Indicative range of cost estimates for conversion and interregional

transportation for LNG, 2020 (2012 dollars per MBtu), page 133, **IEA (2013): World Energy Outlook 2013, Paris**

	US to Europe		US to Japan	
	Low	High	Low	High
Liquefaction	3.0	4.5	3.0	4.5
Shipping	1.0	2.5	2.0	3.5
Regasification	0.3	0.5	0.3	0.5
Total	4.3	7.5	5.3	8.5

Fossil fuel import prices by scenario (dollars per unit)

WEO 2013, page 48

			New Policies Scenario				Current Policies Scenario				450 Scenario			
	Unit	2012	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
Real terms (2012 prices)														
IEA crude oil imports	barrel	109	113	116	121	128	120	127	136	145	110	107	104	100
Natural gas														
United States	MBtu	2.7	5.1	5.6	6.0	6.8	5.2	5.8	6.2	6.9	4.8	5.4	5.7	5.9
Europe imports	MBtu	11.7	11.9	12.0	12.3	12.7	12.4	12.9	13.4	14.0	11.5	11.0	10.2	9.5
Japan imports	MBtu	16.9	14.2	14.2	14.4	14.9	14.7	15.2	15.9	16.7	13.4	12.8	12.2	11.7
OECD steam coal imports	tonne	99	106	109	110	110	112	116	118	120	101	95	86	75
Nominal terms														
IEA crude oil imports	barrel	109	136	156	183	216	144	171	205	245	132	144	157	169
Natural gas														
United States	MBtu	2.7	6.1	7.5	9.1	11.6	6.2	7.7	9.3	11.7	5.8	7.2	8.6	10.0
Europe imports	MBtu	11.7	14.2	16.1	18.5	21.5	14.9	17.3	20.2	23.6	13.8	14.7	15.4	16.0
Japan imports	MBtu	16.9	17.1	19.1	21.7	25.1	17.7	20.4	24.0	28.2	16.1	17.2	18.4	19.7
OECD steam coal imports	tonne	99	127	146	165	186	134	155	178	202	121	128	129	127

Notes: Gas prices are weighted averages expressed on a gross calorific-value basis. All prices are for bulk supplies exclusive of tax. The US price reflects the wholesale price prevailing on the domestic market. Nominal prices assume inflation of 2.3% per year from 2012.

IEA (2012): Golden Rules for are Golden Age of Gas, Paris

Page 10:

We have developed a set of "Golden Rules", suggesting principles that can allow policymakers, regulators, operators and others to address these environmental and social impacts.1 We have called them Golden Rules because their application can bring a level of environmental performance and public acceptance that can maintain or earn the industry a "social licence to operate" within a given jurisdiction, paving the way for the widespread development of unconventional gas resources on a large scale, boosting overall gas supply and making the golden age of gas a reality.

The Golden Rules underline that full transparency, measuring and monitoring of environmental impacts and engagement with local communities are critical to addressing public concerns. Careful choice of drilling sites can reduce the above-ground impacts and most effectively target the productive areas, while minimising any risk of earthquakes or of fluids passing between geological strata. Leaks from wells into aquifers can be prevented by high standards of well design, construction and integrity testing. Rigorous assessment and monitoring of water requirements (for shale and tight gas), of the quality of produced water (for coalbed methane) and of waste water for all types of unconventional gas can ensure informed and stringent decisions about water handling and disposal. Productionrelated emissions of local pollutants and greenhouse-gas emissions can be reduced by investments to eliminate venting and flaring during the well-completion phase.
We estimate that applying the Golden Rules could increase the overall financial cost of development a typical shale-gas well by an estimated 7%. However, for a larger development project with multiple wells, additional investment in measures to mitigate environmental impacts may be offset by lower operating costs.

page 71:

„…shale gas wells do cost more than conventional gas wells in the same conditions, because

of the additional costs of multistage hydraulic fracturing…"

page 73:

„…the Golden Rules does have some cost impact, but not sufficient to push

up the costs of production significantly (and, possibly, not at all)…"

pages 72:

„Since conventional gas resources are already fairly depleted onshore and most future

conventional gas production will therefore come from more expensive offshore locations,

the range of break-even costs for conventional and unconventional gas in the United States

is fairly similar."

„In Europe, the costs of production are expected to be about 50% higher, with a range of

break-even costs between $5/MBtu and $10/MBtu. Conventional and unconventional gas

are expected to be in the same range, as conventional resources are depleted and new projects are moving to the more expensive Norwegian Arctic.

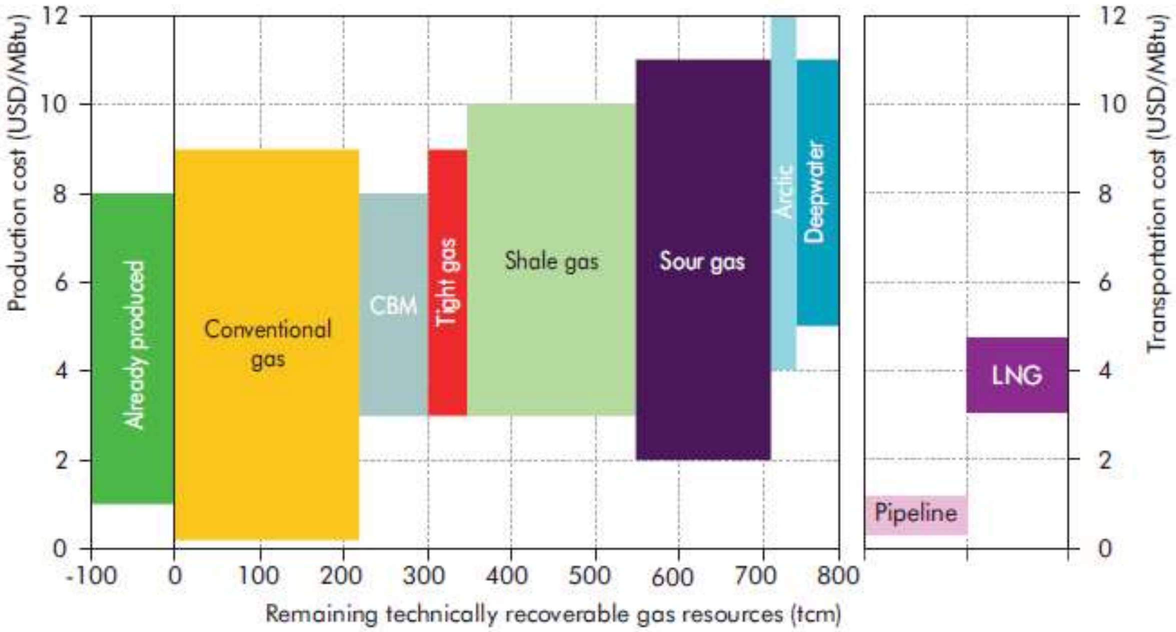
Table 2.2 ▷ Indicative natural gas well-head development and production costs in selected regions (in year-2010 dollars per MBtu)

	Conventional	Shale gas	Coalbed methane
United States	3 - 7	3 - 7	3 - 7
Europe	5 - 9	5 - 10	5 - 9
China	4 - 8	4 - 8	3 - 8
Russia	0 - 2, 3 - 7*	-	3 - 5
Qatar	0 - 2	-	-

* The lower range for Russia represents production from the traditional producing regions of Western Siberia and the Volga-Urals; the higher range is for projects in new onshore regions such as Eastern Siberia, offshore and Arctic developments.

IEA (2013): Resources to Reserves 2013. Oil, Gas and Coal Technologies fort he Energy Market oft he Future; Chapter 8: Production costs of fossil fuels, Production cost curve for gas

Page 231/232, number oft he site



Notes: CBM = coal-bed methane; LNG = liquefied natural gas; Pipeline costs refer to costs per 1 000 km; MBtu = million British thermal units; tcm = trillion cubic metres.

The potential long-term contributions that each of the various types of conventional and unconventional natural gas categories currently in commercial production make to the global gas supply can been seen in Figure 8.4. This figure also outlines the range of production and transportation costs in 2008 (IEA, 2009). The volumes shown are based on the latest estimates of resource potential. Gas hydrates are not included as commercial production has not yet been proven, and they are not expected to contribute significantly to supply in the immediate future.

The total long-term potential gas resource base from these sources is estimated

at approximately 790 tcm. Of this total,some 105 tcm have already been produced

(and flared and vented to the atmosphere) at costs of up to USD 8/MBtu.

To compare this with the cost of oil for the same energy content, USD 8/MBtu equates to USD 46.4/boe. Production costs for associated gas (gas produced in an oil operation) would generally be lower than for non-associated gas (gas produced from a natural gas field). This is particularly true for fields in which infrastructure for producing oil had already been installed before exploitation of the gas resource had been planned. Significant quantities of associated gas are still flared because it is not currently worth treating and transporting the gas to market.

More than 1.5 tcm has been flared worldwide in the last decade alone, equal to more than 5% of marketed production.

The most easily accessible part of the remaining conventional resources amounts to about 220 tcm, with typical production costs between USD 0.20/MBtu and USD 9/MBtu. Other conventional resources include sour gas and gas produced from the Arctic or from deep water. Sour gas resources, with high concentrations of hydrogen sulphide (H2S) or CO2 total some 160 tcm and could be produced at costs between USD 2/MBtu and USD 11/MBtu. Resources in the Arctic Circle could amount to 30 tcm, at costs between USD 4/MBtu and USD 12/MBtu, while deepwater resources of 50 tcm could be produced at costs ranging from USD 5/MBtu to USD 11/MBtu. Unconventional resources totalling 330 tcm (including 80 tcm tight gas, 200 tcm shale gas and 50 tcm CBM) could be produced at costs between USD 3/MBtu and USD 10/MBtu. An essential cost factor for gas is transportation. For pipelines, the transportation costs areUSD0.30/MBtu toUSD1.20/MBtu per 1 000 kilometres of pipeline, varying for onshore and offshore segments and according to pipe capacity and age of installation. For LNG, total costs for liquefaction, transportation and regasification vary from USD 3.10/MBtu to USD 4.70/MBtu, depending on the installation size and the transportation distances involved. So the production and transportation costs should be added to the total cost at the market location (Figure 8.4).

IEA (2013): Gas. Medium-Term Market Report 2013. Market Trends and Projections to 2018, Paris

page 37

Figure 12 Monthly quantity of power produced by coal and gas in Germany, Spain, United Kingdom, Jan 2004-Jan 2013

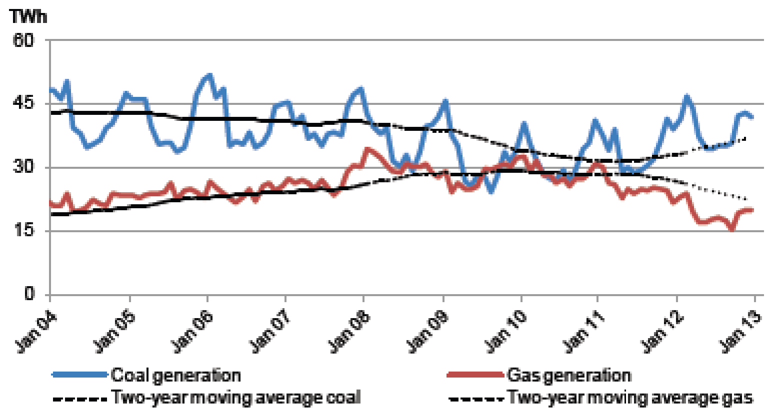


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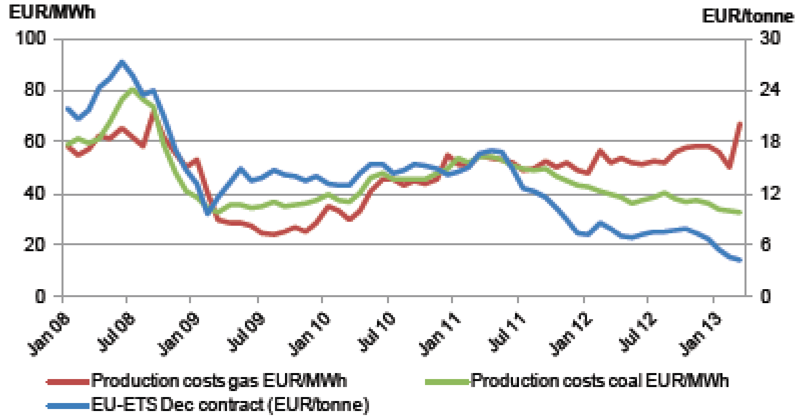
Figure 13 Carbon price and production costs of gas- and coal-fired generation, Jan 2008-Jan 2013



Notes: MWh = megawatt hour. Assumptions for production cost calculations: gas 49% efficient and emits 0.411 tonnes per MWh; coal 36% efficient, emits 0.96 tonnes per MWh and EUR 1 per MWh transportation costs to plant.

Sources: McCloskey; European Central Bank exchange rates; IEA; Intercontinental Exchange.