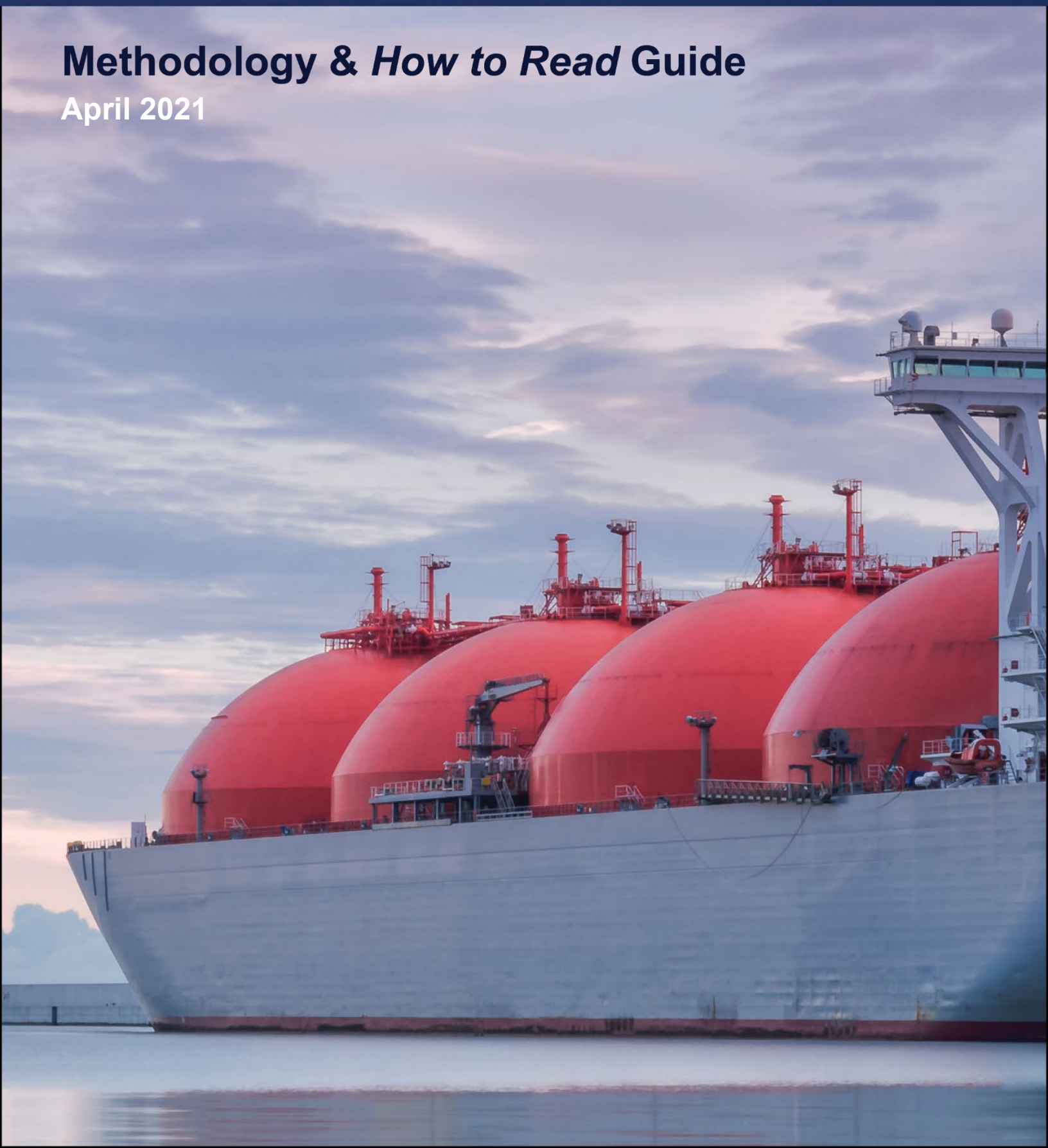
NGI's LNG INSIGHT

Bringing a North American Focus to International LNG

Methodology & *How to Read* Guide

April 2021



NGI's LNG Insight Methodology & "How to Read" Guide

Natural Gas Intelligence's (NGI) *LNG Insight* is a daily pricing, data and news service targeting the North American Liquefied Natural Gas (LNG) market. With more than 30 years of adding transparency to natural gas markets through its reports and services, NGI aims to shed light on the evolving LNG market with its newest offering.

Developed in collaboration with the North American LNG and natural gas markets and first published in October 2019, *NGI's LNG Insight* aims to provide a global perspective on the North American natural gas market, particularly as the United States assumes a larger role in the worldwide LNG industry.

This document serves as both a methodology and a "how to read" guide for the various LNG-related charts, graphs and tables we publish each business day. For more information, please contact us at lng@naturalgasintel.com.

Previous 5 Trading Days Summary Table

The Summary Table on page 1 provides a quick snapshot of key data from the 20 different charts and data tables we publish in each day in *LNG Insight*. Our goal in providing data from the previous 5 trading days is to allow readers to pick up on trends and relationships that may be forming in the marketplace in one concise, easy to read format.

Prompt Month Statistics - Previous 5 Trading Days

	10-Jul	13-Jul	14-Jul	15-Jul	16-Jul
Max GOM Netback ($US/MMBtu)	1.346	1.234	1.231	1.279	1.502
L48 LNG Feedstock Deliveries (dth/d)	3.11	3.36	3.27	3.40	3.61
Futures ($US/MMBtu)					
Henry Hub	1.805	1.739	1.746	1.778	1.776
JPN/KOR	2.175	2.155	2.160	2.164	2.500
NBP	1.727	1.557	1.624	1.713	1.880
TTF	1.815	1.702	1.699	1.748	1.928
Shipping ($US/MMbtu)*					
Sabine Pass to Tokyo	0.973	0.973	0.974	0.973	0.998
Sabine Pass to Milford Haven (U.K.)	0.451	0.449	0.450	0.451	0.461
Sabine Pass to Gate (NW Europe)	0.469	0.468	0.468	0.469	0.480
Landed Price Arbitrage ($US/MMbtu)**					
Sabine to Tokyo	-0.873	-0.818	-0.822	-0.854	-0.540
Sabine to Gate	-0.730	-0.766	-0.777	-0.765	-0.594
Europe Fundamentals					
Gas in Storage (TWh)***	905.5	917.2	917.2	924.9	926.8
% Full	*81.8%*	*82.9%*	*82.9%*	*83.6%*	*83.7%*
Difference to Last Year (TWh)	83.6	82.8	82.8	82.0	79.2
Gas in LNG Storage (10^3 m^3)***	5604.05	5233.3	5354.0	5496.8	5313.9
% Full	*66.1%*	*63.0%*	*63.2%*	*64.8%*	*62.7%*
Spark Spread (Eur/MWh)	22.63	24.11	22.83	22.90	22.90
Clean Spark Spread (Eur/MWh)	9.89	11.34	9.86	10.28	10.28
Dark Spread (Eur/MWh)	16.86	17.78	16.46	16.63	16.63
Clean Dark Spread (Eur/MWh)	-13.53	-12.68	-14.48	-13.48	-13.48
PVB/TTF Premium (%)	28.5%	30.9%	33.3%	32.6%	34.3%
NW Europe Mean Temp (°F)	63	65	64	62	TBD
% Diff From 30-Yr Normal	*-2.9%*	*1.2%*	*-0.7%*	*-4.0%*	*N/A*
Asia Fundamentals					
JKM/KOR Oil Parity Slope	5.0%	5.0%	5.0%	4.9%	5.8%
Brent Oil Price Parity ($US/MMBtu)	7.44	7.35	7.38	7.53	7.46
JKM/KOR Futures ($US/MMBtu)	2.18	2.16	2.16	2.16	2.50
Japan Coal Price ($US/MMBtu)	2.97	2.88	2.90	2.90	2.89
Beijing Mean Temp (°F)	72	77	81	83	83
% Diff From Normal	*2.9%*	*-0.5%*	*0.5%*	*-6.6%*	*3.6%*
Seoul Mean Temp (°F)	76	68	69	72	75
% Diff From Normal	*4.2%*	*-8.2%*	*-6.4%*	*-2.9%*	*0.5%*
Tokyo Mean Temp (°F)	78	71	75	70	70
% Diff From Normal	*2.9%*	*-7.1%*	*-1.8%*	*-8.7%*	*-8.6%*
Latin America Fundamentals ($US/MMbtu)					
Mexico					
East (Altamira) DES	1.51	1.40	1.40	1.44	1.37
West (Manzanillo) DES	1.93	1.81	1.81	1.86	1.79
Argentina DES	1.94	1.83	1.83	1.88	1.81
Brazil DES	1.73	1.61	1.61	1.66	1.59
Chile DES	2.02	1.91	1.90	1.95	1.89
Colombia DES	1.56	1.45	1.44	1.49	1.42
Panama DES	1.58	1.47	1.47	1.51	1.44

Current prompt month prices are for Aug, unless otherwise noted.
*Assumes full freight for both laden and ballast legs.
**Excludes regas fees.
***Most recent data available. Typically delayed by two calendar days.

NGI's LNG INSIGHT

North America Focused Content

NGI's U.S. Gulf Coast LNG Netback Prices (12-Month Strip)

Our **U.S. Gulf Coast Netback Prices** table aims to measure the value of LNG sold on a Free On Board (FOB) basis in the U.S. Gulf Coast by starting with the futures prices of natural gas in both Asia and Europe, and deducting from that shipping costs to move LNG from Sabine Pass to those respective markets. The highest netback from the three individual routes we consider is the resulting netback price for each month.

For example, in the chart below, the November Japan/Korea futures price is $5.820/MMBtu, and the estimated round-trip cost to transport LNG from Sabine Pass to, and back from, that part of the world is $2.551/MMBtu. The resulting netback from that route is therefore $3.269/MMBtu. Applying the same formula to the National Balancing Point (U.K.) and the Title Transfer Facility (Netherlands) yields respective netbacks of $4.046/MMBtu and $3.865/MMBtu. $4.046 is the highest of the three – or maximum as we call it in the chart - and thus is the November Gulf Coast netback price for that day.

Example Calculation of NGI's U.S. Gulf Coast LNG Netback Price

All Figures in $US/MMBtu	JPN/KOR	National Balancing Point (NBP)*	Title Transfer Facility (TTF)*
November Futures Price	$5.820	$5.340	$5.235
Less: Round Trip Shipping Costs from Sabine Pass	$2.551	$1.294	$1.370
U.S. Gulf Coast Netback	$3.269	$4.046	$3.865
Maximum Netback (& therefore the overall November Gulf Coast Netback Price):	$4.046		

*Because the NBP and TTF contracts trade in pence/therm and Euro/MWh, respectively, we convert them to $US/MMBtu, based on the current forex futures strip for each currency. We list actual NBP and TTF prompt month futures settles in a different table, as shown in the Prompt Month Global NatGas Futures Settlements section below.

We calculate the U.S. Gulf Coast LNG netback prices in the same manner for the next 11 months, using relevant futures contract prices, shipping rate assumptions and exchange rates for each listed month.

Higher Gulf Coast netback prices certainly indicate stronger international LNG demand, but we also believe they could lead to increased pipeline gas flows into the Gulf Coast region, which in turn could impact U.S. regional natural gas basis differentials.

One of the key inputs we use to calculate months 2-12 shipping costs is the **West of Suez LNG Vessel Rate Curve**, a chart we describe in more detail on page 5. Since these shipping costs are based on historical seasonality, the resulting netback curve may not necessarily reflect what current conditions the market may be discounting. However, we believe this chart offers the industry a comparative baseline as to where the next 12 months of Gulf Coast netback prices likely would be, assuming current market vessel rates and historical vessel rate seasonality hold.

U.S. Gulf Coast LNG Netback Prices (12-Month Strip) 16-Jul-2020

	Futures Settle ($US/MMbtu)			Est Shipping Cost from Gulf Coast ($US/MMBtu)			Gulf Coast Netback ($US/MMBtu)					Netback Less Henry Hub Futures ($US/MMbtu)	
Spot Month (shipping based on spot market vessel rate)													
Month	JPN/KOR	NBP	TTF	JPN/KOR	NBP	TTF	JPN/KOR	NBP	TTF	***Max***	Chg	HH	Diff (Margin)
Sep-20	$2.500	$1.880	$1.928	$0.998	$0.461	$0.480	$1.502	$1.418	$1.449	***$1.502***	$0.123	$1.776	($0.274)
Rest of Curve (shipping based on 1-Yr vessel rate, adjusted for seasonality)													
Oct-20	$3.050	$2.456	$2.576	$1.474	$0.715	$0.753	$1.576	$1.741	$1.823	***$1.823***	($0.057)	$1.879	($0.056)
Nov-20	$3.825	$3.829	$3.698	$1.590	$0.786	$0.825	$2.235	$3.043	$2.873	***$3.043***	($0.089)	$2.350	$0.693
Dec-20	$4.515	$4.571	$4.138	$1.518	$0.748	$0.779	$2.997	$3.823	$3.359	***$3.823***	($0.081)	$2.747	$1.076
Jan-21	$4.850	$4.855	$4.258	$1.339	$0.651	$0.673	$3.511	$4.204	$3.585	***$4.204***	($0.068)	$2.875	$1.329
Feb-21	$5.025	$4.906	$4.283	$1.211	$0.581	$0.597	$3.814	$4.325	$3.686	***$4.325***	($0.069)	$2.875	$1.450
Mar-21	$4.665	$4.597	$4.225	$1.077	$0.511	$0.526	$3.588	$4.086	$3.699	***$4.086***	($0.071)	$2.740	$1.346
Apr-21	$4.350	$4.202	$4.088	$1.017	$0.477	$0.495	$3.333	$3.724	$3.593	***$3.724***	($0.094)	$2.480	$1.244
May-21	$4.170	$3.972	$4.022	$1.030	$0.484	$0.504	$3.140	$3.488	$3.518	***$3.518***	($0.045)	$2.449	$1.069
Jun-21	$4.060	$3.774	$3.917	$1.092	$0.516	$0.540	$2.968	$3.258	$3.377	***$3.377***	($0.043)	$2.488	$0.889
Jul-21	$4.115	$3.794	$3.945	$1.112	$0.526	$0.551	$3.003	$3.268	$3.394	***$3.394***	($0.029)	$2.535	$0.859
Aug-21	$4.260	$3.847	$3.985	$1.188	$0.565	$0.593	$3.072	$3.282	$3.392	***$3.392***	N/A	$2.548	$0.844
NTM Avg	***$4.115***	***$3.890***	***$3.755***				***$2.895***	***$3.305***	***$3.146***	***$3.351***	***$0.132***	***$2.479***	***$0.873***

West of Suez Spot 174K XDF/MEGI Day Rate **$43,000** West of Suez 1-Yr TC 174K XDF/MEGI Vessel Rate: **$56,000**

Understanding the LNG Production Margin

Subtracting current Henry Hub futures contracts from our Gulf Coast Netback prices yields an estimated LNG production **margin** at Sabine Pass, which is another measure used by the industry to estimate relative global demand for LNG.

The higher this difference/margin, the more U.S. LNG is in demand, and the more robust LNG liquefaction gross margins in the Gulf Coast become, everything else being equal. We believe this is similar to the "cryo-spread" figure Tellurian Inc. publishes each day.

How Does NGI Calculate Shipping Costs?

Each of our shipping costs represents the estimated round-trip cost to transport LNG from Sabine Pass to Asia and Europe, and are based on the following assumptions:

NGI Shipping Route Calculation Assumptions

All Routes	
Vessel	
Vessel Size (m^3)	174,000
Vessel Propulsion	XDF/MEGI
Assume cold vessel?	Yes
Spot & 1-Yr West of Suez Vessel Headline Rates	Updated daily from Fearnleys
Ballast Leg Discount?	No
Includes ballast bonus/repositioning fees?	No
Knots (Both Laden & Ballast)	17
Boiloff/Fuel	
Boiloff (both Laden & Ballast)	0.06%
Boiloff (in port)	0.02%
Heel	5.0%
# of Port Days	4
Bunker Fuel (mt/d)	65
Spot Houston 380 Centistoke Bunker Fuel	Current Bloomberg rate
Other	
m^3 to MMbtu Conversion Rate	23.12
Insurance/day	Not included
Ship broker fees	Not included

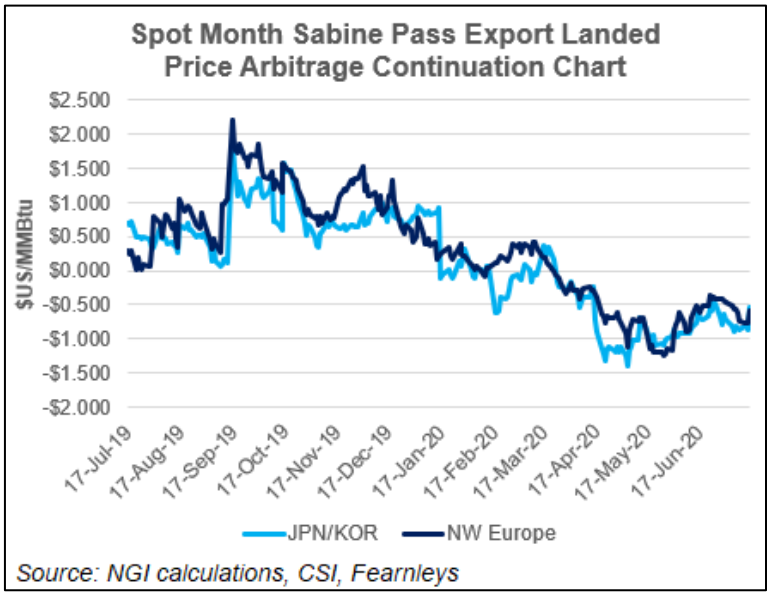
Specific Routes			
Route	**JPN/KOR**	**NBP**	**TTF**
Receiving Port	Futtsu	Milford Haven	Gate
Shipping Days (one-way)	23.1	11.2	12.2
Total Shipping Days*	50.2	26.5	28.4
Canal Fees	Panama	None	None
Port Fees	Market	Market	Market

*Includes port days

Monthly Forward Vessel Rates

* Based on current spot market and 1-year TC rates for a 174,000 m^3 XDF/MEGI vessel.
* First month of curve equals the spot price, simple average of all curves equals the one-year rate.
* Months 2-12 shaped based on historical seasonality.

Calculations for months 2-12 include relevant commodity prices and exchange rates for each of those months, along with our estimate of what a 12-month forward strip may look like, based on the current $USD spot market and 1-year time charter rates for a 174,000 m^3 (cubic meters) two-stroke vessel published by Fearnleys AS, along with historical seasonality. For more information, please see the **Spot Vessel Rate Forward Curve** section below.



Please also be advised that our other assumptions, such as knots, boiloff percentages, number of days in port, etc. differ somewhat from those used by Fearnleys, so the various Sabine Pass-based shipping costs they calculate may also differ from our figures.

Defining the Spot Month

In our calculations, the spot month changes to the next month after the 15th of each month since that is the approximate date when the Asian futures contract expires.

For example, on the first trading day after Oct. 15, the spot month would become December for all the futures contracts in the table, even though some of those other contracts would still be trading for November. This allows a way to remain consistent in the months measured.

In this example, the actual spot month Henry Hub contract (November) does not expire until the third to last trading day of the month, and the two European contracts go off the board one trading day later. In order to fill this coverage gap, we continue to list the actual spot market contracts for each of the futures prices in our separate **Prompt Month Global NatGas Futures Settlements** table, as shown on Page 8.

Spot Month Sabine Pass Export Landed Price Arbitrage Continuation Chart

The **Spot Month Sabine Pass Export Landed Price Arbitrage Continuation Chart** represents what the spreads have been over the last year to ship LNG from Sabine Pass to the Gate Terminal in the Netherlands, and to the Futtsu Terminal in Japan.

These calculations incorporate feed gas and variable liquefaction charges, which we assume to be 115% of the current Henry Hub futures contract (in accordance with the Cheniere Energy Inc. methodology for some of its contractual arrangements), along with the total shipping charges (variable and the fixed cost of the charter vessel) we list in the Gulf Coast Netback table. Comparing the two calculations also suggests how much more advantageous it is to send LNG from Sabine Pass to Europe vs. Asia, although that of course depends on the actual terminal to which the LNG is shipped.

For example, if the spot TTF futures contract is $5.235/MMBtu, the spot Henry Hub futures contract is $2.214/MMBtu, and the shipping cost between Sabine Pass and the Gate Terminal in the Netherlands is $1.370/MMBtu, then the spread between Sabine Pass and Gate is $5.235 - $1.370 – ($2.214*1.15) = $1.319/MMBtu.

Our calculations only assume **landed prices**, or delivery to the respective regasification terminals, and include neither regasification fees nor any charges to access the pipeline grid. This is an important consideration, since JPN/KOR is a pure LNG price, whereas NBP and TTF are delivered-to-pipeline prices. As a result, one should also include the variable costs of regasification and variable charges to access the pipeline grids in the UK (NBP) and the Netherlands (TTF), to get a better measure for the true arbitrage spread to those European nations. We believe such variable charges tend to range between US$0.10-$0.50/MMbtu. Such an adjustment is not necessary for cargoes to Asia, once again because JPN/KOR futures are a pure LNG price.

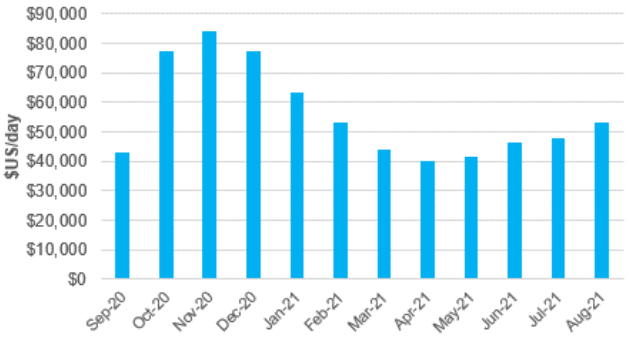
West of Suez LNG Vessel Rate Curve

The spot market vessel rate curve we publish each day serves two main functions. First, it is a major component in our monthly shipping rates calculations, which we need to fill out months 2-12 of our Gulf Coast Netback table. Second, it indicates what spot market LNG vessel rates ***could*** look like for the next 12 months, based on current LNG vessel rates and historical seasonality.

Our West of Suez LNG Vessel Rate Curve is not an actual traded curve. Rather, it is something we impute based on the current one-month spot market rate for a 174,000 m^3 XDF/MEGI vessel in the Atlantic Basin, the 1-yr term contract rate for the same vessel, and historical spot market rate seasonality. Said differently, our spot LNG vessel rate curve indicates what the expected Atlantic Basin spot rate should be for the next 12 months ***if*** current LNG spot vessel rates, current LNG 1-year term charter rates and historical vessel rate seasonality all hold.

The average of our individual 12-month rates will equal the current 1-year term contract rate.

We also list absolute prices for the curve in the table on the lower righthand corner on page 5.



Note: Based on 174,000 m^3 XDF/MEGI vessels. This is *not* an actual traded curve. Figures represent NGI's estimate of a laden leg forward curve based on current spot market and 1-yr charter rates, adjusted for historical seasonality. The simple average of all months equals the 1-yr charter rate.

West of Suez LNG Vessel Rate Curve 16-Jul-2020

Month	16-Jul	15-Jul	Chg
Sep-20	43,000	57,898	-14,898
Oct-20	77,271	76,784	487
Nov-20	84,219	83,688	531
Dec-20	77,308	76,821	487
Jan-21	63,172	62,774	398
Feb-21	53,257	52,921	336
Mar-21	44,095	43,817	278
Apr-21	40,270	40,016	254
May-21	41,698	41,436	263
Jun-21	46,553	46,260	293
Jul-21	47,888	47,586	302
Aug-21	53,269	N/A	N/A
Average	***56,000***	***56,000***	***0***

Note: Based on 174,000 m^3 XDF/MEGI vessels. This is *not* an actual traded curve. Figures represent NGI's estimate of a laden leg forward curve based on current spot market and 1-yr charter rates, adjusted for historical seasonality. The simple average of all months equals the 1-yr charter rate.

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Source: NGI estimates based on Fearnleys data

Other North America LNG Netback Prices

In addition to our signature Gulf of Mexico LNG netback price, we also calculate netback prices to Cove Point, MD; Kitimat, BC; and Costa Azul, MX. Our methodology for these three locations is exactly the same as that described above for the Gulf of Mexico, in that we start with gas prices in Asia and Europe, and deduct LNG shipping costs from those to determine the maximum netback price at each location for the next twelve months. We then compare that forward LNG netback strip to the forward curve for the nearest physical market index in order to determine the LNG production margin at each location. We also include Waha forward prices in a separate column, because we believe more U.S. LNG purchases will be tied to this index in the coming years.

Other North America LNG Netback Prices 16-Jul-2020

	Netback to Western Canada $US/MMBtu	NGI's AECO Forwards $US/MMBtu	Diff $US/MMBtu	Diff %	Netback to Costa Azul $US/MMBtu	NGI's SoCal Border Forwards $US/MMBtu	Diff $US/MMBtu	Diff %	Netback to Cove Point $US/MMBtu	NGI's Transco Zn 5 Forwards $US/MMBtu	Diff $US/MMBtu	Diff %	NGI's Waha Forwards $US/MMBtu
Sep-20	$2.099	$1.476	$0.623	42%	$2.026	$1.872	$0.154	8%	$1.558	$1.847	-$0.289	-16%	$1.455
Oct-20	$2.569	$1.488	$1.081	73%	$2.478	$1.820	$0.658	36%	$2.130	$1.897	$0.233	12%	$1.368
Nov-20	$3.302	$1.832	$1.470	80%	$3.202	$2.342	$0.860	37%	$3.367	$2.419	$0.948	39%	$1.857
Dec-20	$3.865	$1.922	$1.943	101%	$3.737	$3.333	$0.404	12%	$4.002	$3.515	$0.487	14%	$2.295
Jan-21	$4.153	$2.002	$2.151	107%	$4.014	$3.386	$0.628	19%	$4.246	$4.872	-$0.626	-13%	$2.496
Feb-21	$4.368	$1.988	$2.380	120%	$4.238	$3.220	$1.018	32%	$4.333	$4.734	-$0.401	-8%	$2.445
Mar-21	$4.101	$1.927	$2.174	113%	$3.991	$2.460	$1.531	62%	$4.101	$3.053	$1.048	34%	$2.190
Apr-21	$3.852	$1.648	$2.204	134%	$3.757	$1.983	$1.774	89%	$3.761	$2.653	$1.108	42%	$1.894
May-21	$3.731	$1.614	$2.117	131%	$3.649	$1.965	$1.684	86%	$3.610	$2.492	$1.118	45%	$1.823
Jun-21	$3.646	$1.586	$2.060	130%	$3.570	$2.157	$1.413	66%	$3.528	$2.545	$0.983	39%	$1.945
Jul-21	$3.691	$1.638	$2.053	125%	$3.613	$2.706	$0.907	34%	$3.548	$2.352	$1.196	51%	$2.131
Aug-21	$3.804	$1.651	$2.153	130%	$3.719	$2.749	$0.970	35%	$3.559	$2.415	$1.144	47%	$2.166
NTM Avg	***$3.598***	***$1.731***	***$1.867***	***108%***	***$3.500***	***$2.499***	***$1.000***	***40%***	***$3.479***	***$2.900***	***$0.579***	***20%***	***$2.005***

Note: Netbacks are based on deliveries to Asia & Europe. LNG Canada and Costa Azul liquefaction facilities are not expected to be in-service until 2025 and 2023, respectively. But the above calculations give an indication of how LNG may be priced on an FOB basis if those locations were operational. NGI's Forward Look has 10-year forward curves for more than 60 locations in North America. For more information, please visit our Forward Look product page at natgasintel.com/product/forward-look

Source: NGI's Forward Look, CSI, Fearnleys, NGI calculations

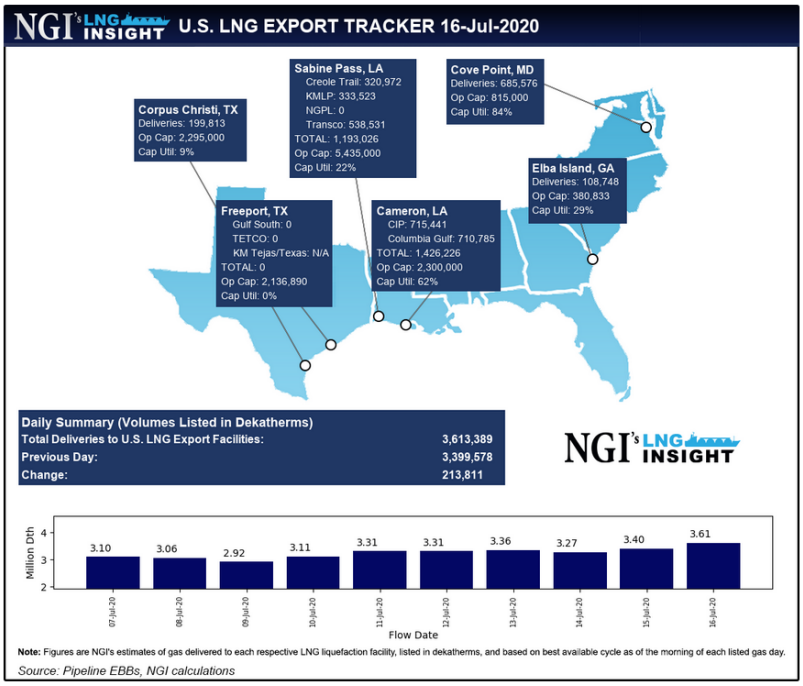
NGI's LNG INSIGHT

How Can NGI Publish Netback Prices for Kitimat & Costa Azul? Those Export Facilities Aren't Operational Yet!

As of this writing (May 2020), the LNG Canada facility in Kitimat, BC, was scheduled to enter service by 2025, and Sempra Energy had yet to reach its final investment decision on building export capability at the exiting Costa Azul import terminal. Obviously, the netback prices we publish for these two locations are not based on any actual LNG flows. However, we believe these figures will allow the industry to monitor the theoretical profitability of these two locations over time, and will help the market understand how seasonal physical market price movements in Western Canada and near the California/Mexico border could impact the economics of these two locations over the coming years.

NGI's U.S. LNG Export Tracker

Our **U.S. LNG Export Tracker** is created each trading morning and shows the number of dekatherms (Dth) that have been nominated via the pipelines serving each of the six U.S. LNG liquefaction facilities in the lower 48 (L48) states for that gas day. Because we create the tracker in the morning (U.S. Eastern Time), the flows are based on the best nomination cycle at the time, which tends to be the evening cycle.

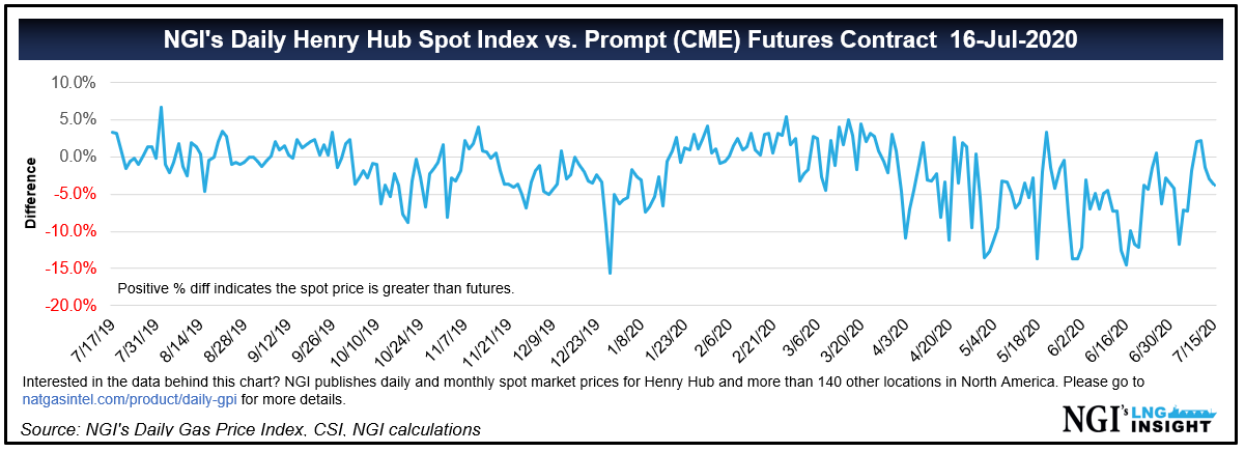


However, we realize more gas may be nominated during the subsequent three intraday cycles, so we also perform another scrape of the various pipeline electronic bulletin boards the next day, to ensure we bank the final total. For example, in the chart above, the 3.61 million Dth for July 16 represent flows based on the evening cycle, whereas the 9 days before that are all adjusted figures taken after the final intraday 3 nomination cycles for those flow days. However, if that 3.61 million Dth preliminary figure for July 16 were to change, we would show the updated and final number in following versions of that table.

NGI's Daily Henry Hub Spot Index vs. Prompt (CME) Futures Contract

The Henry Hub in Erath, LA, continues to gain prominence as a global natural gas pricing benchmark, especially as U.S. sourced LNG increases its global market share. The prompt Henry Hub futures contract expires three trading days before the start of the next calendar month, and while laws of market arbitrage dictate that cash and futures prices must converge at the moment the futures contract goes off the board, those two prices can vary greatly in the days prior to expiration. Our Daily Henry Hub Spot Index vs. Prompt (CME) Futures Contract table compares the percentage difference in NGI's day-ahead Henry Hub spot market index found in our *NGI's Daily Gas Price Index* service to the prompt month Henry Hub CME futures contract for each trading day during the previous 12 months. Any historically wide percentage difference suggests that one (or both) of the two markets may be in for a significant price change, especially if that wide differential still exists closer to the final trading day of the futures contract.

For more information about our daily, weekly and monthly North American natural gas price indexes, please visit our website.



General/Global Focused Content

Prompt Month Global NatGas Futures Prices

Daily settlement prices in this table appear in both local currency/measurement units and $USD/MMBtu, based on the current spot market exchange rate for the two European futures contracts.

Note these prompt month contracts all settle at different points throughout the month. For example, the JPM/KOR futures contract tends to settle on or around the 15th of each month, while Henry Hub futures expire on the third to last trading day before the start of the next month. The two European contracts go off the board on the penultimate trade day of the month.

Global LNG & NatGas Futures Prices (Aug 2020) 16-Jul-2020

Contract	Cur/Unit	Settle	Chg	% Chg	Settle ($US/MMBtu)
JPN/KOR	$US/MMBtu	$2.164	$0.000	0.0%	$2.164
NBP	pence/therm	12.99p	-0.62p	-4.6%	$1.630
TTF	Eur/MWh	€ 5.058	-€ 0.168	-3.2%	$1.688
Henry Hub	$US/MMBtu	$1.723	-$0.055	-3.1%	$1.723

NBP & TTF converted to $US/MMBtu using same month forex futures contracts.

Source: NGI calculations, CSI

NGI's LNG INSIGHT

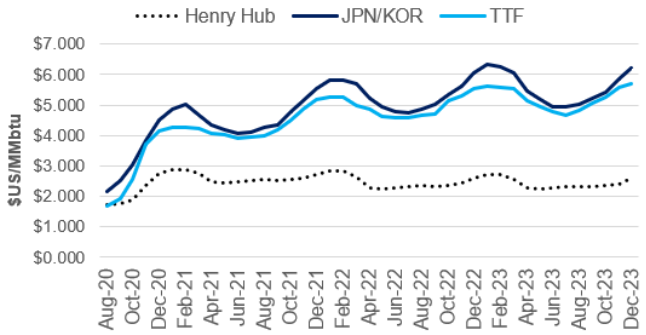
After the expiration of all four prompt month futures contracts listed in this chart, we will start listing prices for the next prompt futures month on the first trading day of that next calendar month. For example, assume the November JPN/KOR futures expires October 15th, the November Henry Hub futures contract expires October 29, and the two November European contracts expire October 30. We would begin listing December futures contract information (the next prompt futures month) on the first trading day of November (the next calendar month).

Global Natural Gas Futures Settles

Our global natural gas futures settle table expands upon our **Prompt Month Global NatGas Futures Price** table by providing next 12-month and next complete three-year calendar strips for the Henry Hub, JPN/KOR and TTF futures contracts. Each curve is expressed in $US/MMbtu. Both the Henry Hub and JPN/KOR contracts trade in $US/MMbtu, but because TTF trades in Euro/MWh, we convert those to $US/MMBtu by bootstrapping a Euro/USD foreign exchange forward curve for each relevant month.

Please note these curves only list futures prices, and do not incorporate any shipping costs to move gas between the U.S. and Asia/Europe. As a result, these curves should not be taken as a direct proxy for the economics of shipping gas from the U.S to Asia/Europe, or between Asia & Europe. However, the wider these spreads, the more in the money such transactions are likely to be. This is particularly relevant for the so-called 2nd wave of proposed North American LNG export facilities, as many of those projects have yet to reach FID.

Global Futures Settles Through 2023 16-Jul-2020



Henry Hub	Date	12-Month Strip*	CY2021	CY2022	CY2023
	16-Jul-20	$2.410	$2.617	$2.462	$2.426
	15-Jul-20	$2.424	$2.613	$2.453	$2.424
	Chg	*($0.014)*	*$0.004*	*$0.009*	*$0.002*
JPN/KOR	Date	12-Month Strip*	CY2021	CY2022	CY2023
	16-Jul-20	$3.941	$4.609	$5.325	$5.575
	15-Jul-20	$3.978	$4.643	$5.338	$5.575
	Chg	*($0.038)*	*($0.034)*	*($0.012)*	*$0.000*
TTF	Date	12-Month Strip*	CY2021	CY2022	CY2023
	16-Jul-20	$3.564	$4.288	$4.963	$5.227
	15-Jul-20	$3.620	$4.326	$5.003	$5.262
	Chg	*($0.056)*	*($0.038)*	*($0.040)*	*($0.035)*

*Aug 2020 through Jul 2021

Source: Bloomberg, CSI, NGI calculations

NGI's LNG INSIGHT

Fearnleys LNG Freight Costs & Spot LNG Vessel Rates

Each day, we republish with permission certain key LNG shipping data provided by Fearnleys, one of the world's most prominent shipbrokers.

Spot LNG Vessel Rates ($USD/day)
16-Jul-2020

Vessel Rates		
Vessel Type / Region	WEST	EAST
174k XDF / MEGI	43,000	41,000
155k - 165k TFDE	35,000	32,000
138k - 145k ST	24,000	22,000

Pacific Voyage Parameters
Fuel and 50% Hire on Ballast Bonus to Singapore
Middle East Voyage Parameters
Fuel and 50% Hire on Ballast Bonus to Fujairah
Atlantic Voyage Parameters
Fuel and 50% Hire on Ballast Bonus to Load Port; or to Gibraltar for intra Atlantic basin voyages

Source: Fearnleys (www.fearnleys.com)

The Fearnleys charts provide spot market vessel rates and related charges for steam turbine, TFDE and two stroke vessels (XDF & MEGI) in both the Atlantic (West) and Pacific (East) Basins.

LNG Freight Costs for Selected Routes 16-Jul-2020

Trade Route ($ / MMBtu)	174k MEGI			160k TFDE			145k ST		
Bonny / Montoir	0.412	0.004	▲	0.416	0.004	▲	0.452	0.005	▲
Bonny / Tokyo	0.862	0.012	▲	0.918	0.014	▲	1.033	0.017	▲
Ras Laffan / Montoir	0.444	0.005	▲	0.453	0.006	▲	0.475	0.007	▲
Ras Laffan / Tokyo	0.339	0.006	▲	0.360	0.007	▲	0.403	0.008	▲
Dampier / Tokyo	0.289	0.004	▲	0.308	0.005	▲	0.354	0.006	▲
Zeebrugge / Bahia Blanca	0.511	0.008	▲	0.566	0.009	▲	0.643	0.011	▲
Zeebrugge / Dahej	0.549	0.008	▲	0.592	0.009	▲	0.718	0.011	▲
Zeebrugge / Tokyo	0.863	0.013	▲	0.967	0.015	▲	1.079	0.018	▲
Sabine / Bahia Blanca	0.507	0.008	▲	0.570	0.010	▲	0.639	0.011	▲
Sabine / Dahej	0.762	0.012	▲	0.862	0.014	▲	0.945	0.017	▲
Sabine / Tokyo	0.748	0.012	▲	0.842	0.014	▲	0.935	0.016	▲
Sabine / Zeebrugge	0.425	0.007	▲	0.516	0.008	▲	0.616	0.010	▲
Port Moresby / Tokyo	0.287	0.004	▲	0.305	0.005	▲	0.347	0.006	▲

Source: Fearnleys (www.fearnleys.com). Assumes cold vessel. Speed used is 17 knots on laden passage and 16 knots on ballast passage.

In addition, Fearnleys provides *NGI* with LNG freight cost calculations for certain key routes throughout the world and breaks those down by the three propulsion classes.

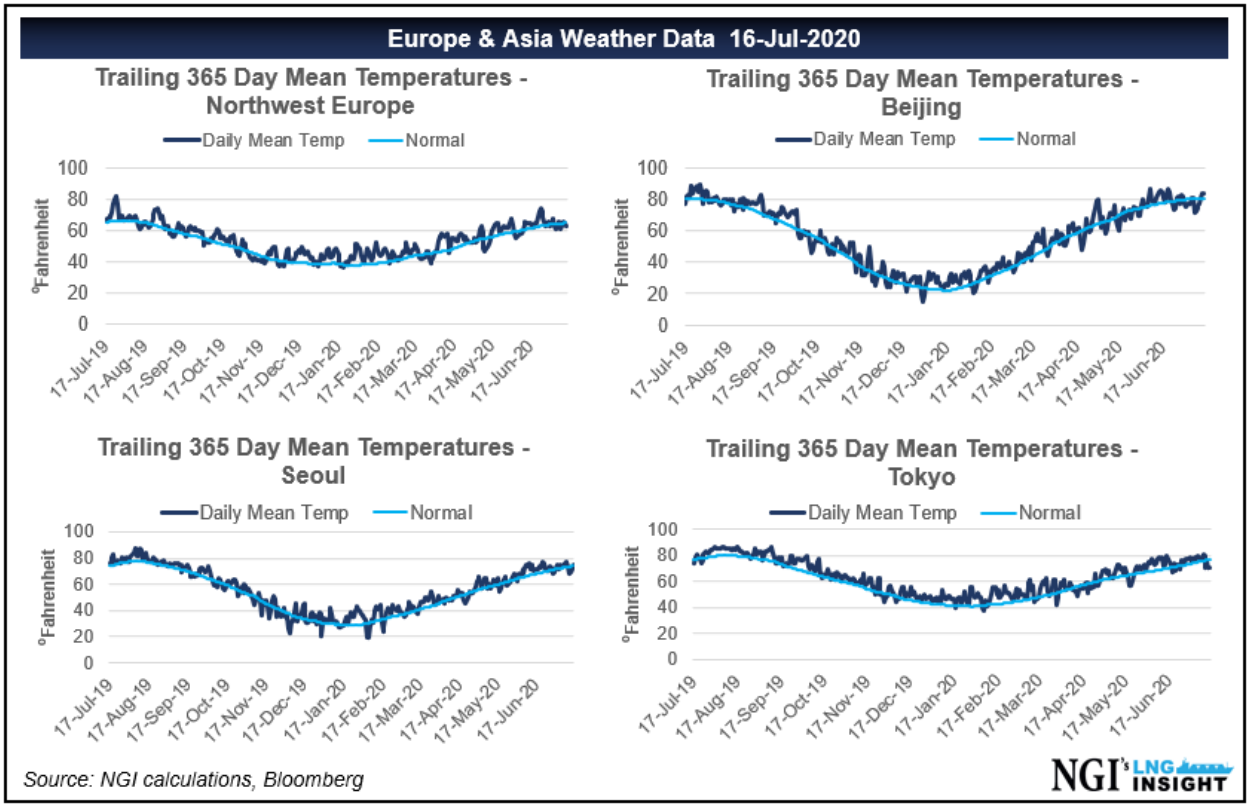
We believe these charts provide an excellent reference point for shipping costs around the world. As noted before, our Sabine Pass route calculations may differ a bit from those in the Fearnleys charts, because our assumptions are somewhat different (see page 3 for our assumptions).

For more information about these Fearnleys data, please go to www.fearnleys.com.

Europe & Asia Weather Data

According to data from the International Group of Liquefied Natural Gas Importers (GIIGNL), Europe and Asia accounted for 93% of global LNG imports in 2019, and weather is a key driver of consumption in both regions. Our daily Europe & Asia Weather Data chart shows actual and normal average temperatures for the trailing 365 days in Northwest Europe, Beijing, Seoul, and Tokyo.

Weather is certainly not the only determinant of demand in these two continents, but we believe the historical normal temperature curve, which is based on data from the previous 30 years, is a good approximation for the load profile and seasonality in each of these markets. Notice the shape of the 30-year normal curve is different for each of these areas. For example, Northwest Europe tends to have cooler summers than those in Asia, while winters in Beijing are typically colder than they are in Seoul and Japan. All these regions have a somewhat different load profile from that in the United States. So, to the extent that these areas are having an atypically mild or cold winter/summer, that could impact demand for U.S. cargoes that runs counter to historical U.S.-only seasonal consumption.



Asia Focused Content

While Europe serves as the market of "last resort" for LNG, thanks in large part to its ample underground storage capacity, Asia's high demand for the fuel often times makes it the market of "first resort" for LNG shippers. According to GIIGNL, Asia accounted for 69% of global LNG imports in 2019, led by Japan, China, and South Korea. Moreover, we believe overall LNG demand tends to be less price sensitive in Asia than in Europe, because several key Asian energy consuming countries have relatively low to no access to pipeline gas and other fuel sources.

Estimated Sabine Pass / Asia 12-Month Forward Arbitrage Curve

This chart shows the economics of shipping LNG from Sabine Pass to Asia (specifically, to the Futtsu import facility near Tokyo, Japan) for the next twelve months. Our methodology is similar to the calculation we use in our Sabine Pass / Gate (Europe) 12-month arbitrage curve chart, in that we start by taking 115% of the Henry Hub price, and add to that our estimate of shipping costs between Sabine Pass and Japan for each month in the forward curve. We also calculate separate variable cost only and total cost curves, for the reasons explained on pages 13-14.

However, there are two main differences between Asia and Europe one should keep in mind when comparing our Asia and European Arbitrage Curves. First, LNG delivered into Asia tends to change hands at sea, which means the JPN/KOR futures prices are much more of an LNG price than the TTF price in Europe. One does not have to factor in any regasification or pipeline access fees for Asian deliveries, as is the case for LNG cargoes shipped to Europe. Second, negative portions of this Asia arbitrage curve are

not necessarily a signal that U.S. cargo shut-ins may be forthcoming, because those cargoes could still be injected into underground storage facilities in Europe, the so-called market of last resort. But a deeply negative curve does potentially eliminate Asia as a destination for U.S. cargoes, and that could place downward pressure on both the Henry Hub and U.S. Gulf of Mexico FOB LNG prices.

Daily Prompt Oil Linked Asia Parity Prices

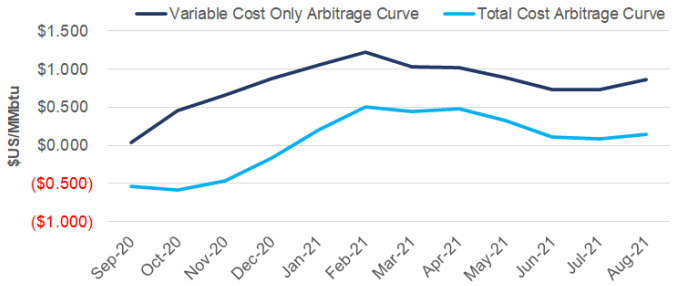
Our **Daily Prompt Oil Linked Asia Parity Prices** chart lists the current spot market value of LNG delivered to Asia, the current actual slope of that Asian LNG price, the theoretical maximum 17.2% slope vs. the current spot Brent crude price, and the estimated cost of coal in Japan. We also calculate the 17.2% slope vs. the trailing three-month average of the Japan Crude Cocktail price, as that is a common reference point as well.

According to GIIGNL, which we believe is one of the most referred to sources in the LNG industry, Asia represented 69% of global LNG demand in 2019, and the majority of LNG contracts in that region are linked to Brent crude oil prices. As a result, Brent prices tend to serve as a cap on Asian LNG prices.

The percentage of Brent at which LNG is priced, also called the **slope**, can vary. Historically, it has tended to be more than 14%, but as of this writing, we believe new contracts were being signed more in the 11%-12% range.

Our **oil parity price** uses a slope of 17.2% of Brent, which we believe is a bit more conservative, since it is based on the reciprocal of the 5.8-to-1 heating value equivalent to a

Estimated Sabine Pass / Asia 12-Month Forward LNG Arbitrage Curves 16-Jul-2020



Note: Assumes title changes hands at sea, so no regas fees. Negative GOM/Asia spreads may not increase the risk of GOM LNG shut-ins as much as those between GOM and Europe, since Europe has much more storage capacity than Asia. As such, Europe often serves as the market of "last resort." Variable costs assume vessels have been chartered, and include fuel, boiloff, Panama Canal and port fees only. Total costs includes variable expenses and fixed vessel chartering fees.

Month	115% HH Futures	Shipping Costs Variable	Shipping Costs Fixed	Variable Only Landed Cost	Total Landed Cost	JPN/KOR Futures	Variable Arbitrage Spread	Total Arbitrage Spread
Sep-20	$2.042	$0.421	$0.576	$2.464	$3.040	$2.500	$0.036	($0.540)
Oct-20	$2.161	$0.438	$1.036	$2.599	$3.634	$3.050	$0.451	($0.584)
Nov-20	$2.703	$0.461	$1.129	$3.164	$4.293	$3.825	$0.661	($0.468)
Dec-20	$3.159	$0.482	$1.036	$3.641	$4.677	$4.515	$0.874	($0.162)
Jan-21	$3.306	$0.492	$0.847	$3.798	$4.645	$4.850	$1.052	$0.205
Feb-21	$3.306	$0.497	$0.714	$3.804	$4.517	$5.025	$1.221	$0.508
Mar-21	$3.151	$0.486	$0.591	$3.637	$4.228	$4.665	$1.028	$0.437
Apr-21	$2.852	$0.477	$0.540	$3.329	$3.869	$4.350	$1.021	$0.481
May-21	$2.816	$0.471	$0.559	$3.288	$3.847	$4.170	$0.882	$0.323
Jun-21	$2.861	$0.468	$0.624	$3.329	$3.953	$4.060	$0.731	$0.107
Jul-21	$2.915	$0.470	$0.642	$3.385	$4.027	$4.115	$0.730	$0.088
Aug-21	$2.930	$0.474	$0.714	$3.404	$4.118	$4.260	$0.856	$0.142

Source: NGI calculations, CSI, Fearnleys

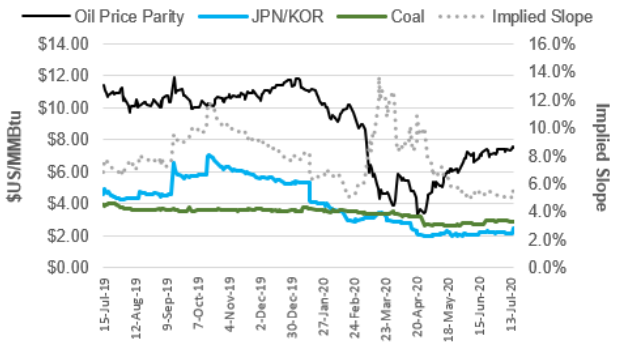
NGI's LNG INSIGHT

Daily Prompt Oil Linked Asia Parity Prices 16-Jul-2020

Current Spot Month Japan/Korea Futures Contract Price (Sep):	**$2.500**
Current Spot Month Brent Crude Oil Futures Price (Sep):	**$43.37**
Current Spot Month Japan Coal Price (Jul):	**$2.89**
Implied Current Japan/Korea Slope to Brent:	**5.8%**

	Oil Price		Oil Parity Price (17.2% Slope)	
Crude Mo	3 Mo Avg JCC	Brent	3 Mo Avg JCC	Brent
Sep-20	$58.23	$43.37	$10.02	$7.46

Trailing 12M Daily Prompt Japan/Korea Futures



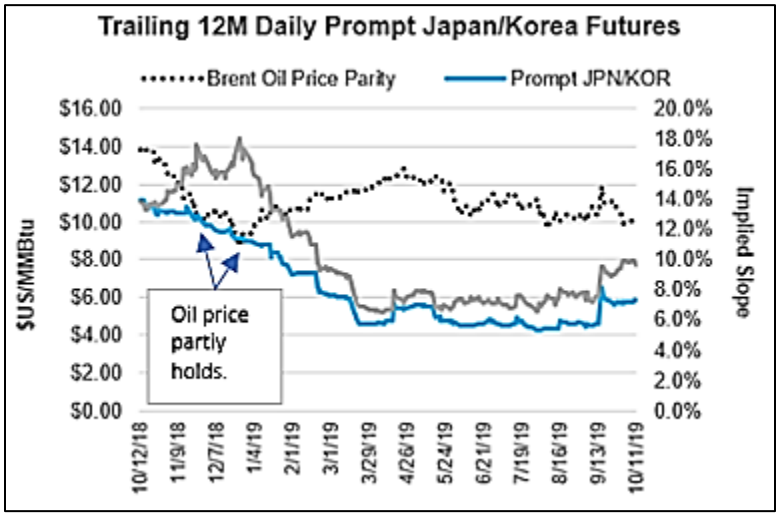
Note: Oil linked parity figures tend to serve as a cap on Asian LNG market prices, while coal prices can help act as a floor.

Source: NGI calculations, ICE, CSI, METI

NGI's LNG INSIGHT

barrel of crude oil to one MMBtu of natural gas. As such, this should be the theoretical maximum slope at which Asian LNG should trade against crude, something that occurred two times in the chart below.

We also show the estimated price of coal in Japan, which is based on the prompt month Australia Newcastle Coal futures price, plus the current cost of transport to ship coal from Australia to Japan. Unlike how Brent Oil Price Parity tends to serve as a hard cap on JKM prices, coal prices do not necessarily serve as an absolute floor on LNG prices in Asia, but they do show the area in which coal becomes more economic relative to gas fired generation in the region.



Europe Focused Content

Europe tends to be the "market of last resort" for LNG cargoes, because of its extensive underground storage network and well-established physical pipeline network. As a result, if U.S. sourced LNG cannot work its way into Europe, then there is an increased probability that these American cargoes may be cancelled, or "shut in," everything else being equal.

There are a number of reasons that U.S. LNG cargoes may not be able to discharge in Europe, including realized prices in Europe that are less than the variable transportation costs between those two markets, otherwise profitable U.S. LNG cargoes are still more expensive than local European prices, or storage in the European Union (EU) could be full. We assess these various factors via the following charts:

Estimated Sabine Pass / Gate 12-Month Forward LNG Arbitrage Curve

This chart shows the potential for U.S. LNG shut-ins by subtracting the landed price of Sabine Pass sourced LNG versus the TTF price for each of the next twelve months. We calculate the various landed prices by taking 115% of the monthly Henry Hub futures price and adding our estimate of shipping costs between Sabine Pass and the Gate Terminal in the Netherlands for those the next twelve months.

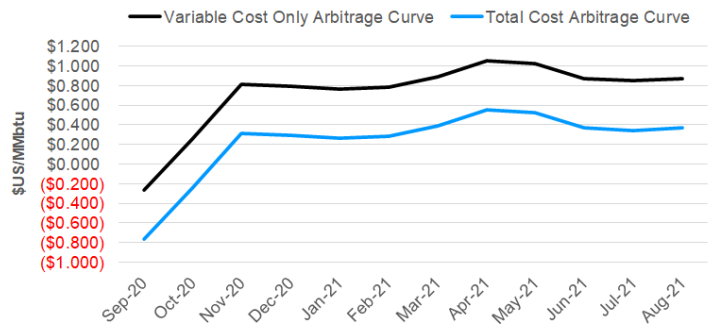
Those shipping costs can have both a fixed (sunk) and a variable (incremental) component to them, depending on how one treats the expense of procuring an LNG vessel. Similar to the obligations faced by firm transportation take-or-pay pipeline shippers in the United States, who must pay those fees regardless of whether they use that capacity, LNG shippers are on the hook for vessel charter fees no matter their usage. As a result, these are sunk, or non-incremental costs, and existing holders of LNG

vessels will be more concerned about covering the variable, or incremental costs of transporting LNG. We show this via our **variable cost only arbitrage curve**, in which we only include boil-off, fuel, port fees, and canal charges (where applicable) in our calculated shipping costs.

Our **total cost arbitrage curve** includes all shipping costs, including the variable costs mentioned above, and the expense of chartering an LNG vessel. Such a curve is more appropriate for entities who do not already have an LNG vessel, because for them, charting a vessel is a variable cost.

Said differently, our variable cost-only arbitrage curve should be used by existing shippers who have LNG vessel capacity already, while our total cost arbitrage curve is more appropriate for 1.) entities who are considering entering the LNG space, and 2.) analysts who are looking at the long-term competitiveness of U.S. sourced LNG. The higher the total cost-only arbitrage window, the greater the potential threat for other LNG players to enter the market.

Estimated Sabine Pass / Europe (Gate) 12-Month Forward LNG Arbitrage Curves 16-Jul-2020



Note: Negative spreads increase the odds of U.S. Gulf of Mexico sourced LNG cargoes being shut-in. Variable costs assume vessels have been chartered, and include fuel, boil-off, and port fees only. Total costs include both variable expenses and fixed vessel chartering fees. Both exclude regas fees, which we estimate would add another $0.10-$0.50 in additonal costs to each arbitrage curve calculation.

NGI's LNG INSIGHT

Month	115% Henry Hub Futures	Shipping Costs *Variable*	Shipping Costs *Fixed*	Variable Only Landed Cost	Total Landed Cost	TTF Futures	**Variable Arbitrage Spread**	**Total Arbitrage Spread**
Sep-20	$2.042	$0.150	$0.330	$2.193	$2.693	$1.928	($0.264)	($0.764)
Oct-20	$2.161	$0.161	$0.592	$2.322	$2.822	$2.576	$0.255	($0.245)
Nov-20	$2.703	$0.179	$0.645	$2.882	$3.382	$3.698	$0.816	$0.316
Dec-20	$3.159	$0.187	$0.592	$3.346	$3.846	$4.138	$0.792	$0.292
Jan-21	$3.306	$0.189	$0.484	$3.495	$3.995	$4.258	$0.763	$0.263
Feb-21	$3.306	$0.189	$0.408	$3.495	$3.995	$4.283	$0.788	$0.288
Mar-21	$3.151	$0.188	$0.338	$3.339	$3.839	$4.225	$0.886	$0.386
Apr-21	$2.852	$0.186	$0.309	$3.038	$3.538	$4.088	$1.050	$0.550
May-21	$2.816	$0.185	$0.320	$3.001	$3.501	$4.022	$1.021	$0.521
Jun-21	$2.861	$0.183	$0.357	$3.044	$3.544	$3.917	$0.873	$0.373
Jul-21	$2.915	$0.184	$0.367	$3.099	$3.599	$3.945	$0.846	$0.346
Aug-21	$2.930	$0.184	$0.408	$3.115	$3.615	$3.985	$0.870	$0.370

Source: NGI calculations, CSI, Fearnleys

Complicating this analysis is the fact that the TTF is a pipeline price, so one should also include the variable costs of LNG regasification and accessing the Dutch pipeline grid in order to create a true apples-to-apples comparison. We have elected to exclude such fees from our arbitrage window calculations, for the sake of simplicity, and because actual variable costs can differ greatly among shippers. We believe a representative range of them is somewhere between $0.10 and $0.50 per MMBtu, depending on the regasification facility. So, those looking for "fully loaded" arbitrage window calculations should add another $0.10 to $0.50 to both the variable only and total cost arbitrage curves.

U.S. Landed vs. European Prices

U.S. LNG competes with natural gas delivered via pipeline in Europe, so even if the Sabine Pass-TTF arbitrage window is positive, meaning U.S LNG is cheaper than gas in the Netherlands, it could still be the case that U.S. LNG is more expensive than gas prices in other European countries.

Our **U.S. Landed vs European Prices** chart compares the landed price of U.S. LNG at the Gate Terminal in the Netherlands ("Gate Landed Price," or GLP) to the prompt futures price in Belgium, Czech Republic, France, Germany, Italy, Netherlands, Slovakia, Spain, and the U.K. Negative values in the "Diff to GLP" column indicate that imported U.S. LNG from the Gulf of Mexico is more expensive than the local price.

U.S. Landed vs. European Prices Sep 2020
16-Jul-2020

Estimated U.S. LNG Landed Price ($US/MMBtu)

Source	Pricing Point	HH Price	Gate Landed Price (GLP)
GOM	Henry Hub	$1.776	$2.193

European NatGas Futures Prices (Eur/MWh & Pound/therm)

Country	Pricing Point	Local Price MWh or therm	Local Price $US/MMBtu	Diff to GLP* $US/MMBtu
Belgium	ZTP	€ 4.94	$1.649	-$0.543
Czech Rep	CZ VTP	€ 6.20	$2.070	-$0.122
France	PEG	€ 5.65	$1.886	-$0.306
Germany	NCG	€ 5.98	$1.997	-$0.196
Italy	PSV	€ 6.81	$2.273	$0.080
Netherlands	TTF	€ 5.78	$1.928	-$0.264
Slovakia	CEGH VTP	€ 6.53	$2.179	-$0.014
Spain	PVB	€ 7.25	$2.419	$0.226
UK	NBP	14.98p	$1.880	-$0.313

Euro Exchange Rate: **1.13925**
Pound Exchange Rate: **1.25490**

NGI's LNG INSIGHT

Note: U.S. landed price is to the Gate Terminal in the Netherlands, and exclude any regas or European pipeline grid access fees. We estimate the variable portion of such charges range between $0.10-$0.50 per MMbtu. All local European prices are Eur/MWh, except UK, which is pence/therm.

**Negative numbers indicate imported U.S. LNG is more expensive than the local price.

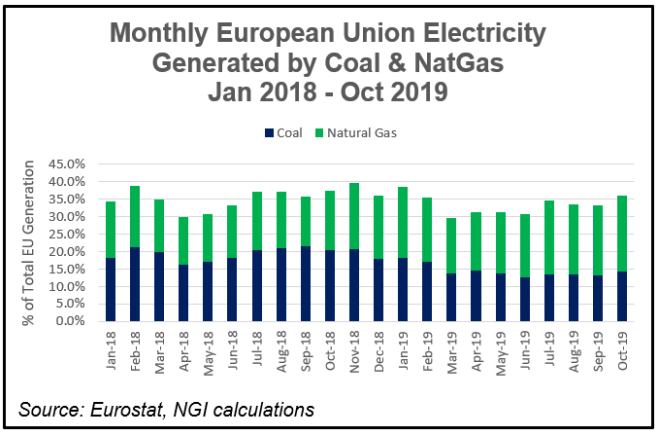
Source: NGI calculations, CME, ICE, EEX, Powernext, CSI, Fearnleys

Note our GLP calculation only includes variable shipping costs and does not include the charter cost of the vessel. We also exclude any additional European variable costs from this calculation, such as regasification and pipeline access fees. For more on these costs, please see the Estimated Sabine Pass / Gate 12-Month Forward Arbitrage Curve section above.

European Spark/Dark Spreads

The combination of coal and natural gas fired generation typically accounts for between 30%-40% of European Union electricity generation, not an insignificant figure. However, the relative percentage use of those two competing fuels at any particular time depends heavily on just how economic each is in producing electricity.

Each day, we calculate the gross margin of producing power in Europe by natural gas via the **spark spread**, and the comparative gross margin for generating European electricity by coal by way of the **dark spread**.



Source: Eurostat, NGI calculations

European Spark/Dark Spreads (Sep 2020)
16-Jul-2020

EUA Carbon Price (Eur/mt): **28.81**

			Spark Spread		Clean Spark Spread	
		EFFCY	49%	45%	49%	45%
Nation	Power Futures Eur/MWh	Gas Futures Eur/MWh	Spark Spread Eur/MWh	Spark Spread Eur/MWh	Spark Spread Eur/MWh	Spark Spread Eur/MWh
BE	33.00	5.080	22.66	21.71	10.93	8.78
CZ	35.21	5.709	23.59	22.52	11.86	9.59
FR	34.13	5.075	23.80	22.85	12.07	9.92
DE	33.01	5.275	22.27	21.29	10.55	8.35
IT	35.59	6.126	23.12	21.98	11.40	9.04
NL	31.79	5.226	21.15	20.18	9.43	7.24
SK	36.21	6.175	23.64	22.49	11.92	9.55
ES	35.70	6.930	21.59	20.30	9.87	7.36
UK*	34.68	5.120	24.25	23.30	4.45	1.45
Average			***22.90***	***21.85***	***10.28***	***7.92***

			Dark Spread	Clean Dark Spread
		EFFCY	35%	35%
Nation	Power Futures Eur/MWh	Coal Futures $US/Mt	Dark Spread Eur/MWh	Dark Spread Eur/MWh
BE	33.00	49.60	15.26	-12.71
CZ	35.21	49.60	17.47	-10.50
FR	34.13	49.60	16.39	-11.58
DE	33.01	49.60	15.27	-12.70
IT	35.59	49.60	17.85	-10.12
NL	31.79	49.60	14.05	-13.92
SK	36.21	49.60	18.47	-9.50
ES	35.70	49.60	17.96	-10.01
UK*	34.68	49.60	16.94	-30.31
Average			***16.63***	***-13.48***

Belgium (**BE**) / Czech Rep (**CZ**) / France (**FR**) / Germany (**DE**) / Italy (**IT**)
Holland (**NL**) / Slovakia (**SK**) / Spain (**ES**) / United Kingdom (**UK**)

*UK clean spark and dark spreads incorporate the cost of the UK Carbon Price Support levy. See methodology for all assumptions.

Source: NGI calculations, CSI NGI's LNG INSIGHT

NGI European Spark/Dark Spread Assumptions & Formulas

Assumptions

Electricity Prices: Prompt month baseload futures contract for each individual country. All futures contracts in Eur/MWh.
Natural Gas Prices: Prompt month futures contract for each individual country. All futures contracts trade in Eur/MWh, expect the National Balancing Point, which is listed in pence/therm. We contract that to Eur/MWh for our calculations.
Coal Price: Prompt month CIF ARA futures contract. We use this as the coal price for all European countires. The contract trades in $US/mt, but we convert this to Eur/MWh using the formula listed in the section below.
Coal Conversion Factor: 1 mt of coal = 7 Mwh
Carbon Price: December EUA futures price. Trades in Eur/mt, which we convert to Eur/MWh.
UK Carbon Price Support Levy (for UK spark & dark spreads only): 18.00 GBP/mt, which we convert to Eur/MWh.
Plant Efficiencies: 49% and 45% for natural gas fired plants, 35% for all coal generation.
CO^2 Adjustment Factors: Gas Fired 49% efficiency: .407 Gas fired 45% efficiency: .449
Coal fired 35% efficiency: .971

Formulas

Dirty Spark Spread

Dirty Spark Spread = Power Price (Eur/MWh) - (Gas Price (Eur/Mwh) /Power Plant Efficiency)

Ex.) Power Price = 28.05 Eur/MWh Gas Price = 8.675 Eur/MWh Efficiency = 49%
Dirty Spark Spread = 28.05 - (8.675/.49) = 10.39

Clean Spark Spread

*Clean Spark Spread = Dirty Spark Spread - (Carbon Price (Eur/MWh) * CO^2 Adjustment)*

Ex.) Dirty Spark Spread from above = 10.39 Carbon Price = 19.82 Eur/mt CO^2 Adjustment .407
Clean Spark Spread = 10.39 - (19.82*.407) = 2.33

Dirty Dark Spread

Dirty Dark Spread = Power Price - (Coal Price (Eur/MWh) / Power Plant Efficiency)
Coal Price (Eur/MWh) = Coal Price ($US/mt) / (US/Euro exchange rate) / coal energy conversion factor

Ex.) Power Price = 28.05 Eur/MWH Coal Price = US$ 45.85/mt Efficiency = 35%
Euro/US Exchange Rate = 1.09915 Coal Energy Conversion Factor = 7
Coal Price (Eur/MWh) = 45.85/1.09915/7 = 5.959
Dirty Dark Spread = 28.05 - (5.959/.35) = 11.02

Clean Dark Spread

*Clean Dark Spread = Dirty Dark Spread - (Carbon Price * CO^2 Adjustment)*

Ex.) Carbon Price = 19.82 Eur/MWh CO^2 Adjustment = .971
Clean Dark Spread = 11.02 - (19.82*.971) = -8.22

Dirty spark and dark spreads only consider the input fuel cost of generating electricity, while **clean** spark and dark spreads also include the cost of emissions in Europe (and in the case of the United Kingdom, the local Carbon Support levy).

The more economic the clean spark spread is to the clean dark spread, the more likely Europe will burn natural gas in favor of coal in generating electricity.

Our daily **European Spark/Dark Spreads** table features clean and dirty spark/dark spreads that we calculate for Belgium, Czech Republic, France, Germany, Italy, the Netherlands, Slovakia, Spain, and the United Kingdom, based on applicable prompt month electricity, natural gas, and coal contracts for each country, and subject to the assumptions and formulas shown above.

Spanish PVB vs. Dutch TTF Futures

Spanish PVB vs. Dutch TTF Futures 16-Jul-2020

Period	PVB $US/ MMBtu	Chg	TTF $US/ MMBtu	Chg	PVB/TTF Premium ($)	PVB/TTF Premium %
Aug-20	$2.267	-$0.051	$1.688	-$0.060	$0.580	34.3%
Sep-20	$2.419	-$0.040	$1.928	-$0.045	$0.490	25.4%
Oct-20	$2.889	-$0.054	$2.576	-$0.054	$0.312	12.1%
4Q20	$3.654	-$0.076	$3.470	-$0.081	$0.184	5.3%
1Q21	$4.488	-$0.063	$4.256	-$0.056	$0.232	5.5%
2Q21	$4.217	-$0.036	$4.009	-$0.043	$0.208	5.2%

Source: NGI calculations, CSI

NGI's LNG INSIGHT

The Dutch Title Transfer Facility (TTF) is one of the most liquid natural gas pricing points in the world, and as a result, it tends to be used as a proxy for LNG prices in Europe. Because of this, we use TTF as the main European pricing point in our various LNG arbitrage calculations. However, TTF is a pipeline price, and therefore is likely more reflective of regional fundamentals rather than those in the global market.

We believe the emerging Punto Virtual de Balance (PVB) in Spain is a more representative price indicator of European LNG, because the Iberian peninsula receives a greater percentage of its total supply from cargoes than the rest of the continent. Spain also has an abundance of storage capacity and a relatively large number of regasification facilities with reloading capability, making it a more of an "LNG friendly" destination.

As of May 2020, the TTF futures contract had more than 100x the open interest of its nascent PVB counterpart, meaning it will likely be quite some time before the PVB gains broader market acceptance. However, the PVB still provides useful price signals, as the contract tends to trade at a premium to TTF. The greater the premium, the greater the price advantage LNG enjoys over pipeline gas in Europe.

European Union Gas Storage

Another potential shut-in signal for U.S. (and globally sourced) LNG cargoes is the amount of gas in storage in Europe since the continent tends to serve as a last resort destination for LNG shipments. The fuller European gas storage, the less likely Europe will be able or willing to accept additional cargoes, among other considerations.

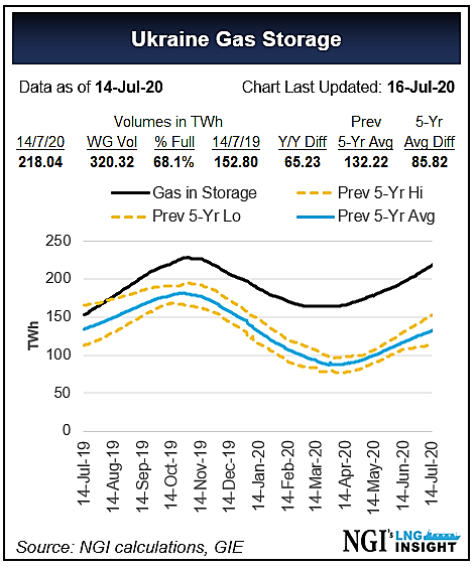
Each day, we run the following European Union Gas Storage chart, based on information furnished by Gas Infrastructure Europe. The top graph displays gas in storage relative to the high, low and average levels over the previous five years, the middle drills down into where current storage levels are compared to a year-ago, and to the previous five-year average, and the bottom display is a running total of gas in storage over the previous six-years, including where storage stood on the current chart date in

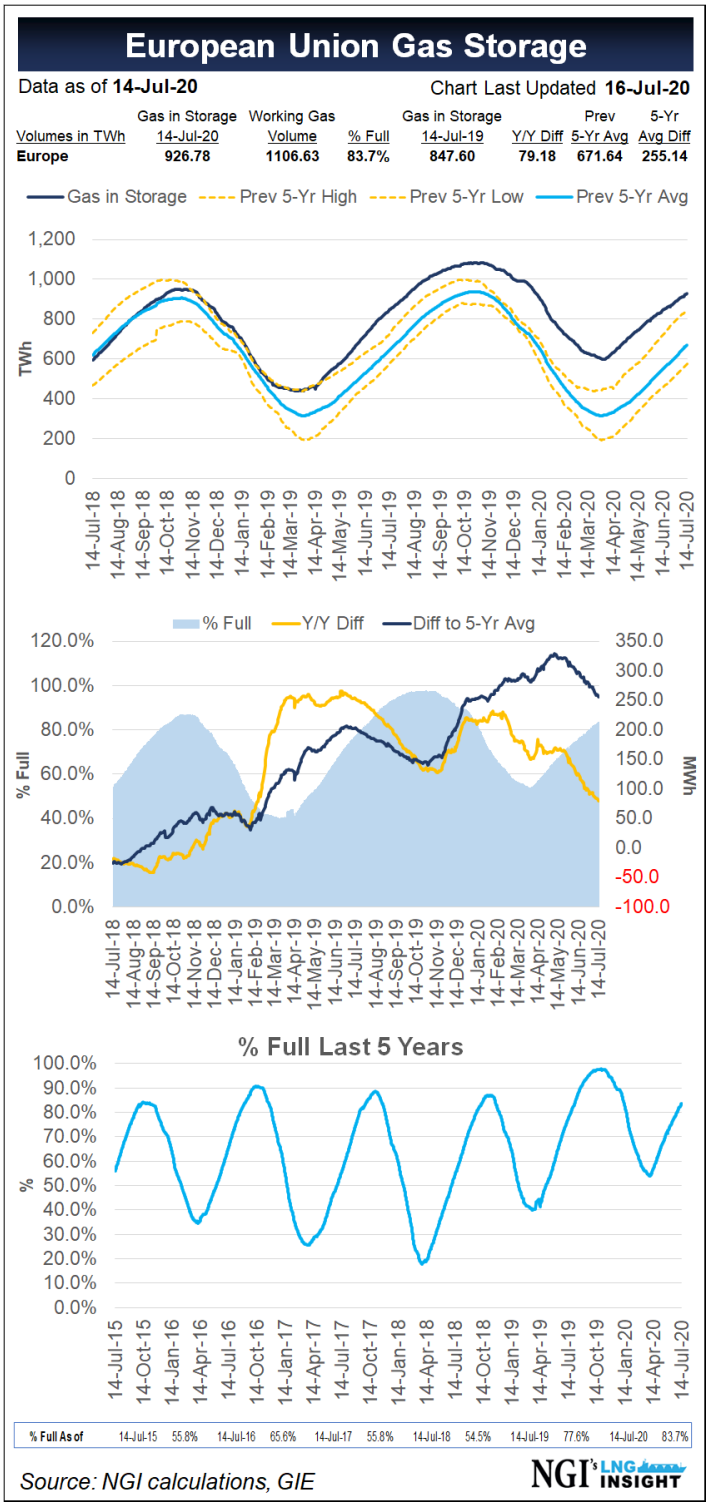
each of those years. That latter chart not only gives readers a sense of historical seasonality, but also highlights where current storage levels are compared to normal.

Note: Our EU storage figures do not include the Ukraine, which is a non-EU country. We list Ukrainian storage in a separate table, as described below.

Ukraine Gas Storage

Historically, the sizable natural gas storage capacity in the Ukraine existed primarily to serve Gazprom, but that has changed dramatically in recent months. In April 2019, Ukrtransgaz, which manages storage and the country's transmission system operator, began to open its system and incentive non-Gazprom buyers and sellers with discounted transportation tariffs and exemptions from customs duties.





The Ukraine is not part of the European Union, and as such, GIE does not include Ukrainian storage in its main Europe storage count, hence our decision to publish a separate Ukraine storage table each day. However, we believe the new accessibility of storage in the Ukraine provides a significant secondary

source of storage capacity in Europe, which should help extend and build upon Europe's existing role as the global LNG market of last resort.

European Union LNG Regas Terminal Gas Storage

Our European Union LNG Regas Terminal Storage table shows daily changes in on-site storage levels at a number of key LNG import facilities in the region. Storage capacity at the various European regasification terminals represents a very small fraction of total European underground storage, and therefore does not act as a substitute for or complement to our European Union Gas Storage table described above.

However, we believe monitoring the daily percentage of storage utilization at these regasification facilities can help yield clues about their collective ability to receive more cargoes in the short-term. Between January 2013 and April 2020, the average storage capacity utilization of the European regasification facilities listed in the adjacent table was 48.7%, so any current figure close to this total indicates recent European regasification activity has been operating close to normal. The maximum utilization since 2013 is 80%, meaning any utilization approaching that figure indicates these facilities may be effectively full. Similarly, storage at these regasification terminals was never lower than 22.7% during this time period, which suggests any capacity figure close to 23% means more cargoes are needed.

European Union LNG Regas Terminal Storage

Data as of **14-Jul-20** Chart Last Updated: **16-Jul-20**

Country	Terminal	Inventory (10^3 m^3)	Chg	Max Cap (10^3 m^3)	% Util
Belgium	Zeebrugge	354.0	-14.5	563.0	62.9%
France	Dunkerque	428.3	-3.5	586.1	73.1%
	Fos Tonkin	34.8	-0.8	80.0	43.5%
	Montoir	181.9	-38.8	360.0	50.5%
	Fas Cavaou	242.9	-34.2	330.0	73.6%
Greece	Revythoussa	152.2	-12.9	225.0	67.6%
Italy	Porto Levante	179.0	53.1	250.0	71.6%
	Panigaglia	36.6	7.3	40.0	91.6%
	Toscana	86.1	0.0	137.2	62.8%
Lithuania	Klaipedos	54.2	N/A	167.1	N/A
Netherlands	Gate	266.4	-47.3	540.0	49.3%
Poland	Swinoujscie	170.1	-15.8	320.0	53.1%
Portugal	Sines	219.1	-22.4	390.0	56.2%
Spain	Barcelona	470.1	0.0	758.0	62.0%
	Bilbao	294.9	0.0	448.8	65.7%
	Cartagena	377.6	0.0	585.5	64.5%
	Huelva	360.9	0.0	617.9	58.4%
	Mugardos	138.8	0.0	300.0	46.3%
	Sagunto	0.0	0.0	0.0	0.0%
	TVB (Virtual)	0.0	0.0	0.0	0.0%
UK	Grain	789.3	-4.9	1026.4	76.9%
	South Hook	476.8	-37.4	751.7	63.4%
Total		***5313.9***	***-172.0***	***8476.6***	***62.7%***

Source: NGI calculations, GIE

NGI's LNG INSIGHT

Latin America Focused Content

Latin America DES Prices

Our Latin America DES Prices table aims to measure the price of LNG for the next three months that is delivered ex-ship to Argentina, Brazil, Colombia, Chile, Mexico East (Altamira), Mexico West (Manzanillo), and Panama. These prices are essentially cost-plus, or net forward prices, that start with cost of LNG from a source country on an FOB basis and include estimated shipping costs to transport LNG from the source to the destination country. Our calculations are based on the following assumptions:

Latin America DES Prices 16-Jul-2020

		$US/MMBtu					
Country	Terminal	Aug	Chg	Sep	Chg	Oct	Chg
Argentina	Bahia Blanca	1.81	-0.06	2.43	0.45	3.46	0.99
Brazil	Pecem	1.59	-0.07	2.21	0.45	3.26	1.00
Chile	Quintero	1.89	-0.07	2.50	0.45	3.72	1.17
Colombia	Colombia	1.42	-0.07	2.04	0.45	3.26	1.17
Mexico East	Altamira	1.37	-0.07	1.99	0.45	3.21	1.16
Mexico West	Manzanillo	1.79	-0.07	2.41	0.45	3.63	1.17
Panama	Costa Norte	1.44	-0.07	2.06	0.45	3.28	1.17

For more regional coverage of Latin America, please see NGI's Mexico Gas Price Index at natgasintel.com/news/mexico-gas-price-index

Source: NGI calculations, CME Group, CSI, Fearnleys

1.) The shipping routes we consider are heavily influenced by the source country of recent LNG imports into each nation. In most cases, those have been primarily from the U.S. or Trinidad & Tobago, especially since more L48 liquefaction capacity has come online, but we also consider reloaded cargoes from Europe.

2.) For U.S. and Trinidad-based cargoes, we use the netbacks we calculate in our U.S. Gulf Coast LNG Netback Prices table as the starting FOB price, and for Europe FOB prices, we use Spanish PVB futures prices, since as explained earlier in this document, we believe PVB prices are a closer representation of the LNG market than are the more commonly referred to TTF prices.

3.) The shipping costs we add to our U.S. netback and PVB futures prices are based on a 160,000 m^3 DFTE/TFTE vessel, as opposed to our U.S. GOM calculations, which are based on a 174,000 m^3 XDF/MEGI sized ship.

4.) Our published DES prices are the minimum delivered price from the U.S. GOM and Spain for each location.

LNG Data Suite

NGI provides a portion of the data featured in this methodology in both Microsoft Excel format, as part of our datafeeds via API, and through our channel partners. The data suite offers daily netback prices, arbitrage curves, U.S. LNG export flow data, shipping costs, vessel rate curves (West of Suez), landed prices, Latin America DES Prices, and Slope-to-Brent Prices (Slopes). For more information about this service and the data series included, click here.

For more information on how to download/scrape these data, please see our Data Spec & Automation page.

When Are the Various LNG Insight Tables Updated Each Day?

NGI's LNG Insight is available in both pdf and html (website) formats. While we generally send out the PDF by 6 p.m. Eastern Time each business day, we do update the html versions of our content continuously throughout the day, according to the following schedule (charts/tables listed in order of appearance in the daily .pdf file):

Chart/Table	Update Time (U.S. Eastern Time)
LNG Related News/Analysis	Throughout the day
Prompt Month Statistics – Previous 5 Trading Days	Afternoon (usually after 4:00p)
U.S. Gulf Coast LNG Netback Prices (12-Month Strip)	Afternoon (usually after 4:00p)
Spot Month Sabine Pass Export Landed Price Arbitrage Continuation Chart	Afternoon (usually after 4:00p)
Other North America LNG Netback Prices	Afternoon (usually after 4:00p)
U.S. LNG Export Tracker	Morning (usually by 10:00a)
NGI's Daily Henry Hub Spot Index vs. Prompt (CME) Futures Contract	Morning (usually by 10:00a)
Fearnleys LNG Freight Costs & Spot LNG Vessel Rates	Morning (usually by 10:00a)
West of Suez LNG Vessel Rate Curve	Afternoon (usually after 4:00p)
Prompt Month Global LNG & NatGas Futures Prices	Afternoon (usually after 4:00p)
Estimated Sabine Pass / Asia 12-Month Forward LNG Arbitrage Curves	Afternoon (usually after 4:00p)
Daily Prompt Oil Linked Asia Parity Prices	Afternoon (usually after 4:00p)
Europe & Asia Weather Data	Afternoon (usually after 4:00p)

Chart/Table	Update Time (U.S. Eastern Time)
U.S. Landed vs European Prices	Afternoon (usually after 4:00p)
Spanish PVB vs. Dutch TTF Futures	Afternoon (usually after 4:00p)
Estimated Sabine Pass / Gate 12-Month Forward LNG Arbitrage Curves	Afternoon (usually after 4:00p)
European Spark/Dark Spreads	Afternoon (usually after 4:00p)
European & Ukraine Gas Storage	Morning (usually by 10:00a)
European LNG Regas Terminal Storage	Morning (usually by 10:00a)
Latin America DES Prices	Afternoon (usually after 4:00p)

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