

Norconsult 

LNG at Faroe Island, case study

Technical, environmental and economical evaluation



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[LNG_NETWORK v.2.mp4](#)

[Video](#)

Why LNG?

Significant environmental impact improvement



- ▶ Significant reduction in emissions to air for all exhaust flue gas components
 - ▶ CO₂ 20,6 %
 - ▶ NO_x 79,4 %
 - ▶ SO₂ 80,0 %
 - ▶ Particles 99,0 %
- ▶ Calculations based on 169 GWh/y
- ▶ Based on information from engine manufacturer MAN Gmbh for 9L51/60 &HFO & DF version

Subject	Single fuel	Dual fuel engine	
	HFO	HFO	GAS
	Main fuel	Backup only	Main fuel
CO ₂ kton/y @ 50% load	102	102	81
NO _x mg/Nm ³	1940	2000	400
NO _x mg/Nm ³ , Note 1	450	2000	400
Particles mg/Nm ³	50	50	10
SO ₂ mg/Nm ³ , Note 2	560	560	5,6

Note 1, Exhaust gas downstream SCR

Note 2, If operated on low sulphur diesel oil (less than 0.1%), and with less than 1% diesel injected

Data from MANDieselTurbo

Way LNG?

CAPEX evaluation

Subject	Single fuel engine	Dual fuel engine
	HFO Main fuel	GAS Main fuel
Base case 5 000 m³ LNG terminal		
Investment 4 engines	16,1	16,1
Rebuild to Dual Fuel		5,4
SCR exhaust gas NO _x reduction	18,4	
Urea tank 100 m ³	1,0	
LNG terminal 5 000 m ³		17,2
Margin on LNG terminal 30%		5,2
Modifications in power station, Note 1		2,9
Transport and insurance, Note 1		1,0
Project administration and follow up, Note 1		2,5
LNG terminal 5 000 m³	35,5	50,3
Upgrade from 5 000 m³ to 8 000m³		
3 new tanks 1000 m ³		3,6
Plant preparation		1,2
Margin 30%		1,4
Transport, Note 1		0,3
Project administration and follow up, Note 1		1,0
	35,5	57,8
All cost figures are in MEUR		
Note 1, Estimates only		

- ▶ The CAPEX include:
 - ▶ New MAN HFO 9.6 MW generator sets
 - ▶ Converting to dual fuel HFO/LNG
 - ▶ Selective Catalytic Reduction (SCR) for NO_x reduction
 - ▶ Complete LNG terminal with storage of 5 000 m³
 - ▶ Necessary upgrade in power station

- ▶ Alternative increased storage capacity
 - ▶ 3 new LNG storage tanks each 1 000 m³
 - ▶ Additional landfill

- ▶ The LNG investment is higher due to the fact that there are existing HFO facilities at the location.

Why LNG?

Fuel cost development

European Union Natural Gas Import Price: **6.02 USD/MMBtu for Nov 2017** [Add to Watchlists](#) [Create an Alert](#)

Overview **Interactive Chart**

European Union Natural Gas Import Price is at a current level of 6.02, down from 6.08 last month and up from 4.909 one year ago. This is a change of -0.99% from last month and 22.64% from one year ago.

Category: [Energy](#)

Report: [Commodity Markets Review](#)

Region: [European Union](#)

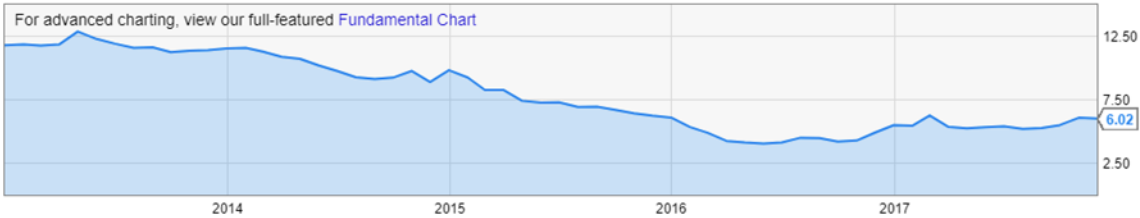
Source: [World Bank](#)

European Union Natural Gas Import Price Chart

[View Full Chart](#)

5d 1m 3m 6m YTD 1y 5y 10y Max

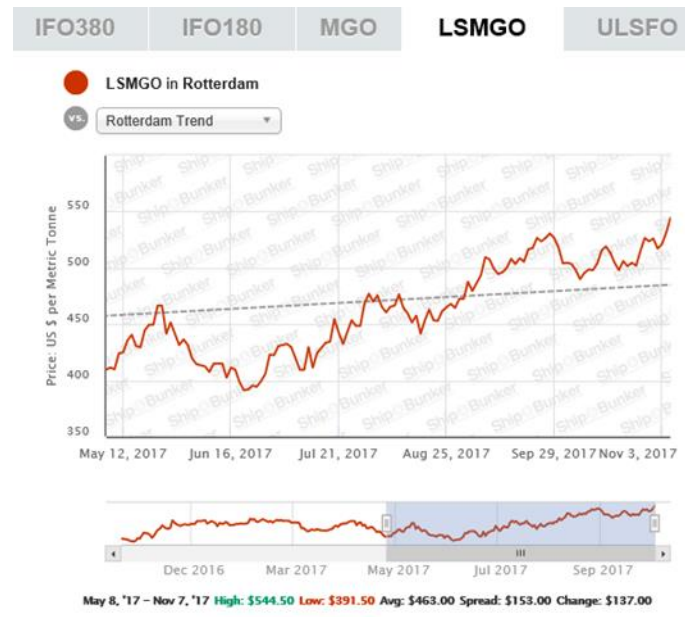
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▶ Tendency of fuel cost is significant in the faouvour of LNG

▶ The heating value is higher for LNG

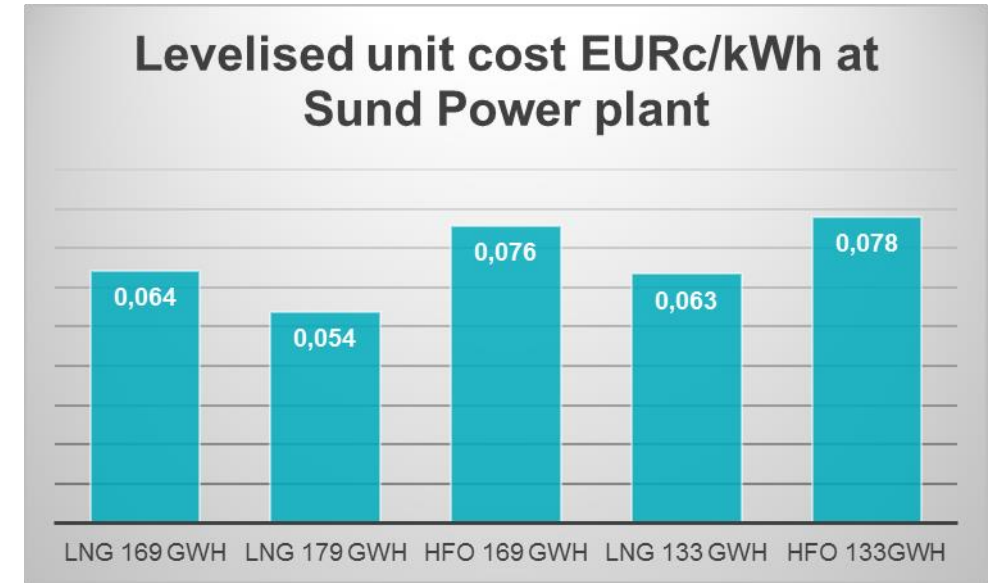
- ▶ HFO 40.0 MJ/kg LHV
- ▶ LNG 49.0 MJ/kg LHV



Why LNG?

Complete economical comparison is in favor of LNG

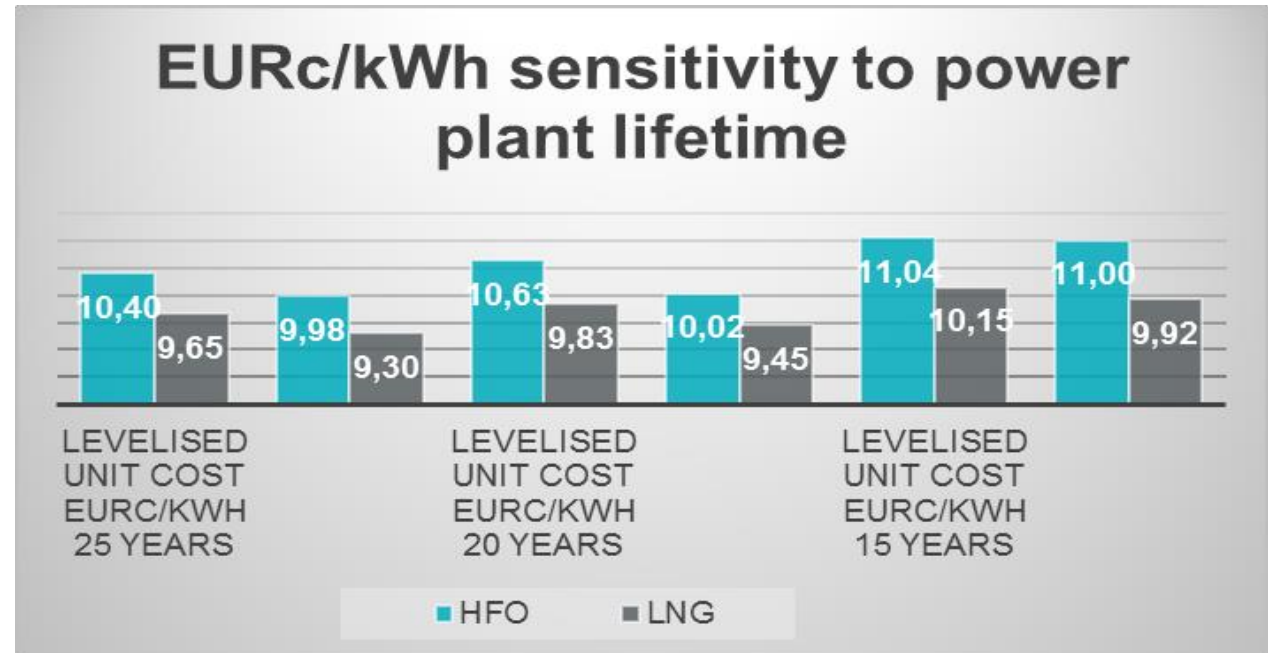
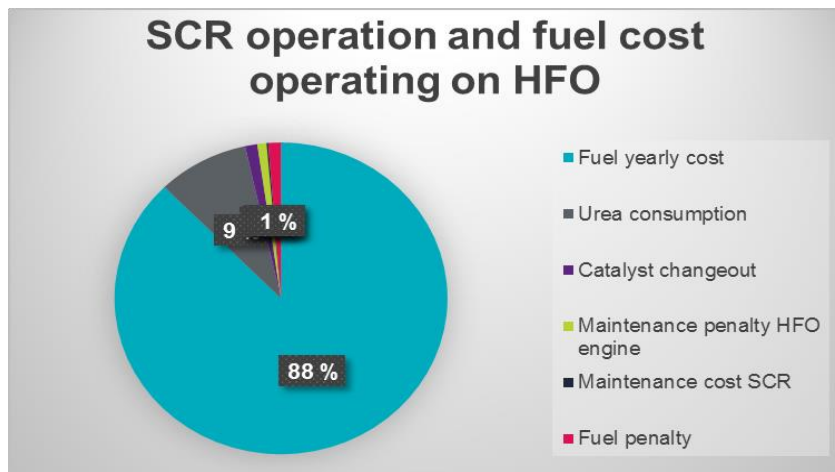
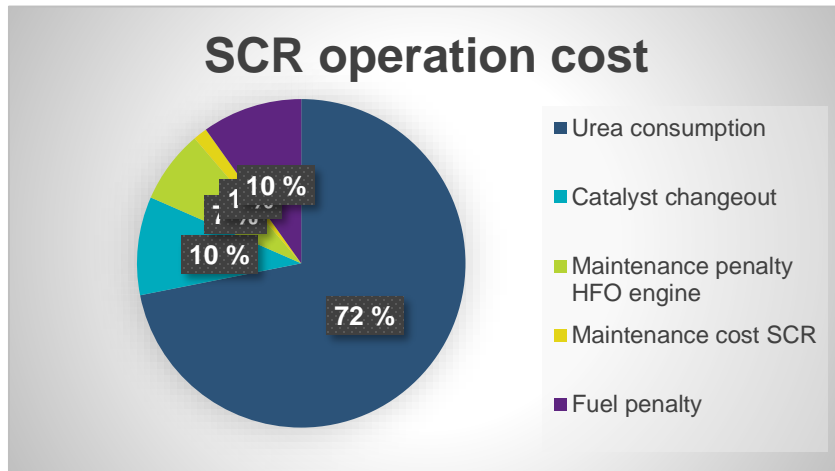
Future Sund 37 MW power plant		Yearly production GWh/y				
		169	179	169	133	
		Per load equal to 60 000 m ³ LNG			Per 41% load (15 MW)	
		Cargo 3 750 m ³ Note 1	Cargo 7 000 m ³ Note 2	HFO	LNG Note 3	HFO
LNG Fuel cost	Volume LNG, per call	3 750	7 050		3 750	m ³
	Distance Rotterdam-Sund	720	720		720	nm
	Number of calls	16	9		12,4	
	Volume LNG/HFO per year	60 000	63 450		46 680	m ³ /y
	Fuel consumption	27 000	28 553	34 977	21 006	26 816 ton/y
	HFO cost per year			10 967 306		8 408 446 EUR/y
	LNG molecules per cargo	387 742	728 954		387 742	EUR
	Margin	46 298	87 039		46 298	EUR
	Reload at Gate terminal	67 000	67 000		67 000	EUR
	Shipping and fuel for vessel	168 857	168 857	889 241	168 857	681 766 EUR
	Sum fuel value per call	669 896	1 051 851		669 896	EUR
	Pilot fuel 1% LSMGO	125 847	133 084		97 909	
Fuel yearly cost	10 844 187	9 599 739	11 856 547	8 436 720	9 090 212 EUR/Year	
SCR operational cost	Urea consumption			1 199 446	919 595	EUR
	Catalyst changeout			161 538	97 014	EUR
	Maintenance penalty HFO engine			120 000	120 000	EUR
	Maintenance cost SCR			23 077	13 859	EUR
	Fuel penalty			164 510	126 127	EUR
	Future CO ₂ tax			0	0	EUR
Fuel cost per year, not incl. CAPEX		10 844 187	9 599 739	13 525 118	8 436 720	10 366 807 EUR/Y
EUR/kWh		0,064	0,054	0,076	0,063	0,078 EUR/kWh



- ▶ Note 1: Based on part cargo of a LNG tanker 7500 m³. If smaller LNG carrier is used i.e. 4 000 m³ to 5000 m³ the cost will be more like full cargo cost. Production estimated to 169 GWh/y.
- ▶ Note 2: Based on full cargo of a LNG tanker 7500 m³. For this case the production will be 5% higher than the base case 177 GWh/y
- ▶ Note 3: Based on cargo load of 3 750 m³

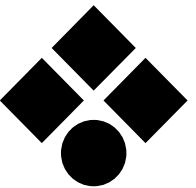
Why LNG?

Sensitivity evaluation



GWh	Levelised unit cost EURc/kWh	
	LNG 5000 m ³ storage	LNG 8000 m ³ storage
133	9,98	10,53
169	9,65	9,73
200	9,65	8,30

GWh	20% increase in LNG investment		20% decrease in SCR investment	
	Levelised unit cost EURc/kWh		Levelised unit cost EURc/kWh	
	HFO	LNG	HFO	LNG
133	10,40	10,41	10,11	9,98
169	9,64	9,63	9,42	9,00

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GO FOR LNG, GREENER, CHEAPER

THANK YOU