU-28 for pipeline imports

Origin of natural gas transported to RER-region	Distance offshore pipeline origin	Distance onshore pipeline origin
	km	km
Russian Federation	410	3'890
Norway	660	50
Algeria	130	1'050
Libyan Arab Jamahiriya	520	530

The shipping distances are estimated with an online tool[4]. The average transport distances from the gas field to RER-region are shown in Tab. 4.2. The ports of origin are mainly the same as for the transport of oil (Meili et al. 2021b) except for Russia and Norway. In both countries, the main liquefaction terminal is located far in the north and the distance changes considerably.

Tab. 4.2 Transport distances from country of origin to EU-28 for LNG imports

Origin of natural gas transported to RER-region	Port of Origin for LNG imports	Distance gas field to liquefaction plant, offshore pipeline	Distance gas field to liquefaction plant, onshore pipeline	Distance LNG shipping
		km	km	km
Russian Federation	Sabetta	-	30	4'900
Norway	Hammerfest	160	0	2'500
Algeria	Algiers	-	450	3'300
Qatar	Halul Island	90	0	11'700
United States	Houston	-	1020	9'700
Nigeria	Lagos	170	30	7'700

Other than in the report on extraction (Meili et al. 2021a), the emission rates of the transport activities are not modelled with data from IEA 2020b. The data is only available on the level of natural gas producing countries and the available downstream data of IEA 2020b can neither be allocated to the different distribution stages (long-distance, regional, local) nor converted to tkm which is required for modelling the long-distance transport. Hence, different data sources (Faist-Emmenegger et al. 2015, Ushakov et al. 2019) were used.

4.2 Pipeline transport

4.2.1 Infrastructure

For the infrastructure of long-distance pipelines, the formerly consulted literature information on data for pipelines (Tab. 4.3-Tab. 4.5) is considered to be still valid (c.f. Schori et al. 2012). No update was commissioned. Therefore, also uncertainty information is kept as in the former report.

[4] www.sea-distances.org

Tab. 4.3 Unit process raw data of “Pipeline, natural gas, long distance, low capacity, onshore/GLO/I”

Explanations	Name	Location	InfrastructureProcess	Unit	*pipeline, natural gas, long distance, low capacity, onshore*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				*GLO*			
	InfrastructureProcess				*1*			
	Unit				*km*			
Resources, land	Transformation, from forest	-	0	m2	2.00E+3	1	2.11	(4,3,3,1,1,5); qualified estimates
	Transformation, to heterogeneous, agricultural	-	0	m2	2.00E+3	1	2.11	(4,3,3,1,1,5); qualified estimates
	Occupation, construction site	-	0	m2a	3.33E+3	1	1.64	(4,3,3,1,1,5); qualified estimates
Resources, in wa	Water, unspecified natural origin	-	0	m3	1.87E+2	1	1.10	(2,3,1,1,1,3); environmental report
Technosphere	diesel, burned in building machine	GLO	0	MJ	3.31E+6	1	1.10	(2,3,1,1,1,3); environmental report
	reinforcing steel, at plant	RER	0	kg	2.40E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	polyethylene, LDPE, granulate, at plant	RER	0	kg	4.64E+3	1	1.31	(2,1,4,1,1,5); estimates based on published data
	sand, at mine	CH	0	kg	1.95E+6	1	1.31	(2,1,4,1,1,5); estimates based on published data
	bitumen, at refinery	RER	0	kg	2.32E+3	1	1.31	(2,1,4,1,1,5); estimates based on published data
	drawing of pipes, steel	RER	0	kg	2.40E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	transport, helicopter	GLO	0	h	2.60E+1	1	2.10	(2,3,1,1,3,5); estimates based on published data
	transport, helicopter, LTO cycle	GLO	0	unit	1.04E+1	1	2.10	(2,3,1,1,3,5); estimates based on published data
	transport, lorry 32t	RER	0	tkm	1.78E+5	1	2.09	(4,5,na,na,na,na); standard distance
	transport, freight, rail	RER	0	tkm	5.03E+4	1	2.09	(4,5,na,na,na,na); standard distance
	disposal, natural gas pipeline, 0% water, to inert material landfill	CH	0	kg	1.10E+6	1	1.41	(3,5,3,1,3,5); estimates
	disposal, plastics, mixture, 15.3% water, to municipal incineration	CH	0	kg	2.32E+3	1	1.41	(3,5,3,1,3,5); estimates
	disposal, bitumen, 1.4% water, to sanitary landfill	CH	0	kg	1.16E+3	1	1.41	(3,5,3,1,3,5); estimates
	disposal, municipal solid waste, 22.9% water, to municipal incineration	CH	0	kg	4.84E+3	1	3.01	(2,3,1,1,1,3); environmental report
	disposal, hazardous waste, 25% water, to hazardous waste incineration	CH	0	kg	3.53E+3	1	3.01	(2,3,1,1,1,3); environmental report
Outputs	pipeline, natural gas, long distance, low capacity, onshore	GLO	1	km	1.00E+0			

Tab. 4.4 Unit process raw data of “Pipeline, natural gas, long distance, high capacity, onshore/ GLO/I”

Explanations	Name	Location	InfrastructureProcess	Unit	*pipeline, natural gas, long distance, high capacity, onshore*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				*GLO*			
	InfrastructureProcess				*1*			
	Unit				*km*			
Resources, land	Transformation, from forest	-	0	m2	2.00E+3	1	2.11	(4,3,3,1,1,5); qualified estimates
	Transformation, to heterogeneous, agricultural	-	0	m2	2.00E+3	1	2.11	(4,3,3,1,1,5); qualified estimates
	Occupation, construction site	-	0	m2a	3.33E+3	1	1.64	(4,3,3,1,1,5); qualified estimates
Resources, in wa	Water, unspecified natural origin	-	0	m3	1.87E+2	1	1.10	(2,3,1,1,1,3); environmental report
Technosphere	diesel, burned in building machine	GLO	0	MJ	3.31E+6	1	1.10	(2,3,1,1,1,3); environmental report
	reinforcing steel, at plant	RER	0	kg	3.76E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	polyethylene, LDPE, granulate, at plant	RER	0	kg	4.64E+3	1	1.31	(2,1,4,1,1,5); estimates based on published data
	sand, at mine	CH	0	kg	2.28E+6	1	1.31	(2,1,4,1,1,5); estimates based on published data
	bitumen, at refinery	RER	0	kg	2.32E+3	1	1.31	(2,1,4,1,1,5); estimates based on published data
	drawing of pipes, steel	RER	0	kg	3.76E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	transport, helicopter	GLO	0	h	2.60E+1	1	2.10	(2,3,1,1,3,5); estimates based on published data
	transport, helicopter, LTO cycle	GLO	0	unit	1.04E+1	1	2.10	(2,3,1,1,3,5); estimates based on published data
	transport, lorry 32t	RER	0	tkm	2.19E+5	1	2.09	(4,5,na,na,na,na); standard distance
	transport, freight, rail	RER	0	tkm	7.75E+4	1	2.09	(4,5,na,na,na,na); standard distance
	disposal, natural gas pipeline, 0% water, to inert material landfill	CH	0	kg	1.33E+6	1	1.41	(3,5,3,1,3,5); estimates
	disposal, plastics, mixture, 15.3% water, to municipal incineration	CH	0	kg	2.32E+3	1	1.41	(3,5,3,1,3,5); estimates
	disposal, bitumen, 1.4% water, to sanitary landfill	CH	0	kg	1.16E+3	1	1.41	(3,5,3,1,3,5); estimates
	disposal, municipal solid waste, 22.9% water, to municipal incineration	CH	0	kg	4.84E+3	1	1.10	(2,3,1,1,1,3); environmental report
	disposal, hazardous waste, 25% water, to hazardous waste incineration	CH	0	kg	3.53E+3	1	1.10	(2,3,1,1,1,3); environmental report
Outputs	pipeline, natural gas, long distance, high capacity, onshore	GLO	1	km	1.00E+0			

Tab. 4.5 Unit process raw data of “Pipeline, natural gas, long distance, high capacity, offshore/ GLO/I”

Explanations	Name	Location	InfrastructureProcess	Unit	pipeline, natural gas, long distance, high capacity, offshore	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				GLO			
	InfrastructureProcess				1			
	Unit				km			
Resources, land	Transformation, from sea and ocean	-	0	m2	1.10E+2	1	2.11	(4,3,3,1,1,5); estimates
	Transformation, to industrial area, benthos	-	0	m2	1.10E+2	1	2.11	(4,3,3,1,1,5); estimates
	Transformation, from industrial area, benthos	-	0	m2	5.50E+1	1	2.11	(4,3,3,1,1,5); estimates
	Transformation, to sea and ocean	-	0	m2	5.50E+1	1	2.11	(4,3,3,1,1,5); estimates
	Occupation, industrial area, benthos	-	0	m2a	5.50E+3	1	2.11	(4,3,3,1,1,5); estimates
Resources, in wa	Water, unspecified natural origin	-	0	m3	8.05E+2	1	1.10	(2,3,1,1,1,3); environmental report
Technosphere	diesel, burned in building machine	GLO	0	MJ	2.53E+6	1	2.01	(2,3,1,1,5,3); environmental report
	reinforcing steel, at plant	RER	0	kg	6.05E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	concrete, sole plate and foundation, at plant	CH	0	m3	3.61E+2	1	1.31	(2,1,4,1,1,5); estimates based on published data
	aluminium, production mix, cast alloy, at plant	RER	0	kg	3.32E+3	1	10.43	(5,5,1,1,1,na); Estimation for aluminium anode, basic uncertainity estimated = 10
	cast iron, at plant	RER	0	kg	4.20E+0	1	10.43	(5,5,1,1,1,na); Estimation for aluminium anode, basic uncertainity estimated = 10
	MG-silicon, at plant	NO	0	kg	5.25E+0	1	10.43	(5,5,1,1,1,na); Estimation for aluminium anode, basic uncertainity estimated = 10
	copper, at regional storage	RER	0	kg	2.10E-1	1	10.43	(5,5,1,1,1,na); Estimation for aluminium anode, basic uncertainity estimated = 10
	zinc for coating, at regional storage	RER	0	kg	1.75E+2	1	10.43	(5,5,1,1,1,na); Estimation for aluminium anode, basic uncertainity estimated = 10
	drawing of pipes, steel	RER	0	kg	6.05E+5	1	1.22	(2,1,1,1,1,5); estimates based on published data
	transport, lorry 32t	RER	0	tkm	7.61E+4	1	2.09	(4,5,na,na,na,na); standard distance
	transport, freight, rail	RER	0	tkm	1.22E+5	1	2.09	(4,5,na,na,na,na); standard distance
	transport, transoceanic freight ship	OCE	0	tkm	1.82E+5	1	2.33	(5,3,1,1,3,5); estimated distances
	disposal, natural gas pipeline, 0% water, to inert material landfill	CH	0	kg	3.03E+5	1	1.41	(3,5,3,1,3,5); estimates
	disposal, municipal solid waste, 22.9% water, to municipal incineration	CH	0	kg	1.26E+3	1	1.10	(2,3,1,1,1,3); environmental report
	disposal, hazardous waste, 25% water, to hazardous waste incineration	CH	0	kg	1.13E+3	1	1.10	(2,3,1,1,1,3); environmental report
emission water, ocean	Aluminum	-	-	kg	2.82E+3	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
	Iron, ion	-	-	kg	3.57E+0	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
	Silicon	-	-	kg	4.46E+0	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
	Copper, ion	-	-	kg	1.79E-1	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
	Zinc, ion	-	-	kg	1.49E+2	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
	Titanium, ion	-	-	kg	7.44E-1	1	10.43	(5,5,1,1,1,na); Estimation 85% utilisation of anode
Outputs	pipeline, natural gas, long distance, high capacity, offshore	GLO	1	km	1.00E+0			

4.2.2 Operation of the network

4.2.2.1 Surveillance with helicopters

The amount of helicopter hours per km pipeline was assumed to remain constant (c.f. Tab. 4.3 and Tab. 4.4). The environmental impacts of the flights were modelled with the dataset "transport, helicopter, single engine, LTO cycle" of the UVEK database.

4.2.2.2 Operational energy use

To compensate the pressure loss in the long-distance pipeline network, compressor stations are located every 100-200 km along the network (Schori et al. 2012). The natural gas consumption of the compressor stations is expressed in % per 1'000 km pipeline. Schori et al. 2012 and Faist-Emmenegger et al. 2015 used a value of 1.9 %/1'000 km for Russian pipelines and of 1.8 %/1'000 km for all other countries. These values are based on older expert judgements. Müller-Syring et al. 2016 and Schuller et al. 2017 present more current values for several countries as shown in Tab. 4.6. Based on these numbers, average values were calculated for Russia, Europe, and other regions. As there is no traceable source given for the energy use in Dutch and African pipeline in Schuller et al. 2017 and this value is considerable higher than the other values, it is not considered in the calculation of the average. For countries of the Middle East and Africa the energy use of Russian pipelines is applied.

Tab. 4.6 Energy use of long-distance pipelines in different regions. The values highlighted in grey are not used for calculating the averages used in this study.

Parameter	Unit	Schori 2012	Faist-Emmenegger 2015	Schuller 2017	Müller-Syring 2016	This study
Energy use (RU)	%/1000 km	1.9%	1.9%	2.1%	2.3%	2.2%
Energy use (NL)	%/1000 km			3.0%	0.6%	
Energy use (NO)	%/1000 km			0.8%	1.5%	
Energy use (UK)	%/1000 km			0.8%		
Energy use (RER)	%/1000 km	1.8%	1.8%			0.9%
Energy use (RME, RAF)	%/1000 km	1.8%	1.8%	3.0%		2.2%

Emissions and infrastructure need of the compressor stations are modelled with the datasets "natural gas, burned in gas turbine". This dataset is used for all natural gas inputs for energy purposes. In former studies (Schori et al. 2012; Faist Emmenegger et al. 2007), three different datasets for modelling natural gas as energy input were used. It was differentiated between "natural gas, burned in gas turbines" and natural gas, burned in gas turbines, for compressor station". For the latter, it was assumed that relatively old turbines are in place, which results in high NO_x emissions.

For this study, it was assumed that turbines installed more than three decades ago were subsequently replaced by newer turbines and hence no differentiation between compressor stations and other turbines used is necessary. The third dataset "natural gas, burned in gas motor, for storage" was used in former studies to model the energy use of storage and liquefaction processes. As the dataset showed only slightly lower results than the dataset "natural gas, burned in gas turbine", it was replaced by the latter one in this study. The former datasets were only available for a few countries, with a country specific natural gas input. This is corrected in this study and the dataset "natural gas, burned in gas turbines" is modelled for all countries under study. The emissions are based on generic estimates of the former dataset since an update was not commissioned. Tab. 4.7 shows the data for the combustion in a gas turbine exemplarily for natural gas extracted in Russia.

Tab. 4.7 Unit process raw data of "natural gas, burned in gas turbine" (Example for Russia)

RU	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*RU*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	RU	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	RU	Nm3	4.63E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	RU	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

4.2.2.3 *Natural gas losses and other process related emissions*

Natural gas losses in the long-distance network mainly occur at junctions between sections and pneumatic devices. Schori et al. 2012 differentiated for the loss rate between Russia and other regions, whereas Faist-Emmenegger et al. 2015 differentiated between Europe and other regions (see Tab. 4.8). The latter values are used for this study. As a conservative approach, it is assumed that the entire emissions are emitted to the atmosphere and no pollutants are held back by the soil.

Tab. 4.8 Leakage rates of long-distance pipelines in different regions

Parameter	Unit	Schori 2012	Faist-Emmenegger 2015	This study
Loss rate, RU	%/1000 km	0.218%	0.204%	0.204%
Loss rate, RER	%/1000 km	0.026%	0.019%	0.019%
Loss rate, RME and NAC	%/1000 km	0.026%	0.204%	0.204%

The composition of the natural gas changes slightly during the long-distance transport as higher hydrocarbons and water condensate and are collected in condensate separators. It is further assumed that part of the mercury content is secreted with the condensate as well. As in Schori et al. 2012, 1.16 E-06 kg condensate are estimated per tkm pipeline transport. The treatment of the condensate is modelled with the dataset "Disposal, used mineral oil, 10% water, to hazardous waste incineration". A transport distance of 100 km is assumed to the treatment facility.

The figures derived in Schori et al. 2012 for the use of refrigerants are 6.93 E-08 kg/tkm freon and 2.2 E-08 kg/tkm halon. Due to the Montreal Protocol the use of chlorofluorocarbons and hydrochlorofluorocarbons is phasing out. It is assumed, that the substances are replaced by HFC-23 and the use of halon in 2019 is reduced by 90 % (UNEP 2018).

4.2.3 Inventory of natural gas transport in pipelines

4.2.3.1 Description

The data of Russian natural gas transport is shown exemplarily in Tab. 4.9. The inventories describe the energy consumption and emissions linked to the transport of one ton natural gas over a distance of one km in the unit ton-km (tkm). Onshore pipelines were modelled for all countries, offshore pipelines only for countries where necessary (c.f. Tab. 4.1).

The leakage rate of Russian pipelines is higher than in other regions (Faist-Emmenegger et al. 2015). The refrigerant emissions as well as the amount of secreted condensate is assumed to be equal in all countries. Furthermore, it is assumed that the emissions and energy use of offshore pipeline are equal to the ones of onshore pipelines.

4.2.3.2 Data quality

The energy use data is based on qualified estimates from industrial experts for the years 2014 and 2015 (Müller-Syring et al. 2016; Schuller et al. 2017). The infrastructure needs are based on values given in Schori et al. 2012 (qualified estimates). Dutch company reports (Gasunie 1998; 2001) are used for the amount of condensate (verified data partly based on assumptions) and refrigerant emissions. The refrigerants used are updated to current legislation (non-expert estimate). Other emissions are calculated based on the loss rates (qualified estimates) and a generic natural gas composition. For the auxiliary datasets "Natural gas, burned in gas turbine", the natural gas input is specified by country of origin. For the emissions, generic factors were used.

Tab. 4.9 Unit process raw data of the pipeline transport from Russia

RU	Name	Location	Unit	*transport, natural gas, onshore pipeline, long distance*	*transport, natural gas, offshore pipeline, long distance*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*RU*	*RU*			
	Unit			*tkm*	*tkm*			
	transport, natural gas, onshore pipeline, long distance	RU	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	RU	tkm		1.00E+0	0	0.00	
	Natural gas, at production	RU	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	RU	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	2.59E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

4.3 Transport of Liquefied Natural Gas

4.3.1 Natural Gas Liquefaction

After extraction, the natural gas is transported via pipeline to the liquefaction plant at the coast. In the liquefaction plant, the natural gas is cooled to -161 °C to reach its liquid state and the CO_2 is separated. The volume of natural gas in liquid state decreases to 1/600 of the volume in gaseous state. The liquefaction process is modelled in the dataset "Natural gas, liquefied, at liquefaction plant". Schori et al. 2012 stated that 15 % of the natural gas is consumed to run the liquefaction process, in Faist-Emmenegger et al. 2015 this value decreased to 10.3 %. More recent figures published in Pospíšil et al. 2019 indicate that on average 8.6 % of the natural gas is consumed in the liquefaction process. The latter value was used in this study.

In most liquefaction plants, the separated CO_2 is emitted into air and not pumped back into the gas reservoir[5]. The resulting CO_2-emissions are based on the natural gas composition. The leakage rate of 0.05 %, based on Schori et al. 2012, is used to calculate the emissions of other natural gas components. The infrastructure requirements of liquefaction and evaporation plants are based on Schori et al. 2012.

4.3.2 Storage and ship transportation of LNG

Prior to the transoceanic transport by LNG carriers, the LNG is stored in storage tanks. Typically, the storage and transport time of LNG is very short. The duration of storage is between 1 and 1.5 days (Cerbe et al. 1999). Assuming a service lifetime of the tank of 50 years, this leads to 9'000 turnover cycles per tank. Therefore, the material usage per transported Nm^3 of natural gas is very small. In this study the material use for the tanks is therefore not included.

According to IMO 2016, early LNG carriers burned LNG for steam propulsion as modelled in Schori et al. 2012, but most modern LNG carriers use dual fuel diesel engines as in the study of Faist-Emmenegger et al. 2015 (see Tab. 4.10). The values of the latter studies are used in this study. The share of LNG, which evaporates during the transport (boil-off gas), is used as fuel and burned in the engine (IMO 2015).

Tab. 4.10 Fuel consumption of LNG carriers

Parameter	Unit	Schori 2012	Faist Emmenegger 2015	This study
LNG consumption	Nm³/tkm	0.00935	0.00429	0.00429
heavy fuel oil consumption	MJ/tkm		0.06789	0.06789

IMO 2015 stated emission factors for various marine fuels including heavy fuel oil (HFO), marine diesel oil (MDO) and LNG combusted in Otto-cycle engines. Ushakov et al. 2019 present emission factors for LNG combusted in Otto-cycle engines based on ocean and manufacturer measurements. The latter ones were used for this study, values for substances not reported in Ushakov et al. 2019 are supplemented with data from IMO 2015. The emission factors for

5 https://www2.gov.bc.ca/assets/gov/environment/climate-change/ind/lng/lng_production_in_british_columbia_-_ghg_emissions_assessment_and_benchmarking_-_may_2013.pdf, online 11.09.2020

different marine fuels are given in Tab. 4.11. To calculate the airborne emissions of the LNG-transport, the fuel consumption as reported in Tab. 4.10 is multiplied with the emission factors for HFO and LNG as given in Tab. 4.11.

Tab. 4.11 Emission factor for marine fuels based on IMO 2015 and Stenersen and Thonstad 2017. HFO: heavy fuel oil, MDO: marine diesel oil, LNG: liquefied natural gas

Source		**IMO 2015**	**IMO 2015**	**IMO 2015**	**Ushakov 2019**	**This study**
Substance	**Unit**	**HFO**	**MDO**	**LNG (Otto-cycle)**	**LNG (Otto-cycle)**	**LNG (Otto-cycle)**
Methane	g/g fuel	6.00E-05	6.00E-05	5.12E-02	4.09E-02	4.09E-02
Carbon dioxide	g/g fuel	3.11E+00	3.21E+00	2.75E+00	2.63E+00	2.63E+00
Carbon monoxide	g/g fuel	2.77E-03	2.77E-03	7.83E-03	1.10E-02	1.10E-02
NMVOC	g/g fuel	3.08E-03	3.08E-03	3.01E-03	2.30E-03	2.30E-03
Nitrogen oxides	g/g fuel	6.05E-02	5.68E-02	7.83E-03	1.04E-02	1.04E-02
Dinitrogen monoxide	g/g fuel	1.60E-04	1.50E-04	1.10E-04		1.10E-04

As in Schori et al. 2012, it is assumed that the wastewater is contaminated with 10% bilge oil[6] and that 2.18 E-03 kg wastewater are discarded per tkm.

Fuel consumption, emissions and infrastructure requirements are modelled in the dataset "Transport, liquefied natural gas (country code), freight ship", while the transport distance is taken into account in the dataset "Natural gas, liquefied, at freight ship".

4.3.3 Evaporation plant

Various regasification technologies to vaporize LNG are available; common heat sources are ambient air, sea water and natural gas. The selected technology depends on the geographical and meteorological conditions of the location. Open rack vaporizers (ORV) use seawater to vaporize the LNG. Sodium hypochlorite is added to the seawater inlet stream to avoid algae growth within the heat exchanger tubes. The colder seawater is then, together with the sodium hypochlorite, discharged to the sea. Seawater only is only an effective heat source for vaporizing LNG if its temperature is higher 5 °C. In submerged combustion vaporizers (SCV), LNG flows in tubes through a water bath, which is heated by burning natural gas. SCVs are mainly used for peak shaving purposes. The technology mix in Europe is calculated based on the shares of technologies used: 60 % open rack vaporizers (ORV) and 40 % submerged combustion vaporizers (Agarwal et al. 2017). Tab. 4.12 shows the energy and material consumption recorded of different vaporizing technologies and the values derived for this study. The vaporized LNG is fed into the natural gas distribution network. Methane emissions from the evaporation are estimated as 3.5E-04 kg Methane/m^3 (Schori et al. 2012).

6 Bilges are the lowest compartments of ships. Water collects there, which can be contaminated with harmful substances.

Tab. 4.12 Energy and material consumption of vaporizing technologies in different sources.

Parameter	Unit	Schori 2012	Faist Emmenegger 2015	Pospisil 2019	Agarwal 2017	Asprofos engineering 2014	This study	This study	This study
Technology		SCV	average	SCV	SCV	ORV	ORV	SCV	RER-mix
Electricity	MJ/Nm³		0.042						
Natural gas	%	1.6%	0.43%	1.0-2.5%	1.5-2.0%			1.7%	0.69%
Sea water	m³/m³ gas					1.1E+01	1.1E+01		6.4E+00
Sodium hypochlorite	kg/m³ gas					5.6E-02	5.6E-02		3.4E-02

4.3.4 Inventory of LNG transport

4.3.4.1 Description

The inventory data of the LNG datasets are shown exemplarily for LNG from Russia in Tab. 4.13. The inventories describe the energy consumption and emissions linked to the liquefaction, transport, and evaporation of one cubic metre natural gas in gaseous form.

The inventory data of the modelled countries differs with respect to the emissions and natural gas consumption as the country specific natural gas composition and heating values were used for the calculation.

4.3.4.2 Data quality

The energy use of the liquefaction and evaporation process is based on the average values of different scientific publications summarized in Pospíšil et al. 2019 (qualified estimates). The material consumption of the evaporation process calculated based on figures given in an environmental study for a Greek LNG terminal (Asprofos Engineering 2014) (qualified estimates). Emission factors based on measurements and expert estimations (qualified estimates) and qualified estimates of fuel consumption are used to model transport the emissions. Emissions during liquefaction are calculated based on the leakage rates (qualified estimates) and the country specific natural gas composition. The infrastructure requirements are based on rough estimates.

Tab. 4.13 Unit raw datasets for LNG (Example for Russia)

RU	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production RU, at evaporation plant*	*transport, liquefied natural gas RU, freight ship*
	Location			*RU*	*RU*	*RER*	*OCE*
	InfrastructureProcess			*0*	*0*	*0*	*0*
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*
	natural gas, liquefied, at liquefaction plant	RU	Nm3	1.00E+0			
	natural gas, liquefied, at freight ship	RU	Nm3		1.00E+0		
	natural gas, production RU, at evaporation plant	RER	Nm3			1.00E+0	
	transport, liquefied natural gas RU, freight ship	OCE	tkm				1.00E+0
	Natural gas, at production	RU	Nm3	1.00E+00			
	natural gas, burned in gas turbine	RU	MJ	1.86E+00		1.49E-01	1.65E-03
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13	
	natural gas, liquefied, at liquefaction plant	RU	Nm3		1.00E+00		4.29E-03
	transport, liquefied natural gas RU, freight ship	OCE	tkm		3.72E+00		
	natural gas, liquefied, at freight ship	RU	Nm3			1.00E+00	
	heavy fuel oil, at regional storage	RER	kg				1.65E-03
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05
	transoceanic freight ship	OCE	unit				2.43E-11
	operation, maintenance, port	RER	unit				2.43E-11
	maintenance, transoceanic freight ship	RER	unit				2.43E-11
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04
	Water, salt, ocean	-	m3			6.42E+00	1.12E-02
air, low population	Methane, fossil	-	kg	3.31E-04		3.50E-04	2.94E-07
	Ethane	-	kg	2.75E-05			
	Propane	-	kg	6.18E-06			
	Butane	-	kg	3.18E-06			
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07			
	Carbon dioxide, fossil	-	kg	2.29E-02			1.33E-02
	Mercury	-	kg	5.00E-12			
	Carbon monoxide, fossil	-	kg				1.36E-05
	Nitrogen oxides	-	kg				2.34E-04
	Dinitrogen monoxide	-	kg				7.53E-07
	Water	-	kg			6.42E+03	

4.4 Supply mixes at destination

4.4.1 Seasonal natural gas storage

The temporal storage of natural gas is important to compensate for seasonal demand fluctuations as well as for strategic purposes. In Schori et al. 2012, it is assumed that a share of 10 % of the natural gas supply was temporarily stored. The natural gas is stored underground in caverns or permeable rock foundations with a compressor station on the surface. The energy expenditures of the compressor stations depend on the storage depth and the operation pressure. Schori et al. 2012 assumed a natural gas consumption of the compressor station of 1.5 % of the stored natural gas. The natural gas losses during seasonal storage depend on the storage type. Schori et al. 2012 used an average leakage rate of 0.1 % of the stored gas. Faist-Emmenegger et al. 2015 used the same figures. The European Commission 2015 stated that in the recent years the storage capacities increased faster than the natural gas consumption, hence, in this study it is assumed that 15 % of the natural gas supply is temporarily stored, the other figures remain unchanged.

The seasonal natural gas storage is modelled in the inventory "Natural gas, production (country code), at long-distance pipeline", the emissions caused by leakages are modelled as direct emissions of the process. The dataset "Natural gas, burned in gas turbine" is used to account for the emissions and infrastructure of the operational energy requirements of the storage capacities. The infrastructure of the storage is neglected in this study as it is assumed to be insignificant (Schori et al. 2012).

4.4.2 Supply mix

The EU-28 natural gas mix is modelled according to Tab. 2.4. The Swiss natural gas mix is based on the import shares from DE, FR, NL and IT as presented in Tab. 2.1. Hence, the supply mixes of these four countries are modelled as well. Therefore, the dataset "natural gas, production (country code), at long-distance pipeline" was adjusted for the individual countries to consider the country-specific LNG import shares. France and Italy have with 38% und 19% relevant LNG imports, while Germany and Netherlands only import natural gas through pipelines (see Tab. 4.14). The average transport distance from the countries of origin to RER-region (EU-28) was kept. The supply mixes are composed in the datasets "natural gas, at long-distance pipeline/(country code)".

Tab. 4.14 LNG import shares of FR, DE, NL and IT (BP 2020)

Origin of natural gas transported to Europe	FR	DE	NL	IT
Russian Federation	47%	0%	0%	0%
Norway	7%	0%	0%	7%
Algeria	100%	0%	0%	23%
Nigeria	100%	0%	0%	100%
United States	100%	0%	0%	100%
Qatar	100%	0%	0%	100%
LNG Share of total imports	**38%**	**0%**	**0%**	**19%**

4.4.3 Inventory of supply mixes at destination

4.4.3.1 Description

The inventory of imports from a specific country of origin is exemplarily shown for Russian natural gas imported to EU-28 in Tab. 4.15. The inventory describes the imports per pipeline and LNG as well as the seasonal storage in the destination country. The modelled supply mixes of the considered countries are shown exemplarily for Switzerland in Tab. 4.16.

4.4.3.2 Data quality

The energy use for temporal storage is based on qualified estimates from industry experts. The emissions during liquefaction are calculated based on the leakage rates (qualified estimates) and the natural gas composition. The natural gas supply mixes are based on verified data.

Tab. 4.15 Unit process raw data for the imports of Russian natural gas to RER-region

RU	Name	Location	Unit	*natural gas, production RU, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production RU, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	2.82E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Tab. 4.16 Unit process raw data for the Swiss natural gas supply mix

CH	Name	Location	Unit	natural gas, at long-distance pipeline	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			CH			
	InfrastructureProcess			0			
	Unit			Nm3			
	natural gas, at long-distance pipeline	CH	Nm3	1.00E+0			
Supply mix	natural gas, at long-distance pipeline	DE	Nm3	61.8%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	FR	Nm3	33.1%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	NL	Nm3	1.9%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	IT	Nm3	3.2%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020

5 Life cycle inventory of regional distribution

5.1 Overview

In the long-distance pipeline network, natural gas is transported with a pressure of 70 bar. For the regional distribution, the pressure is reduced to 1-5 bar overpressure (high-pressure network). The pressure is further reduced to less than 0.1 bar overpressure for the local distribution (low-pressure network) which is described in Chapter 6.

Large consumers, e.g. power plants and industries, obtain natural gas from the high-pressure network. Schori et al. 2012 reported, that 18% of the Swiss natural gas consumption is supplied at the high-pressure level, while Faist-Emmenegger et al. 2015 assumed a share of 23 %. For the EU-15[7], a share of 56 % was assumed, due to the larger importance of industry (Schori et al. 2012). In this study, the value of Faist-Emmenegger et al. 2015 is used for both regions.

The high-pressure network accounted for 21 % of the total length of the distribution network in Switzerland in 2018. For the EU-27[8], a similar figure of 19 % is reported[9].

5.2 Infrastructure

The inventories are not updated and kept the same as in a former study (Schori et al. 2012). The share of modern polyethylene pipelines used in Switzerland increased in the recent years. This is not reflected in this study as an update of the infrastructure was not commissioned. This can be justified by the relatively low importance of the infrastructure in the overall LCIA. Tab. 5.1 and Tab. 5.2 show the life cycle inventories for the construction of pipelines for the regional distribution in Switzerland and Europe, based on former studies (Schori et al. 2012).

---

7 Belgium, Germany, France, Italy, Luxembourg, Netherlands, Denmark, Ireland, Greece, Portugal, Spain, Finland, Austria, Sweden, United Kingdom

8 EU-28 without Croatia

9 Marcogaz 2012: Gas infrastructure – position paper on BAT. Retrieved from: https://www.marcogaz.org/app/download/7928289563/WG-AE-12-29.pdf?t=1541675447, online 04.12.2020

Tab. 5.1 Unit process raw data of “pipeline, natural gas, high-pressure distribution network” (CH)

Explanations	Name	Location	InfrastructureProcess	Unit	*pipeline, natural gas, high pressure distribution network*	UncertaintyType	StandardDeviation 95%	GeneralComment
	Location				*CH*			
	InfrastructureProcess				*1*			
	Unit				*km*			
Resources, land	Transformation, from forest	-	0	m2	2.00E+3	1	2.45	(4,3,3,1,1,5); qualified estimate
	Transformation, to arable	-	0	m2	2.00E+3	1	2.45	(4,3,3,1,1,5); qualified estimate
	Transformation, from unknown	-	0	m2	2.49E+0	1	2.11	(4,3,3,1,1,5); qualified estimate
	Transformation, to industrial area, built up	-	0	m2	2.49E+0	1	2.11	(4,3,3,1,1,5); qualified estimate
	Occupation, industrial area, built up	-	0	m2a	4.97E+1	1	1.64	(4,3,3,1,1,5); qualified estimate
	Occupation, construction site	-	0	m2a	3.33E+3	1	2.01	(4,3,3,1,1,5); qualified estimate
Technosphere	reinforcing steel, at plant	RER	0	kg	2.34E+4	1	1.76	(4,3,3,1,1,5); qualified estimate
	cast iron, at plant	RER	0	kg	9.49E+2	1	1.76	(4,3,3,1,1,5); qualified estimate
	polyethylene, HDPE, granulate, at plant	RER	0	kg	9.38E+2	1	1.76	(4,3,3,1,1,5); qualified estimate
	polyethylene, LDPE, granulate, at plant	RER	0	kg	1.09E+3	1	1.76	(4,3,3,1,1,5); qualified estimate
	concrete, normal, at plant	CH	0	m3	2.73E+0	1	1.76	(4,3,3,1,1,5); qualified estimate
	cement, unspecified, at plant	CH	0	kg	3.90E+3	1	1.76	(4,3,3,1,1,5); qualified estimate
	sand, at mine	CH	0	kg	7.86E+5	1	1.76	(4,3,3,1,1,5); qualified estimate
	bitumen, at refinery	RER	0	kg	7.69E+2	1	1.76	(4,3,3,1,1,5); qualified estimate
	drawing of pipes, steel	RER	0	kg	2.44E+4	1	1.76	(4,3,3,1,1,5); qualified estimate
	transport, passenger car	CH	0	pkm	9.60E+2	1	2.45	(4,3,3,1,1,5); qualified estimate
	transport, helicopter	GLO	0	h	4.80E+0	1	2.45	(4,3,3,1,1,5); qualified estimate
	transport, helicopter, LTO cycle	GLO	0	unit	1.92E+0	1	2.45	(4,3,3,1,1,5); qualified estimate
	transport, lorry 28t	CH	0	tkm	1.72E+4	1	2.09	(4,5,na,na,na,na); standard distance
	transport, lorry 32t	RER	0	tkm	6.80E+2	1	2.32	(5,1,1,3,3,5); estimates for waste transport
	transport, freight, rail	CH	0	tkm	1.59E+4	1	2.09	(4,5,na,na,na,na); standard distance
	excavation, skid-steer loader	RER	0	m3	1.90E+4	1	2.45	(4,3,3,1,1,5); qualified estimate
	excavation, hydraulic digger	RER	0	m3	1.20E+3	1	2.45	(4,3,3,1,1,5); qualified estimate
	building, hall, steel construction	CH	1	m2	2.00E-1	1	3.11	(4,3,3,1,1,5); qualified estimate
	building, multi-storey	RER	1	m3	1.60E+1	1	3.11	(4,3,3,1,1,5); qualified estimate
	disposal, natural gas pipeline, 0% water, to inert material landfill	CH	0	kg	1.22E+4	1	1.76	(4,3,3,1,1,5); qualified estimate
	disposal, plastics, mixture, 15.3% water, to municipal incineration	CH	0	kg	1.01E+3	1	1.76	(4,3,3,1,1,5); qualified estimate
	disposal, bitumen, 1.4% water, to sanitary landfill	CH	0	kg	3.84E+2	1	1.76	(4,3,3,1,1,5); qualified estimate
Outputs	pipeline, natural gas, high pressure distribution network	CH	1	km	1.00E+0			

Tab. 5.2: Unit process raw data of "pipeline, natural gas, high-pressure distribution network" (RER)

Explanations	Name	Location	InfrastructureProcess	Unit	*pipeline, natural gas, high pressure distribution network*	UncertaintyType	StandardDeviation 95%	GeneralComment
	Location				*RER*			
	InfrastructureProcess				*1*			
	Unit				*km*			
Resources, land	Transformation, from forest	-	0	m2	2.00E+3	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	Transformation, to arable	-	0	m2	2.00E+3	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	Transformation, from unknown	-	0	m2	2.49E+0	1	2.11	(4,3,3,3,1,5); qualified estimate for CH
	Transformation, to industrial area, built up	-	0	m2	2.49E+0	1	2.11	(4,3,3,3,1,5); qualified estimate for CH
	Occupation, industrial area, built up	-	0	m2a	4.97E+1	1	1.64	(4,3,3,3,1,5); qualified estimate for CH
	Occupation, construction site	-	0	m2a	3.33E+3	1	2.01	(4,3,3,3,1,5); qualified estimate for CH
Technosphere	reinforcing steel, at plant	RER	0	kg	1.36E+4	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	cast iron, at plant	RER	0	kg	3.38E+2	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	polyethylene, HDPE, granulate, at plant	RER	0	kg	2.39E+3	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	polyethylene, LDPE, granulate, at plant	RER	0	kg	7.58E+2	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	concrete, normal, at plant	CH	0	m3	2.73E+0	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	cement, unspecified, at plant	CH	0	kg	3.90E+3	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	sand, at mine	CH	0	kg	6.10E+5	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	bitumen, at refinery	RER	0	kg	1.26E+3	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	drawing of pipes, steel	RER	0	kg	1.39E+4	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	transport, helicopter	GLO	0	h	1.04E+1	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	transport, helicopter, LTO cycle	GLO	0	unit	4.16E+0	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	transport, lorry 32t	RER	0	tkm	3.32E+4	1	2.09	(4,5,na,na,na,na); standard distance
	transport, freight, rail	RER	0	tkm	4.56E+3	1	2.09	(4,5,na,na,na,na); standard distance
	excavation, skid-steer loader	RER	0	m3	1.90E+4	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	excavation, hydraulic digger	RER	0	m3	1.20E+3	1	2.45	(4,3,3,3,1,5); qualified estimate for CH
	building, hall, steel construction	CH	1	m2	2.00E-1	1	3.11	(4,3,3,3,1,5); qualified estimate for CH
	building, multi-storey	RER	1	m3	1.60E+1	1	3.11	(4,3,3,3,1,5); qualified estimate for CH
	disposal, natural gas pipeline, 0% water, to inert material landfill	CH	0	kg	6.96E+3	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	disposal, plastics, mixture, 15.3% water, to municipal incineration	CH	0	kg	1.57E+3	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
	disposal, bitumen, 1.4% water, to sanitary landfill	CH	0	kg	6.32E+2	1	1.77	(4,3,3,3,1,5); qualified estimate for CH
Outputs	pipeline, natural gas, high pressure distribution network	RER	1	km	1.00E+0			

5.3 Operation of the Network

5.3.1 Energy use

Heat is required to reduce the pressure of the natural gas before entering the regional distribution network. This service is not included in the long-distance inventories but is accounted for in the dataset "natural gas, high-pressure, at consumer". For 2019, the Swiss compressor station in Ruswil reported a natural gas consumption of 600 TJ.[10] Tab. 5.3 shows the natural gas consumption per MJ supplied, as reported in former studies, and the value used for this study, as calculated based on official data from the central compressor station in Ruswil. The infrastructure and emissions associated with the combustion of natural gas are modelled with the dataset "natural gas, burned in gas turbine".

Tab. 5.3 Natural gas consumption in the high-pressure network

Source	Natural gas consumption
Schori 2012	0.56%
Faist Emmenegger 2015	0.59%
This study	**0.49%**

10 Communication by Email with Mischa Zschokke (Carbotech), 01.12.2020

5.3.2 Emissions

The emission rate is calculated based on reported methane emissions of the Swiss distribution network for 2018.[11] The available figures for the distribution network differentiate between pipeline leakages, emissions due to pipeline fractures and maintenance, emissions at connection point of households and small businesses as well as emissions at the connection point of industry and power plants. For the emission-rate of the high-pressure network, the emissions at connection points of industry and power plants as well as a share of the emissions due to leakages, fractures, and maintenance, considering the ratio of the length of the high-pressure and low-pressure network, are taken into account. These values are summed up and divided by the annual natural gas consumption in Switzerland. The derived emission rate is considerably higher than the values used in former studies (see Tab. 5.4). In the former studies, only the pipeline leakages were included and thus, the total emission rate was underestimated. To calculate the airborne emissions of the regional distribution of 1 MJ natural gas, the emission rate is multiplied with the substance content of 1 Nm^3 natural gas (see Tab. 3.1) and divided by the net calorific value.

Tab. 5.4 Emission rates of the high-pressure network[12]

Source	**Emission rate**
Schori 2012	0.04%
Faist Emmenegger 2015	0.01%
This study	**0.10%**

5.4 Life cycle inventory of the regional distribution

5.4.1 Description

The dataset «natural gas, high-pressure, at consumer» is shown exemplarily for Switzerland in Tab. 5.5. It describes the energy use, emissions, and infrastructure requirements for the regional distribution of 1 MJ natural gas. The same values for emissions, energy use and infrastructure needs are used for Switzerland and EU-28. This is justified as the relative length of the high-pressure network is similar and as the quality of the Swiss data is good. The inventories only differ regarding the natural gas supply mix used.

5.4.2 Data quality

Recent data is available for the energy use and emissions in the Swiss distribution network (non-verified data partly based on qualified estimates). For the emission rate not only pipeline leakages as in former studies, but also emissions due to fractures and maintenance as well as emissions at the connection point of the consumers are considered. Infrastructure requirements are based on qualified estimates. The infrastructure processes were not updated, but the impact on the emission rate was considered.

11 Communication by Email with Mischa Zschokke (Carbotech), 01.12.2020

12 The exact value was not reported in Faist-Emmenegger et al. 2015. The emission rate was estimated based on the emissions and gas composition.

Tab. 5.5 Unit raw dataset for the regional distribution in Switzerland

CH	Name	Location	Unit	*natural gas, high pressure, at consumer*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*CH*			
	InfrastructureProcess			*0*			
	Unit			*MJ*			
	natural gas, high pressure, at consumer	CH	MJ	1.00E+0			
	natural gas, low pressure, at consumer	CH	MJ				
	natural gas, burned in gas turbine	CH	MJ	4.90E-03	1	1.07	(1,3,1,3,1,BU:1.05); Based on data of Swiss compressor station
	natural gas, at long-distance pipeline	CH	Nm3	4.63E-02	1	1.05	(1,1,1,3,1,BU:1.05); including leakage
	natural gas, high pressure, at consumer	CH	MJ				
	pipeline, natural gas, high pressure distribution network	CH	km	1.07E-09	1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
	pipeline, natural gas, low pressure distribution network	CH	km				
air, low population	Methane, fossil	-	kg	3.21E-05	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Ethane	-	kg	2.66E-06	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Propane	-	kg	5.98E-07	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Butane	-	kg	3.07E-07	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.21E-08	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Carbon dioxide, fossil	-	kg	1.11E-06	1	1.05	(1,1,1,1,1,BU:1.05); calculated based on gas mix and leakage

6 Life cycle inventory of the local supply

6.1 Overview

This chapter describes the local distribution of natural gas to households and small business using the low-pressure network with an overpressure below 0.1 bar. The process step has the dataset "natural gas, high-pressure, at consumer" as input. That means, all gas consumed annually passes the high-pressure network, while only 82 % of the annual consumption flow through the low-pressure network since 18 % are supplied to consumers at high-pressure level (Schori et al. 2012).

6.2 Infrastructure

The inventories are not updated and kept the same as in a former study (Schori et al. 2012). The share of modern polyethylene pipelines in Switzerland increased in the recent years. This is not reflected in this study as an update of the infrastructure is not commissioned. This can be justified by the relatively low importance of the infrastructure in LCIA. Tab. 6.1 shows the life cycle inventory for the construction of pipelines for the regional distribution in Switzerland, based on former studies (Schori et al. 2012). The same dataset is used for the local supply in Europe.

Tab. 6.1: Unit process raw data of „Pipeline, natural gas, low-pressure distribution network“

Explanations	Name	Location	InfrastructureProcess	Unit	*pipeline, natural gas, low pressure distribution network*	UncertaintyType	StandardDeviation 95%	GeneralComment
	Location				*CH*			
	InfrastructureProcess				*1*			
	Unit				*km*			
Technosphere	Transformation, from unknown	-	0	m2	7.14E+0	1	2.11	(4,3,3,1,1,5); qualified estimate
	Transformation, to industrial area, built up	-	0	m2	7.14E+0	1	2.11	(4,3,3,1,1,5); qualified estimate
	Occupation, industrial area, built up	-	0	m2a	1.43E+2	1	1.64	(4,3,3,1,1,5); qualified estimate
	Occupation, construction site	-	0	m2a	3.33E+3	1	2.01	(4,3,3,3,1,5); qualified estimate for CH
	reinforcing steel, at plant	RER	0	kg	5.24E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	cast iron, at plant	RER	0	kg	6.30E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	polyethylene, HDPE, granulate, at plant	RER	0	kg	4.63E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	polyethylene, LDPE, granulate, at plant	RER	0	kg	4.90E+2	1	1.64	(4,3,3,1,1,5); qualified estimate
	concrete, normal, at plant	CH	0	m3	2.73E+0	1	1.64	(4,3,3,1,1,5); qualified estimate
	gravel, round, at mine	CH	0	kg	2.80E+4	1	1.64	(4,3,3,1,1,5); qualified estimate
	cement, unspecified, at plant	CH	0	kg	2.84E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	sand, at mine	CH	0	kg	3.76E+5	1	1.64	(4,3,3,1,1,5); qualified estimate
	bitumen, at refinery	RER	0	kg	1.22E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	drawing of pipes, steel	RER	0	kg	1.15E+4	1	1.64	(4,3,3,1,1,5); qualified estimate
	transport, passenger car	CH	0	pkm	3.77E+4	1	2.34	(4,3,3,1,1,5); qualified estimate
	transport, lorry 28t	CH	0	tkm	9.05E+3	1	2.09	(4,5,na,na,na,na); standard distance
	transport, lorry 32t	RER	0	tkm	3.17E+2	1	2.32	(5,1,1,3,3,5); estimates for waste transport
	transport, freight, rail	CH	0	tkm	8.97E+3	1	2.09	(4,5,na,na,na,na); standard distance
	excavation, skid-steer loader	RER	0	m3	6.76E+2	1	2.34	(4,3,3,1,1,5); qualified estimate
	building, multi-storey	RER	1	m3	5.00E+1	1	3.11	(4,3,3,1,1,5); qualified estimate
	disposal, plastics, mixture, 15.3% water, to municipal incineration	CH	0	kg	5.12E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
	disposal, bitumen, 1.4% water, to sanitary landfill	CH	0	kg	1.22E+3	1	1.64	(4,3,3,1,1,5); qualified estimate
Outputs	pipeline, natural gas, low pressure distribution network	CH	1	km	1.00E+0			

6.3 Operation of the network

6.3.1 Energy use

In Schori et al. 2012 it is assumed that, for Switzerland, 80 % of the energy use in the distribution network is used in the compressor station in Ruswil and 20 % in the local distribution network. The natural gas use of the compressor station Ruswil was 600 TJ in 2019 (cf. Chapter 5). Applying the same assumption results in a natural gas consumption of 150 TJ in the low-pressure network. Tab. 6.2 shows the natural gas consumption per MJ supplied as reported in former studies and the value used for this study. The infrastructure and emissions associated with the combustion of natural gas are modelled with the dataset "natural gas, burned in gas turbine".

Tab. 6.2 Natural gas consumption in the low-pressure network

Source	Natural gas consumption
Schori 2012	0.14%
Faist Emmenegger 2015	0.15%
This study	**0.12%**

6.3.2 Emissions

The emission rate is calculated based on reported methane emissions of the Swiss distribution network for 2018.[13] For the emission rate of the low-pressure network, the emissions at the connection points of households and small businesses as well as a share of the emissions due to leakages, fractures, and maintenance, considering the ratio of the length of the high-pressure and low-pressure network, are considered. These values are summed up and divided by the 77% of the annual natural gas consumption in Switzerland as 23% of the annual demand are consumed by end-users of the high-pressure network. Tab. 6.3 shows the emission rates of former studies and the value calculated for this study. In Faist-Emmenegger et al. 2015 and this study, the consideration of the increased share of PE-pipelines in the low-pressure network resulted in a lower emission rate. To calculate the airborne emissions of the local distribution of 1 MJ natural gas, the emission rate is multiplied with the substance content of 1 Nm^3 natural gas (see Tab. 3.1) and divided by the net calorific value.

Tab. 6.3 Emission rates of the low-pressure network[14]

Source	Emission rate
Schori 2012	0.43%
Faist Emmenegger 2015	0.25%
This study	**0.25%**

13 Date provided by Carbotech

14 The exact value was not reported in Faist-Emmenegger et al. 2015. The emission rate was estimated based on the emissions and gas composition

6.4 Inventory data for the local natural gas supply

6.4.1 Description

The dataset «natural gas, low-pressure, at consumer» is shown exemplarily for Switzerland in Tab. 6.4. It describes the energy use, emissions and infrastructure requirements for the local distribution of 1 MJ natural gas. The same values for emissions, energy use and infrastructure needs are used for Switzerland and EU-28. This is justified by the similar relative length of the low-pressure network and the good quality of the Swiss data.

6.4.2 Data quality

Recent data is available for the energy use and emissions in the Swiss distribution network (non-verified data partly based on qualified estimates). Infrastructure requirements are based on qualified estimates. The infrastructure processes were not updated, but the impact on the emission rate was considered.

Tab. 6.4 Unit raw dataset for the local distribution in Switzerland

CH	Name	Location	Unit	*natural gas, low pressure, at consumer*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*CH*			
	InfrastructureProcess			*0*			
	Unit			*MJ*			
	natural gas, high pressure, at consumer	CH	MJ				
	natural gas, low pressure, at consumer	CH	MJ	1.00E+0			
	natural gas, burned in gas turbine	CH	MJ	1.23E-03	1	1.07	(1,3,1,3,1,BU:1.05); Based on data of Swiss compressor station
	natural gas, at long-distance pipeline	CH	Nm3		1	1.05	(1,1,1,3,1,BU:1.05); including leakage
	natural gas, high pressure, at consumer	CH	MJ	1.00E+00	1	1.05	(1,1,1,3,1,BU:1.05); including leakage
	pipeline, natural gas, high pressure distribution network	CH	km		1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
	pipeline, natural gas, low pressure distribution network	CH	km	3.97E-09	1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
air, low population	Methane, fossil	-	kg	7.30E-05	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Ethane	-	kg	6.05E-06	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Propane	-	kg	1.36E-06	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Butane	-	kg	7.00E-07	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	5.04E-08	1	1.50	(1,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Carbon dioxide, fossil	-	kg	2.53E-06	1	1.05	(1,1,1,1,1,BU:1.05); calculated based on gas mix and leakage

7 Life cycle impact assessment

No detailed impact assessment or impact related interpretation is commissioned. Therefore, the following subchapters only show a brief overview of environmental impacts for top-level processes. The environmental impacts were calculated for one unit of the reference flow, hence the environmental impacts of the long-distance transport refer to 1Nm³ natural gas, while impacts of the regional and local distribution refer to 1 MJ natural gas.

7.1 Ecological scarcity method

Tab. 7.1 shows results in ecological scarcity points 2013 per Nm³ natural gas mix at long distance transport to Switzerland and Europe investigated in this report. The results per MJ natural gas delivered consumers from the high-pressure network (regional distribution) and low-pressure network (local distribution) are shown in Tab. 7.2.

For all three value chain stages, the European dataset has higher overall environmental impacts, mainly due to higher impacts in the categories "global warming potential" and "main air pollutants including particulate matter". Main drivers of these impact categories are direct methane emissions and flaring on the extraction sites in the countries of origin.

Tab. 7.1 Ecological scarcity 2013-points per Nm³ natural gas transported to the border for the updated supply mixes for the Swiss and European market in 2019

	Europe, this study	Switzerland, this study
Total	620.80	585.75
Water resources	0.36	0.31
Energy resources	152.16	150.55
Mineral resources	19.38	19.11
Land use	0.75	0.62
Global warming	273.98	258.79
Ozone layer depletion	0.50	0.53
Main air pollutants and PM	99.95	89.62
Carcinogenic substances into air	11.61	11.15
Heavy metals into air	11.04	10.03
Water pollutants	10.15	9.57
POP into water	0.81	0.71
Heavy metals into water	22.73	21.55
Pesticides into soil	0.08	0.07
Heavy metals into soil	0.28	0.24
Radioactive substances into air	0.00	0.00
Radioactive substances into water	0.39	0.27
Noise	3.40	3.35
Non radioactive waste to deposit	0.83	0.81
Radioactive waste to deposit	12.39	8.47

Tab. 7.2 Ecological scarcity 2013-points per MJ natural gas delivered to in the EU-28 and Switzerland in 2019

	Regional distribution		Local distribution	
	Europe, this study	Switzerland, this study	Europe, this study	Switzerland, this study
Total	17.39	16.44	18.60	17.65
Water resources	0.01	0.01	0.01	0.01
Energy resources	4.12	4.08	4.15	4.11
Mineral resources	0.55	0.55	0.61	0.61
Land use	0.02	0.02	0.03	0.02
Global warming	7.81	7.40	8.54	8.13
Ozone layer depletion	0.01	0.01	0.01	0.01
Main air pollutants and PM	2.79	2.51	2.95	2.67
Carcinogenic substances into air	0.33	0.32	0.37	0.36
Heavy metals into air	0.32	0.29	0.42	0.39
Water pollutants	0.28	0.26	0.28	0.26
POP into water	0.02	0.02	0.02	0.02
Heavy metals into water	0.64	0.61	0.70	0.67
Pesticides into soil	0.00	0.00	0.00	0.00
Heavy metals into soil	0.01	0.01	0.01	0.01
Radioactive substances into air	0.00	0.00	0.00	0.00
Radioactive substances into water	0.01	0.01	0.01	0.01
Noise	0.09	0.09	0.10	0.10
Non radioactive waste to deposit	0.02	0.02	0.03	0.03
Radioactive waste to deposit	0.34	0.23	0.35	0.24

7.1.1 Importance of life cycle stages

Fig. 7.1 shows the main stages of the natural gas supply chain and their share of the ecological scarcity 2013-points for the newly modelled mixes at local distribution. Most of the environmental impacts are caused by resource consumption and emissions of the extraction process. Main reason for differences for the import mixes is the mixture of natural gas from different countries of origins, which differ in gas emission rates and direct release of air pollutants. LNG transport (including liquefaction and evaporation) has a disproportionate high share in the environmental impacts of long-distance transport due to the energy-demanding liquefaction process. The regional distribution is the least important stage. The higher emission rate of the local distribution largely causes the higher impacts of this stage of the natural gas supply chain.

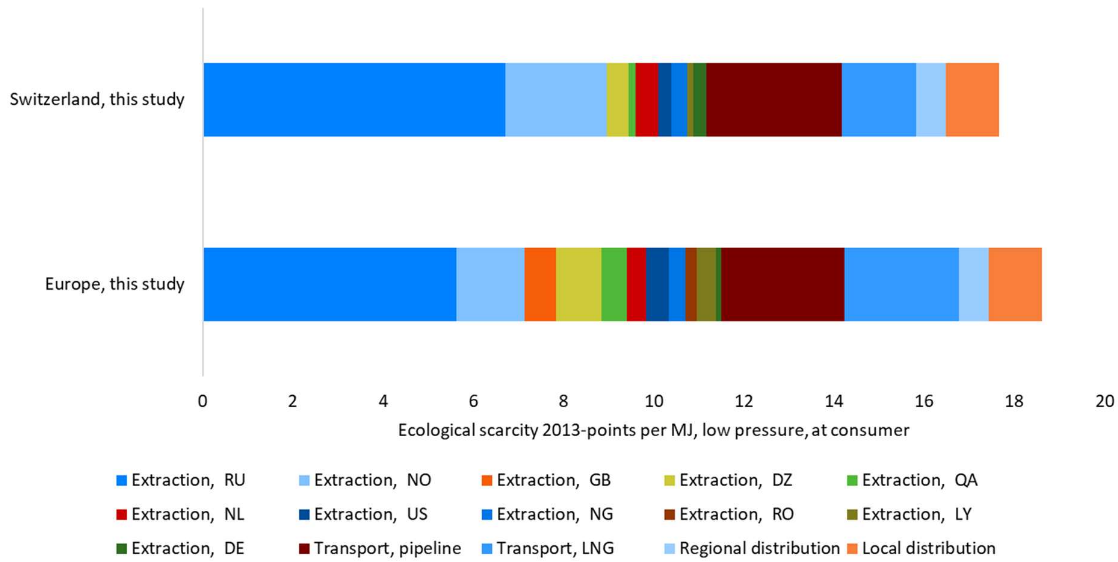


Fig. 7.1 Most relevant activities in terms of Ecological scarcity 2013-points for the EU-28 and Swiss natural gas distribution.

7.1.2 Change of results

Tab. 7.3 shows the relative change of the results in ecological scarcity 2013-points of the newly modelled datasets compared to the datasets available in the UVEK LCI data 2018[15]. The UVEK LCI database does not contain a process for the local distribution of natural gas in Europe. Hence, no relative change is shown in Tab. 7.3 for the local distribution in Europe.

The results are largely dominated by the extraction stage (see Meili et al. 2021a for more details), but for some impact categories updates of the downstream processes changes the results significantly. The increases in "water resources", "heavy metals into air", "radioactive substances into air", "radioactive substances into water" and "radioactive waste to deposit" are partly caused by the higher share of LNG imports, which leads to requirements of port operation and maintenance and associated electricity consumption.

The replacement of chlorofluorocarbons and hydrochlorofluorocarbon refrigerants by HFC-23 explains the reduction of "ozone layer depletion". The different results of the European and Swiss datasets in "Water pollutants", "Pesticides into soil", "Heavy metals into soil" and "Non radioactive waste to deposit" are due to differences in the countries of origin and country-specific data for emissions and well-length. The increase of "global warming potential" is mainly caused by updates of the extraction stage, the higher emission rate of the regional distribution is only of minor importance.

Tab. 7.3 Relative change of ecological scarcity 2013-points of the updated datasets.

	Long-distance transport		Regional distribution		Local distribution
	Europe, this study	Switzerland, this study	Europe, this study	Switzerland, this study	Switzerland, this study
Total	16%	27%	18%	20%	16%
Water resources	147%	233%	139%	189%	167%
Energy resources	3%	6%	5%	5%	5%
Mineral resources	490%	467%	425%	354%	271%
Land use	54%	115%	55%	91%	75%
Global warming	31%	61%	31%	46%	32%
Ozone layer depletion	-61%	-59%	-66%	-69%	-69%
Main air pollutants and PM	36%	27%	36%	19%	18%
Carcinogenic substances into air	261%	341%	237%	241%	192%
Heavy metals into air	188%	261%	173%	192%	127%
Water pollutants	-42%	2%	-41%	0%	0%
POP into water	95%	120%	89%	98%	90%
Heavy metals into water	-65%	-66%	-63%	-66%	-64%
Pesticides into soil	-8%	6%	-5%	3%	4%
Heavy metals into soil	-14%	9%	-12%	4%	7%
Radioactive substances into air	81%	370%	76%	226%	204%
Radioactive substances into water	77%	377%	73%	265%	239%
Noise	120%	173%	112%	133%	123%
Non radioactive waste to deposit	3%	-10%	5%	-11%	0%
Radioactive waste to deposit	80%	374%	76%	252%	227%

7.2 Global warming potential

Tab. 7.4 and Tab. 7.5 show the global warming potential over 100 years in g-CO_2-eq for the newly modelled datasets. The higher global warming potential of the European datasets I caused by higher import shares from countries with higher methane emissions, e.g. Libya.

15 The fundament of this database is ecoinvent v2.2. Updates and data published on www.lc-inventories.ch as well as further studies available on www.treeze.ch are incorporated in this database UVEK LCI Data 2018.

Tab. 7.4 Global warming potential in g CO2-eq. per Nm3 natural gas transported to the border for the updated supply mixes for the Swiss and European market in 2019

	Europe, this study	Switzerland, this study
IPCC GWP 100a	635.4	601.1

Tab. 7.5 Global warming potential in g CO2-eq. per MJ natural gas delivered to in the EU-28 and Switzerland in 2019

	Regional distribution		Local distribution	
	Europe, this study	Switzerland, this study	Europe, this study	Switzerland, this study
IPCC GWP 100a	18.1	17.2	19.9	19.0

Fig. 7.2 main stages of the natural gas supply chain and their share of the greenhouse gas emissions for the newly modelled datasets. In both datasets, the extraction stage is slightly more important than the long-distance transport (pipeline + LNG). For both regions, the share of the LNG transport in the total long-distance transport impacts is higher than the share of LNG in the natural gas imports.

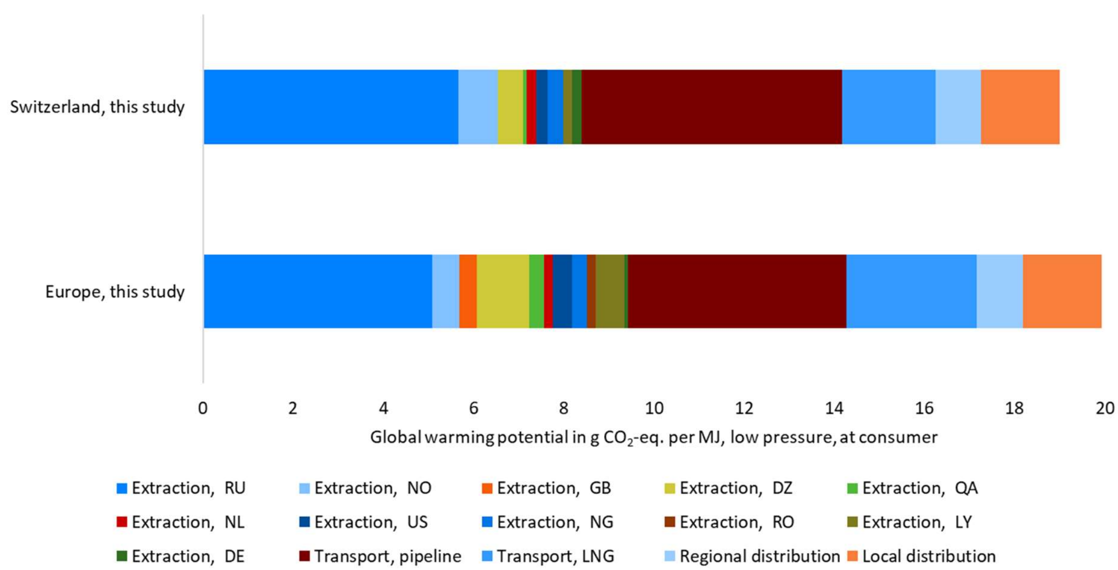


Fig. 7.2 Most relevant activities in terms of global warming potential for the EU-28 and Swiss natural gas distribution.

7.3 Primary energy factors

Tab. 7.6 and Tab. 7.7 shows the primary energy factors in MJ for the newly modelled datasets of natural gas distribution in the EU-28 and Switzerland. The total results are dominated by fossil energy carriers. Nuclear and renewable energy carriers mainly occur in the electricity mixes, while the very small value for land transformation is caused by using vegetable methyl ethers in the diesel mix and lubricating oils (estimated with diesel) used in the drilling fluids.

About 0.2 MJ of primary energy are consumed to provide 1 MJ of useful energy to the final consumer in Switzerland and Europe.

Tab. 7.6 Primary energy factors in MJ per Nm3 natural gas transported to the border for the updated supply mixes for the Swiss and European market in 2019

	Europe, this study	Switzerland, this study
Total	46.728	46.232
Non renewable, fos	46.190	45.837
Non-renewable, nuc	0.391	0.269
Renewable, biomass	0.029	0.023
Renewable, wind, sc	0.017	0.012
Renewable, water	0.100	0.091
Non-renewable, lan	0.001	0.001

Tab. 7.7 Primary energy factors in MJ per MJ natural gas delivered to in the EU-28 and Switzerland in 2019

	Regional distribution		Local distribution	
	Europe, this study	Switzerland, this study	Europe, this study	Switzerland, this study
Total	1.26660	1.25317	1.27588	1.26240
Non renewable, fossil	1.25183	1.24227	1.26033	1.25074
Non-renewable, nuclear	0.01072	0.00741	0.01118	0.00786
Renewable, biomass	0.00083	0.00065	0.00099	0.00081
Renewable, wind, solar, geothermal	0.00047	0.00033	0.00048	0.00034
Renewable, water	0.00274	0.00250	0.00287	0.00264
Non-renewable, land transformation	0.00002	0.00002	0.00002	0.00002

Fig. 7.3 shows the cumulative energy demand in MJ per MJ natural gas delivered to Swiss and European customers. The energy content of the delivered natural gas accounts for about 82% of the total primary energy consumption. For extraction and transportation to the consumer, about 19% (Europe) to 18% (Swiss) of the overall cumulative energy demand are used. The European dataset shows a slightly higher primary energy consumption due to differences in the countries of origin. The long-distance transport, especially for LNG, has relevant influence on the primary energy consumption, while regional and local distribution are of minor importance.

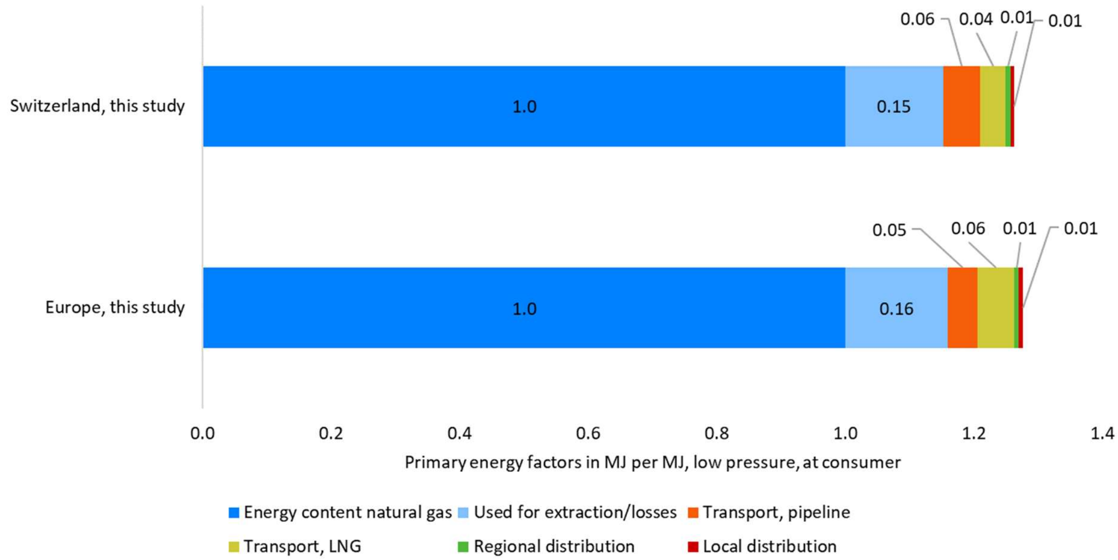


Fig. 7.3 Most relevant activities in terms of primary energy factors for the EU-28 and Swiss natural gas distribution.

7.4 Comparison with literature data

For extraction (upstream), top-down estimates for methane emissions according to IEA 2020b are used in the model (c.f. Meili et al. 2021a, chapter 9.2). However, downstream emissions occur only partially in the country of natural gas extraction. The downstream methane emissions were calculated bottom-up for transportation, distribution and burning in a turbine. Methane emissions for modelled processes natural gas, burned in gas turbine are provided for the European and the Swiss import mix in kg methane per MJ energy content in Tab. 7.8 (lower section). To only account for the downstream emissions, emissions from extraction (upstream) are subtracted.

To check for plausibility of these bottom-up assessments, Tab. 7.8 also shows the global downstream emissions of methane according to IEA 2020b (upper section). The values are set in relation to production data according to BP 2020 and divided by a lower heating value of 36MJ/kg natural gas (c.f. Meili et al. 2021a, chapter 5.1.2).

Despite the different system boundaries, the data can be used to compare the orders of magnitude of the downstream methane emissions with the bottom-up assessment for natural gas, burned in a turbine. The results for both import mixes assessed in this report are below the global IEA data, but the order of magnitude is comparable. The modelled downstream emissions of the Swiss dataset are higher than the emissions of the European dataset, due to the higher share of pipeline imports from Russia.

Tab. 7.8 Comparison of methane downstream emissions per MJ natural gas with IEA data for 2019 (IEA 2020b). Higher methane emissions are highlighted in red, lower in green.

Origin	**Methane emission factor downstream (Natural gas)**
Unit	kg/MJ natural gas
Literature	IEA 2020b
Global	**1.07E-04**
LCI data available for this study	This study
Natural gas, burned in gas turbine/CH	7.30E-05
Natural gas, burned in gas turbine/MJ/RER	6.90E-05
Light fuel oil, burned in industrial furnace 1MW, non-modulating/MJ/CH	
Light fuel oil, burned in industrial furnace 1MW, non-modulating/MJ/RER	

8 Outlook

The following updates where not within the scope of this project. They would be recommended for follow-up projects.

The UVEK database includes data for the supply of natural gas to Japan. An update was not commissioned. It is recommended to update these data and harmonize the assumptions for the three datasets:

- Liquefied, at freight ship/JP (including the mix)

- Evaporation plant
- High pressure supply

The present update for natural gas is also relevant for LCI related to plastic products and other products made directly from natural gas. The data for plastics in the ecoinvent and UVEK database are not yet linked to these inventories. It would be recommended to establish new LCI data linked to the inventories presented in this report. More recent data for the natural gas transmission and distribution infrastructure are available (e.g. Schuller et al. 2017). It would be recommended to update the material needs for different infrastructure facilities (pipelines, liquefaction facility, etc) and the infrastructure requirements of the transport processes (e.g. km pipeline/ m^3 natural gas transported). The infrastructure for seasonal storage of natural gas is not yet considered in the inventories. Its relevance should at least be estimated roughly. The emissions of the gas turbines used for modelling the energy demand of the transport and distribution activities are based on rough estimates and should be updated as well.

As the import of LNG is increasingly important for the European natural gas supply, it is recommended to investigate the process in more detail in a future update.

The LCI is built up for different life cycle stages. It would be recommended to do an assessment and interpretation of the global warming potential for the full chain, in order to better understand possible deviations from data sources like the analysis in the world energy outlook 2018 (IEA 2018, page 486ff).

9 References

Agarwal et al. 2017 Agarwal R., Rainey T., Rahman S., Steinberg T., Perrons R. and Brown R. (2017) LNG Regasification Terminals: The Role of Geography and Meteorology on Technology Choices. *In: Energies*, **10**(12), pp., 10.3390/en10122152.

Asprofos Engineering 2014 Asprofos Engineering (2014) Cumulative Impacts Assessment for the 2nd Upgrade of the LNG Terminal in Revithoussa Island, Greece.

BP 2020 BP (2020) BP Statistical Review of World Energy 2019. BP, London, retrieved from: https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

Cerbe et al. 1999 Cerbe G., Carlowitz O., Kätelhön J. E., Köhler H., Lehmann J., Lendt B., Lethen H., Mauruschat H. and Pietsch H. (1999) Grundlagen der Gastechnik: Gasbeschaffung, Gasverteilung, Gasverwendung. 5., vollständig neubearbeitete Auflage Edition. Carl Hanser Verlag, ISBN 3-446-21109-8, München Wien.

European Commission 2015 European Commission (2015) The role of gas storage in internal market and in ensuring security of supply.

Eurostat 2020 Eurostat (2020) Imports of natural gas by partner country, retrieved from: https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do.

Faist-Emmenegger et al. 2015 Faist-Emmenegger M., Del Duce A. and Zah R. (2015) Update and extension of the inventory data for energy gases. Quantis, Zürich, Switzerland.

Faist Emmenegger et al. 2007 Faist Emmenegger M., Heck T., Jungbluth N. and Tuchschmid M. (2007) Erdgas. In: *Sachbilanzen von Energiesystemen: Grundlagen für den ökologischen Vergleich von Energiesystemen und den Einbezug von Energiesystemen in Ökobilanzen für die Schweiz,* Vol. ecoinvent report No. 6-V, v2.0 (Ed. Dones R.). Paul Scherrer Institut Villigen, Swiss Centre for Life Cycle Inventories, Dübendorf, CH retrieved from: www.ecoinvent.org.

Gasunie 1998 Gasunie (1998) Environmental annual report 1997. N.V. Nederlandse Gasunie, Groningen, retrieved from: www.gasunie.nl/eng/f_gm1.htm.

Gasunie 2001 Gasunie (2001) Safety, Health & Environment - annual report 2000. N.V. Nederlandse Gasunie, Groningen, retrieved from: www.gasunie.nl.

IEA 2018 IEA (2018) World Energy Outlook 2018, Paris, retrieved from: https://www.iea.org/reports/world-energy-outlook-2018.

IEA 2020a IEA (2020a) Gas Trade Flows. Retrieved 05.08 retrieved from: https://www.iea.org/reports/gas-trade-flows.

IEA 2020b IEA (2020b) Methane Tracker 2020. IEA, Paris, retrieved from: https://www.iea.org/reports/methane-tracker-2020.

IMO 2015 IMO (2015) Third IMO GHG Study 2014.

IMO 2016 IMO (2016) Studies on the feasibility and use of LNG as a fuel for shipping.

Meili & Jungbluth 2019a Meili C. and Jungbluth N. (2019a) Life cycle inventories of long-distance transport of crude oil. ESU-services Ltd. commissioned by Plastics Europe, Schaffhausen, Switzerland, retrieved from: confidential.

Meili & Jungbluth 2019b Meili C. and Jungbluth N. (2019b) Life cycle inventories of crude oil and natural gas extraction. ESU-services Ltd. commissioned by Plastics Europe, Schaffhausen, Switzerland, retrieved from: confidential.

Meili et al. 2021a Meili C., Jungbluth N. and Bussa M. (2021a) Life cycle inventories of crude oil and natural gas extraction. ESU-services Ltd. commissioned by FOEN and VSG, Schaffhausen, Switzerland, retrieved from: www.esu-services.ch/data/public-lci-reports/.

Meili et al. 2021b Meili C., Jungbluth N. and Bussa M. (2021b) Life cycle inventories of long-distance transport of crude oil. ESU-services Ltd. commissioned by FOEN and VSG, Schaffhausen, Switzerland, retrieved from: www.esu-services.ch/data/public-lci-reports/.

Müller-Syring et al. 2016 Müller-Syring G., Große C., Glandien J. and Eyßer M. (2016) Critical Evaluation of Default Values for the GHG Emissions of the Natural Gas Supply Chain.

Pospíšil et al. 2019 Pospíšil J., Charvát P., Arsenyeva O., Klimeš L., Špiláček M. and Klemeš J. J. (2019) Energy demand of liquefaction and regasification of natural gas and the potential of LNG for operative thermal energy storage. *In: Renewable and Sustainable Energy Reviews*, **99**, pp. 1-15, 10.1016/j.rser.2018.09.027.

Schori et al. 2012 Schori S., Bauer C. and Frischknecht R. (2012) Life Cycle Inventory of Natural Gas Supply. Paul Scherrer Institut Villigen, Swiss Centre for Life Cycle Inventories, Dübendorf, CH, retrieved from: www.ecoinvent.org.

Schuller et al. 2017 Schuller O., Reuter B., Hengstler J., Whitehouse S. and Zeitzen L. (2017) Greenhousegas Intensity of Natural Gas Transport.

Stenersen & Thonstad 2017 Stenersen D. and Thonstad O. (2017) GHG and NOx emissions from gas fuelled engines.

SWISSGAS 2019 SWISSGAS (2019) Erdgas - Zusammensetzung der Swissgas - Importe im Jahre 2019. Schweizerische Aktiengesellschaft für Erdgas.

UNEP 2018 UNEP (2018) Montreal Protocolon Substances that Deplete the Ozone Layer - Report of the Halons Technical Options Committee - Assessment Report. United Nations Environment Programme, retrieved from: https://ozone.unep.org/sites/default/files/2019-04/HTOC_assessment_2018.pdf.

Ushakov et al. 2019 Ushakov S., Stenersen D. and Einang P. M. (2019) Methane slip from gas fuelled ships: a comprehensive summary based on measurement data. *In: Journal of Marine Science and Technology*, pp., https://doi.org/10.1007/s00773-018-00622-z.

VSG 2020 VSG (2020) Import-Portfolio der Schweizer Erdgas-Wirtschaft 2019.

A.Full list of unit process raw data

The complete list of unit process raw data is attached on the following pages.

Unit process raw data for natural gas combustion

CH	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*CH*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	CH	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	CH	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	CH	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

DE	Name	Location	Unit	natural gas, burned in gas turbine			
	Location			*DE*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	DE	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	DE	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	DE	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

DZ	Name	Location	Unit	natural gas, burned in gas turbine			
	Location			DZ			
	Unit			MJ			
	natural gas, burned in gas turbine	DZ	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	DZ	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	DZ	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

GB	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*GB*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	GB	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	GB	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	GB	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

LY	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*LY*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	LY	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	LY	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	LY	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

NG	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*NG*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	NG	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	NG	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	NG	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

NL	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*NL*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	NL	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	NL	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	NL	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

NO	Name	Location	Unit	natural gas, burned in gas turbine			
	Location			NO			
	Unit			MJ			
	natural gas, burned in gas turbine	NO	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	NO	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	NO	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

QA	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*QA*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	QA	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	QA	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	QA	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

RER	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*RER*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	RER	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	RER	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	RER	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

RO	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*RO*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	RO	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	RO	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	RO	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

RU	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*RU*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	RU	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	RU	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	RU	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for natural gas combustion

US	Name	Location	Unit	*natural gas, burned in gas turbine*			
	Location			*US*			
	Unit			*MJ*			
	natural gas, burned in gas turbine	US	MJ	1.00E+0			
	gas turbine, 10MWe, at production plant	RER	unit	1.15E-10	1	3.28	(4,3,5,3,1,BU:3); infrastructure estimation
	Natural gas, at production	US	Nm3	2.69E-02	1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
	natural gas, at long-distance pipeline	US	Nm3		1	1.57	(4,3,5,3,1,BU:1.05); natural gas input
air, high population	Methane, fossil	-	kg	4.50E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Carbon monoxide, fossil	-	kg	4.00E-05	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dinitrogen monoxide	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Nitrogen oxides	-	kg	1.30E-04	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	NMVOC, non-methane volatile organic	-	kg	1.00E-06	1	2.07	(5,5,5,3,1,BU:1.5); rough estimate
	Sulfur dioxide	-	kg	5.50E-07	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Carbon dioxide, fossil	-	kg	5.60E-02	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate
	Mercury	-	kg	3.00E-11	1	5.58	(5,5,5,3,1,BU:5); rough estimate
	Dioxin, 2,3,7,8 Tetrachlorodibenzo-p-	-	kg	2.90E-17	1	3.50	(5,5,5,3,1,BU:3); rough estimate
	Heat, waste	-	MJ	1.10E+00	1	1.83	(5,5,5,3,1,BU:1.05); rough estimate

Unit process raw data for pipeline transport

DE	Name	Location	Unit	*transport, natural gas, onshore pipeline, long distance*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*DE*			
	Unit			*tkm*			
	transport, natural gas, onshore pipeline, long distance	DE	tkm	1.00E+0	0	0.00	
	transport, natural gas, offshore pipeline, long distance	DE	tkm		0	0.00	
	Natural gas, at production	DE	Nm3	2.50E-04	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	DE	MJ	3.38E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.66E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.37E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.09E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.59E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.14E-07	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	5.73E-06	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.50E-12	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

DZ	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			DZ	DZ			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	DZ	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	DZ	tkm		1.00E+0	0	0.00	
	Natural gas, at production	DZ	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	DZ	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	2.59E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

GB	Name	Location	Unit	*transport, natural gas, onshore pipeline, long distance*	*transport, natural gas, offshore pipeline, long distance*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			*GB*	*GB*			
	Unit			*tkm*	*tkm*			
	transport, natural gas, onshore pipeline, long distance	GB	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	GB	tkm		1.00E+0	0	0.00	
	Natural gas, at production	GB	Nm3	2.50E-04	2.50E-04	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	GB	MJ	3.38E-01	3.38E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.66E-04	1.66E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.37E-05	1.37E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.09E-06	3.09E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.59E-06	1.59E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.14E-07	1.14E-07	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	5.73E-06	5.73E-06	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.50E-12	2.50E-12	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

LY	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			LY	LY			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	LY	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	LY	tkm		1.00E+0	0	0.00	
	Natural gas, at production	LY	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	LY	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

NG	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			NG	NG			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	NG	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	NG	tkm		1.00E+0	0	0.00	
	Natural gas, at production	NG	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	NG	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

NL	Name	Location	Unit	*transport, natural gas, onshore pipeline, long distance*	*transport, natural gas, offshore pipeline, long distance*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			*NL*	*NL*			
	Unit			*tkm*	*tkm*			
	transport, natural gas, onshore pipeline, long distance	NL	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	NL	tkm		1.00E+0	0	0.00	
	Natural gas, at production	NL	Nm3	2.50E-04	2.50E-04	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	NL	MJ	3.38E-01	3.38E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.66E-04	1.66E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.37E-05	1.37E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.09E-06	3.09E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.59E-06	1.59E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.14E-07	1.14E-07	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	5.73E-06	5.73E-06	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.50E-12	2.50E-12	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

NO	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			NO	NO			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	NO	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	NO	tkm		1.00E+0	0	0.00	
	Natural gas, at production	NO	Nm3	2.50E-04	2.50E-04	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	NO	MJ	3.38E-01	3.38E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.66E-04	1.66E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.37E-05	1.37E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.09E-06	3.09E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.59E-06	1.59E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.14E-07	1.14E-07	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	5.73E-06	5.73E-06	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.50E-12	2.50E-12	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

QA	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			QA	QA			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	QA	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	QA	tkm		1.00E+0	0	0.00	
	Natural gas, at production	QA	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	QA	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

RO	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			RO			
	Unit			tkm			
	transport, natural gas, onshore pipeline, long distance	RO	tkm	1.00E+0	0	0.00	
	transport, natural gas, offshore pipeline, long distance	RO	tkm		0	0.00	
	Natural gas, at production	RO	Nm3	2.50E-04	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	RO	MJ	3.38E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	2.59E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	0.00E+00	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.66E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.37E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.09E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.59E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.14E-07	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	5.73E-06	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.50E-12	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

RU	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	transport, natural gas, offshore pipeline, long distance	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			RU	RU			
	Unit			tkm	tkm			
	transport, natural gas, onshore pipeline, long distance	RU	tkm	1.00E+0		0	0.00	
	transport, natural gas, offshore pipeline, long distance	RU	tkm		1.00E+0	0	0.00	
	Natural gas, at production	RU	Nm3	2.68E-03	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	RU	MJ	8.20E-01	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1.78E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	2.59E-09		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	0.00E+00		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

Unit process raw data for pipeline transport

US	Name	Location	Unit	transport, natural gas, onshore pipeline, long distance	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			US			
	Unit			tkm			
	transport, natural gas, onshore pipeline, long distance	US	tkm	1.00E+0	0	0.00	
	transport, natural gas, offshore pipeline, long distance	US	tkm		0	0.00	
	Natural gas, at production	US	Nm3	2.68E-03	1	1.21	(4,2,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, burned in gas turbine	US	MJ	8.20E-01	1	1.21	(4,2,2,1,1,BU:1.05); Qualified estimates from different gas companies
Infrastructure	pipeline, natural gas, long distance, high capacity, offshore	GLO	km		1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, high capacity, onshore	GLO	km	0.00E+00	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
	pipeline, natural gas, long distance, low capacity, onshore	GLO	km	3.57E-09	1	3.27	(4,3,5,1,1,BU:3); based on estimated standard capacity
Waste	transport, freight, lorry 16-32 metric ton, fleet	RER	tkm	1.16E-07	1	2.30	(3,4,5,3,3,BU:2); estimates for waste transport
	disposal, used mineral oil, 10% water, to	CH	kg	1.16E-06	1	1.60	(3,4,5,3,3,BU:1.05); based on dutch data
air, low population	Methane, fossil	-	kg	1.78E-03	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Ethane	-	kg	1.47E-04	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Propane	-	kg	3.32E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Butane	-	kg	1.71E-05	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.23E-06	1	1.57	(2,3,4,1,1,BU:1.5); Calculated based on leakage and average gas composition
	Carbon dioxide, fossil	-	kg	6.15E-05	1	1.22	(2,3,4,1,1,BU:1.05); Calculated based on leakage and average gas composition
	Mercury	-	kg	2.68E-11	1	5.06	(2,3,4,1,1,BU:5); Calculated based on leakage and average gas composition
	Methane, bromochlorodifluoro-, Halon 1211	-	kg	2.24E-09	1	2.11	(5,5,5,3,3,BU:1.5); assuming 10% halon compared to Schori 2012
	Methane, trifluoro-, HFC-23	-	kg	8.95E-08	1	2.11	(5,5,5,3,3,BU:1.5); assuming 90% HFC-23 compared to Schori 2012

DZ	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production DZ, at evaporation plant	transport, liquefied natural gas DZ, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			DZ	DZ	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	natural gas, liquefied, at liquefaction plant	DZ	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	DZ	Nm3		1.00E+0					
	natural gas, production DZ, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas DZ, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	DZ	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	DZ	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	DZ	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas DZ, freight ship	OCE	tkm		2.51E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	DZ	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

DZ	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production DZ, at evaporation plant*	*transport, liquefied natural gas DZ, freight ship*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*DZ*	*DZ*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

Unit process raw data for LNG

NG	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production NG, at evaporation plant	transport, liquefied natural gas NG, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			NG	NG	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	natural gas, liquefied, at liquefaction plant	NG	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	NG	Nm3		1.00E+0					
	natural gas, production NG, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas NG, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	NG	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	NG	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	NG	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas NG, freight ship	OCE	tkm		5.85E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	NG	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

Unit process raw data for LNG

NG	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production NG, at evaporation plant	transport, liquefied natural gas NG, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			NG	NG	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

Unit process raw data for LNG

NO	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production NO, at evaporation plant	transport, liquefied natural gas NO, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			NO	NO	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	natural gas, liquefied, at liquefaction plant	NO	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	NO	Nm3		1.00E+0					
	natural gas, production NO, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas NO, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	NO	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	NO	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	NO	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas NO, freight ship	OCE	tkm		1.90E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	NO	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

NO	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production NO, at evaporation plant*	*transport, liquefied natural gas NO, freight ship*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*NO*	*NO*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

Unit process raw data for LNG

QA	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production QA, at evaporation plant*	*transport, liquefied natural gas QA, freight ship*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			*QA*	*QA*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	natural gas, liquefied, at liquefaction plant	QA	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	QA	Nm3		1.00E+0					
	natural gas, production QA, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas QA, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	QA	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	QA	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	QA	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas QA, freight ship	OCE	tkm		8.89E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	QA	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

Unit process raw data for LNG

QA	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production QA, at evaporation plant*	*transport, liquefied natural gas QA, freight ship*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*QA*	*QA*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

Unit process raw data for LNG

RU	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production RU, at evaporation plant	transport, liquefied natural gas RU, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			RU	RU	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	natural gas, liquefied, at liquefaction plant	RU	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	RU	Nm3		1.00E+0					
	natural gas, production RU, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas RU, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	RU	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	RU	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	RU	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas RU, freight ship	OCE	tkm		3.72E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	RU	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

RU	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production RU, at evaporation plant*	*transport, liquefied natural gas RU, freight ship*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*RU*	*RU*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

US	Name	Location	Unit	natural gas, liquefied, at liquefaction plant	natural gas, liquefied, at freight ship	natural gas, production US, at evaporation plant	transport, liquefied natural gas US, freight ship	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			US	US	RER	OCE			
	Unit			Nm3	Nm3	Nm3	tkm			
	natural gas, liquefied, at liquefaction plant	US	Nm3	1.00E+0						
	natural gas, liquefied, at freight ship	US	Nm3		1.00E+0					
	natural gas, production US, at evaporation plant	RER	Nm3			1.00E+0				
	transport, liquefied natural gas US, freight ship	OCE	tkm				1.00E+0			
technosphere	Natural gas, at production	US	Nm3	1.00E+00				1	1.30	(4,1,1,3,3,BU:1.05); Natural gas input + leakage
	natural gas, burned in gas turbine	US	MJ	3.20E+00		2.56E-01	1.65E-03	1	1.30	(4,1,1,3,3,BU:1.05); Based on technology average
	production plant, natural gas	GLO	unit	7.89E-13		7.89E-13		1	3.29	(5,3,3,3,3,BU:3); Estimate for Europe
	natural gas, liquefied, at liquefaction plant	US	Nm3		1.00E+00		4.29E-03	1	1.05	(1,1,1,1,1,BU:1.05); Estimate based on American data
	transport, liquefied natural gas US, freight ship	OCE	tkm		7.37E+00			1	2.08	(3,3,3,1,3,BU:2); Average weighted distance based on BP statistics 2019
	natural gas, liquefied, at freight ship	US	Nm3			1.00E+00		1	1.05	(1,1,1,1,1,BU:1.05);
	heavy fuel oil, at regional storage	RER	kg				1.65E-03	1	1.33	(4,3,3,3,3,BU:1.05); Estimate based on American data
	transport, freight, lorry 16-32 metric ton, fleet average	RER	tkm				1.09E-05	1	2.00	(1,1,1,1,1,BU:2); Environmental report of Italian company
	transoceanic freight ship	OCE	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	operation, maintenance, port	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	maintenance, transoceanic freight ship	RER	unit				2.43E-11	1	3.47	(5,4,5,1,1,BU:3); Assumptions on the basis of older data
	disposal, bilge oil, 90% water, to hazardous waste incineration	CH	kg				2.18E-04	1	1.53	(2,4,5,1,1,BU:1.05); Assumptions on the basis of older data
	sodium hypochlorite, 15% in H2O, at plant	RER	kg			3.36E-02	2.18E-04	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
resource, in water	Water, salt, ocean	-	m3			6.42E+00	1.12E-02	1	1.40	(4,5,3,3,3,BU:1.05); Environmental report of Greek site
emission air, low population density	Methane, fossil	-	kg	3.31E-04		3.50E-04	1.33E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Ethane	-	kg	2.75E-05				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Propane	-	kg	6.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Butane	-	kg	3.18E-06				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	2.29E-07				1	1.58	(2,5,3,1,1,BU:1.5); Based on leakage rate and natural gas composition
	Carbon dioxide, fossil	-	kg	2.29E-02			1.37E-02	1	1.24	(4,3,3,1,1,BU:1.05); Based on data from IMO (2015) and Sternersen (2017)
	Mercury	-	kg	5.00E-12				1	5.07	(4,3,3,1,1,BU:5); Based on leakage rate and natural gas composition

US	Name	Location	Unit	*natural gas, liquefied, at liquefaction plant*	*natural gas, liquefied, at freight ship*	*natural gas, production US, at evaporation plant*	*transport, liquefied natural gas US, freight ship*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			*US*	*US*	*RER*	*OCE*			
	Unit			*Nm3*	*Nm3*	*Nm3*	*tkm*			
	Carbon monoxide, fossil	-	kg				4.04E-05	1	5.07	(4,3,3,1,1,BU:5); Based on data from IMO (2015) and Sternersen (2017)
	Nitrogen oxides	-	kg				1.34E-04	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Dinitrogen monoxide	-	kg				6.22E-07	1	1.58	(4,3,3,1,1,BU:1.5); Based on data from IMO (2015) and Sternersen (2017)
	Water	-	kg			6.42E+03		1	1.69	(4,5,3,3,3,BU:1.5); Environmental report of Greek site

Unit process raw data for the long-distance transport of natural gas to destination

DE	Name	Location	Unit	*natural gas, production DE, at long-distance pipeline*			
	Location			*DE*			
	Unit			*Nm3*			
	natural gas, production DE, at long-distance pipeline	DE	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	DE	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production DE, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	DE	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	DE	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	DE	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NL	Name	Location	Unit	*natural gas, production NL, at long-distance pipeline*			
	Location			*DE*			
	Unit			*Nm3*			
	natural gas, production NL, at long-distance pipeline	DE	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NL	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NL, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NL	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NL	tkm	5.32E-02	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NL	tkm	1.52E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NO	Name	Location	Unit	*natural gas, production NO, at long-distance pipeline*			
	Location			*DE*			
	Unit			*Nm3*			
	natural gas, production NO, at long-distance pipeline	DE	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NO	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NO, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NO	tkm	3.88E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NO	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RU	Name	Location	Unit	*natural gas, production RU, at long-distance pipeline*			
	Location			*DE*			
	Unit			*Nm3*			
	natural gas, production RU, at long-distance pipeline	DE	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	3.12E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	3.38E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

DZ	Name	Location	Unit	*natural gas, production DZ, at long-distance pipeline*			
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, production DZ, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	DZ	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production DZ, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	DZ	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	DZ	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	DZ	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NG	Name	Location	Unit	natural gas, production NG, at long-distance pipeline			
	Location			FR			
	Unit			Nm3			
	natural gas, production NG, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NG	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NG, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NG	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NL	Name	Location	Unit	*natural gas, production NL, at long-distance pipeline*			
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, production NL, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NL	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NL, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NL	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NL	tkm	3.80E-02	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NL	tkm	3.04E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NO	Name	Location	Unit	*natural gas, production NO, at long-distance pipeline*			
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, production NO, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NO	Nm3	9.30E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NO, at evaporation plant	RER	Nm3	7.00E-02	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NO	tkm	6.38E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NO	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

QA	Name	Location	Unit	*natural gas, production QA, at long-distance pipeline*			
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, production QA, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	QA	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production QA, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	QA	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RU	Name	Location	Unit	natural gas, production RU, at long-distance pipeline			
	Location			FR			
	Unit			Nm3			
	natural gas, production RU, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	5.30E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	4.70E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	4.52E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

US	Name	Location	Unit	*natural gas, production US, at long-distance pipeline*			
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, production US, at long-distance pipeline	FR	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	US	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production US, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	US	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	US	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	US	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

DZ	Name	Location	Unit	*natural gas, production DZ, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production DZ, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	DZ	Nm3	7.70E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production DZ, at evaporation plant	RER	Nm3	2.30E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	DZ	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	DZ	tkm	1.18E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	DZ	tkm	6.99E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

LY	Name	Location	Unit	natural gas, production LY, at long-distance pipeline			
	Location			IT			
	Unit			Nm3			
	natural gas, production LY, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	LY	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production LY, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	LY	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	LY	tkm	3.95E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	LY	tkm	4.03E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NG	Name	Location	Unit	*natural gas, production NG, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production NG, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NG	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NG, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NG	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NL	Name	Location	Unit	*natural gas, production NL, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production NL, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NL	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NL, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NL	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NL	tkm	3.80E-02	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NL	tkm	7.45E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NO	Name	Location	Unit	*natural gas, production NO, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production NO, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NO	Nm3	9.30E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NO, at evaporation plant	RER	Nm3	7.00E-02	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NO	tkm	6.16E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NO	tkm	6.92E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

QA	Name	Location	Unit	*natural gas, production QA, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production QA, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	QA	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production QA, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	QA	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RU	Name	Location	Unit	natural gas, production RU, at long-distance pipeline			
	Location			IT			
	Unit			Nm3			
	natural gas, production RU, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	2.82E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

US	Name	Location	Unit	*natural gas, production US, at long-distance pipeline*			
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, production US, at long-distance pipeline	IT	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	US	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production US, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	US	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	US	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	US	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NL	Name	Location	Unit	*natural gas, production NL, at long-distance pipeline*			
	Location			*NL*			
	Unit			*Nm3*			
	natural gas, production NL, at long-distance pipeline	NL	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NL	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NL, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NL	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NL	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NL	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NO	Name	Location	Unit	*natural gas, production NO, at long-distance pipeline*			
	Location			*NL*			
	Unit			*Nm3*			
	natural gas, production NO, at long-distance pipeline	NL	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NO	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NO, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NO	tkm	3.50E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NO	tkm	7.60E-03	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RU	Name	Location	Unit	*natural gas, production RU, at long-distance pipeline*			
	Location			*NL*			
	Unit			*Nm3*			
	natural gas, production RU, at long-distance pipeline	NL	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	9.35E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	2.76E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

DE	Name	Location	Unit	*natural gas, production DE, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production DE, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	DE	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production DE, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	DE	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	DE	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	DE	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

DZ	Name	Location	Unit	*natural gas, production DZ, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production DZ, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	DZ	Nm3	5.80E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production DZ, at evaporation plant	RER	Nm3	4.20E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	DZ	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	DZ	tkm	9.88E-02	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	DZ	tkm	7.98E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

GB	Name	Location	Unit	*natural gas, production GB, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production GB, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	GB	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production GB, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	GB	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	GB	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	GB	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

LY	Name	Location	Unit	*natural gas, production LY, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production LY, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	LY	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production LY, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	LY	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	LY	tkm	3.95E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	LY	tkm	4.03E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NG	Name	Location	Unit	natural gas, production NG, at long-distance pipeline			
	Location			RER			
	Unit			Nm3			
	natural gas, production NG, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NG	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NG, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NG	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NG	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NL	Name	Location	Unit	*natural gas, production NL, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production NL, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NL	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NL, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NL	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NL	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NL	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

NO	Name	Location	Unit	*natural gas, production NO, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production NO, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	NO	Nm3	9.50E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production NO, at evaporation plant	RER	Nm3	5.00E-02	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	NO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	NO	tkm	5.02E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	NO	tkm	3.80E-02	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

QA	Name	Location	Unit	*natural gas, production QA, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production QA, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	QA	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production QA, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	QA	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	QA	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RO	Name	Location	Unit	*natural gas, production RO, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production RO, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RO	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RO, at evaporation plant	RER	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RO	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RO	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RO	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

RU	Name	Location	Unit	*natural gas, production RU, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production RU, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	RU	Nm3	9.00E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production RU, at evaporation plant	RER	Nm3	1.00E-01	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	RU	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	RU	tkm	3.12E-01	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	RU	tkm	2.96E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the long-distance transport of natural gas to destination

US	Name	Location	Unit	*natural gas, production US, at long-distance pipeline*			
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, production US, at long-distance pipeline	RER	Nm3	1.00E+0	0	0.00	
Natural gas imports	Natural gas, at production	US	Nm3	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via pipeline + losses
	natural gas, production US, at evaporation plant	RER	Nm3	1.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Imports via LNG
Energy use	natural gas, burned in gas turbine	US	MJ	8.36E-02	1	1.62	(4,1,5,3,3,BU:1.05); Energy expenditure of seasonal storage
Transport	transport, natural gas, offshore pipeline, long distance	US	tkm	0.00E+00	1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
	transport, natural gas, onshore pipeline, long distance	US	tkm		1	1.07	(2,1,1,1,1,BU:1.05); Average weighted distance is estimated based on trade statistics and pipeline network.
air, low population	Methane, fossil	-	kg	6.63E-05	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Ethane	-	kg	5.49E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Propane	-	kg	1.24E-06	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Butane	-	kg	6.35E-07	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	4.57E-08	1	1.58	(2,5,3,1,1,BU:1.5); Emissions from storage. Calculated based on average losses and gas composition
	Carbon dioxide, fossil	-	kg	2.29E-06	1	1.24	(2,5,3,1,1,BU:1.05); Emissions from storage. Calculated based on average losses and gas composition
	Mercury	-	kg	1.00E-12	1	5.07	(2,5,3,1,1,BU:5); Emissions from storage. Calculated based on average losses and gas composition

Unit process raw data for the natural gas supply mixes

CH	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*CH*			
	Unit			*Nm3*			
	natural gas, at long-distance pipeline	CH	Nm3	1.00E+0			
Supply mix	natural gas, at long-distance pipeline	DE	Nm3	61.8%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	FR	Nm3	33.1%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	NL	Nm3	1.9%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020
	natural gas, at long-distance pipeline	IT	Nm3	3.2%	1	1.21	(4,1,1,1,1,BU:1.05); VSG 2020

Unit process raw data for the natural gas supply mixes

DE	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*DE*			
	Unit			*Nm3*			
Supply mix	natural gas, at long-distance pipeline	DE	Nm3	1.00E+0			
	natural gas, production RU, at long-distance pipeline	DE	Nm3	53.1%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NO, at long-distance pipeline	DE	Nm3	33.3%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production GB, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DZ, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production QA, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NL, at long-distance pipeline	DE	Nm3	8.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production US, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NG, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production RO, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production LY, at long-distance pipeline	DE	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DE, at long-distance pipeline	DE	Nm3	4.9%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020

Unit process raw data for the natural gas supply mixes

FR	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*FR*			
	Unit			*Nm3*			
	natural gas, at long-distance pipeline	FR	Nm3	1.00E+0			
Supply mix	natural gas, production RU, at long-distance pipeline	FR	Nm3	29.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NO, at long-distance pipeline	FR	Nm3	42.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production GB, at long-distance pipeline	FR	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DZ, at long-distance pipeline	FR	Nm3	6.9%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production QA, at long-distance pipeline	FR	Nm3	3.6%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NL, at long-distance pipeline	FR	Nm3	3.4%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production US, at long-distance pipeline	FR	Nm3	5.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NG, at long-distance pipeline	FR	Nm3	8.3%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production RO, at long-distance pipeline	FR	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production LY, at long-distance pipeline	FR	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DE, at long-distance pipeline	FR	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020

Unit process raw data for the natural gas supply mixes

IT	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*IT*			
	Unit			*Nm3*			
	natural gas, at long-distance pipeline	IT	Nm3	1.00E+0			
Supply mix	natural gas, production RU, at long-distance pipeline	IT	Nm3	40.9%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NO, at long-distance pipeline	IT	Nm3	6.7%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production GB, at long-distance pipeline	IT	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DZ, at long-distance pipeline	IT	Nm3	24.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production QA, at long-distance pipeline	IT	Nm3	12.6%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NL, at long-distance pipeline	IT	Nm3	1.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production US, at long-distance pipeline	IT	Nm3	3.2%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NG, at long-distance pipeline	IT	Nm3	0.2%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production RO, at long-distance pipeline	IT	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production LY, at long-distance pipeline	IT	Nm3	10.6%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DE, at long-distance pipeline	IT	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020

Unit process raw data for the natural gas supply mixes

NL	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*NL*			
	Unit			*Nm3*			
Supply mix	natural gas, at long-distance pipeline	NL	Nm3	1.00E+0			
	natural gas, production RU, at long-distance pipeline	NL	Nm3	19.2%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NO, at long-distance pipeline	NL	Nm3	61.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production GB, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DZ, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production QA, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NL, at long-distance pipeline	NL	Nm3	19.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production US, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NG, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production RO, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production LY, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DE, at long-distance pipeline	NL	Nm3	0.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020

Unit process raw data for the natural gas supply mixes

RER	Name	Location	Unit	*natural gas, at long-distance pipeline*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*RER*			
	Unit			*Nm3*			
	natural gas, at long-distance pipeline	RER	Nm3	1.00E+0			
Supply mix	natural gas, production RU, at long-distance pipeline	RER	Nm3	39.4%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NO, at long-distance pipeline	RER	Nm3	23.7%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production GB, at long-distance pipeline	RER	Nm3	8.2%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DZ, at long-distance pipeline	RER	Nm3	6.4%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production QA, at long-distance pipeline	RER	Nm3	6.1%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NL, at long-distance pipeline	RER	Nm3	5.8%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production US, at long-distance pipeline	RER	Nm3	3.5%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production NG, at long-distance pipeline	RER	Nm3	2.7%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production RO, at long-distance pipeline	RER	Nm3	2.0%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production LY, at long-distance pipeline	RER	Nm3	1.1%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020
	natural gas, production DE, at long-distance pipeline	RER	Nm3	1.1%	1	1.21	(4,1,1,1,1,BU:1.05); BP 2020

Unit process raw data for natural gas distribution

CH	Name	Location	Unit	*natural gas, high pressure, at consumer*	*natural gas, low pressure, at consumer*	UncertaintyType	StandardDeviation95%	GeneralComment
	Location			*CH*	*CH*			
	Unit			*MJ*	*MJ*			
	natural gas, high pressure, at consumer	CH	MJ	1.00E+0				
	natural gas, low pressure, at consumer	CH	MJ		1.00E+0			
	natural gas, burned in gas turbine	CH	MJ	4.90E-03	1.23E-03	1	1.07	(1,3,1,3,1,BU:1.05); based on data of Swiss compressor station
	natural gas, at long-distance pipeline	CH	Nm3	2.69E-02		1	1.12	(3,1,1,3,1,BU:1.05); including leakage
	natural gas, high pressure, at consumer	CH	MJ		1.00E+00	1	1.12	(3,1,1,3,1,BU:1.05); including leakage
	pipeline, natural gas, high pressure distribution network	CH	km	1.07E-09		1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
	pipeline, natural gas, low pressure distribution network	CH	km		3.97E-09	1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
air, low population	Methane, fossil	-	kg	1.87E-05	4.52E-05	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Ethane	-	kg	1.55E-06	3.75E-06	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Propane	-	kg	3.48E-07	8.43E-07	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Butane	-	kg	1.79E-07	4.34E-07	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.29E-08	3.12E-08	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Carbon dioxide, fossil	-	kg	6.45E-07	1.57E-06	1	1.11	(3,1,1,1,1,BU:1.05); calculated based on gas mix and leakage

Unit process raw data for natural gas distribution

RER	Name	Location	Unit	*natural gas, high pressure, at consumer*	*natural gas, low pressure, at consumer*	UncertaintyType	Standard-Deviation95%	GeneralComment
	Location			*RER*	*RER*			
	Unit			*MJ*	*MJ*			
	natural gas, high pressure, at consumer	RER	MJ	1.00E+0				
	natural gas, low pressure, at consumer	RER	MJ		1.00E+0			
	natural gas, burned in gas turbine	RER	MJ	4.90E-03	1.23E-03	1	1.07	(1,3,1,3,1,BU:1.05); based on data of Swiss compressor station
	natural gas, at long-distance pipeline	RER	Nm3	2.69E-02		1	1.12	(3,1,1,3,1,BU:1.05); including leakage
	natural gas, high pressure, at consumer	RER	MJ		1.00E+00	1	1.12	(3,1,1,3,1,BU:1.05); including leakage
	pipeline, natural gas, high pressure distribution network	CH	km	1.07E-09		1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
	pipeline, natural gas, low pressure distribution network	CH	km		3.97E-09	1	3.27	(4,1,5,3,1,BU:3); calculation based on network length and capacity utilization.
air, low population	Methane, fossil	-	kg	1.87E-05	4.52E-05	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Ethane	-	kg	1.55E-06	3.75E-06	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Propane	-	kg	3.48E-07	8.43E-07	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Butane	-	kg	1.79E-07	4.34E-07	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	NMVOC, non-methane volatile organic compounds, unspecified origin	-	kg	1.29E-08	3.12E-08	1	1.52	(3,1,1,1,1,BU:1.5); calculated based on gas mix and leakage
	Carbon dioxide, fossil	-	kg	6.45E-07	1.57E-06	1	1.11	(3,1,1,1,1,BU:1.05); calculated based on gas mix and leakage