Impacts of the Venezuelan Crude Oil Production Loss

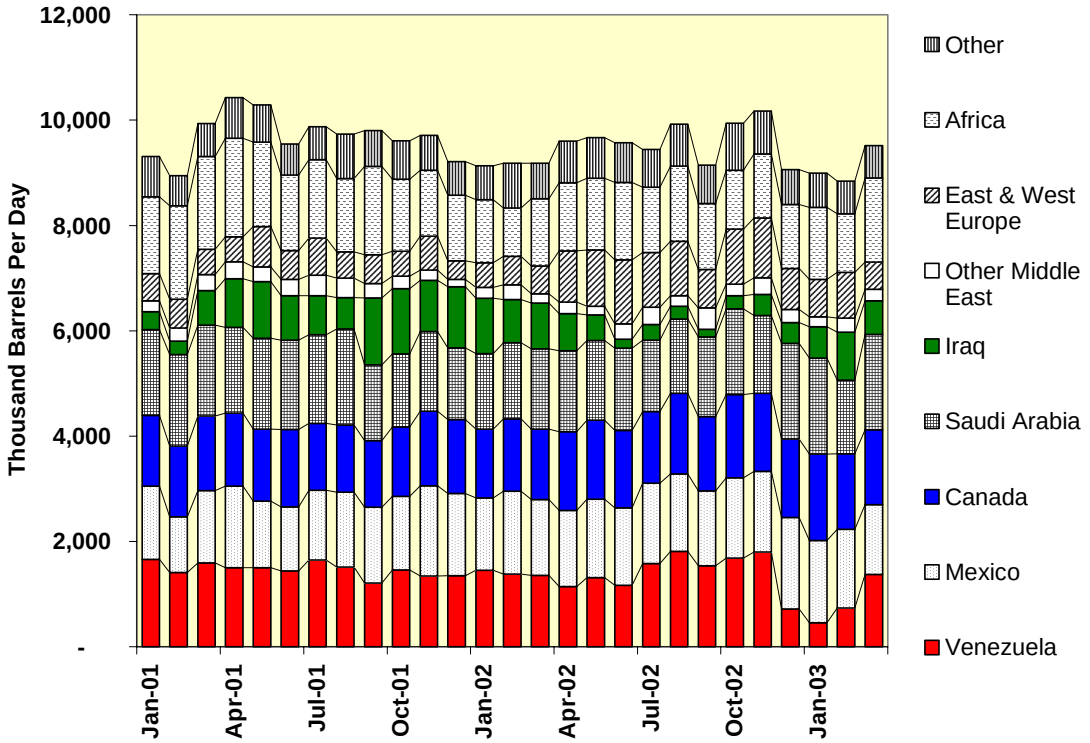
By Joanne Shore and John Hackworth[1]

Introduction

The loss of almost 3 million barrels per day of crude oil production in Venezuela following a strike in December 2002 resulted in an increase in the world price of crude oil. However, in the short term, the volume loss probably affected the United States more than most other areas. This country receives more than half of Venezuela's crude and product exports, and replacing the lost volumes proved difficult.

U.S. imports of Venezuelan crude oil dropped significantly in December 2002 relative to other years (Figure 1). Increases in imports from Mexico and the Middle East, particularly Iraq, helped to cushion the decline, but import volumes were down in general.

Figure 1. Crude Oil Imports by Source Country



Source: Energy Information Administration, Form EIA-814

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Venezuela is only about 5 days away from the U.S. Gulf Coast by tanker. Most of the Venezuelan crude oil used in the United States is heavy, sour quality crude oil,[2] and other nearby sources of similar crude oil, such as Mexico, have little additional capacity to increase supply in the short term. Crude oils from sources somewhat farther away, such as West Africa or the North Sea, are mostly lighter and more expensive than the lost Venezuelan volumes. When the heavier Venezuelan supply was disrupted, these lighter crude oils may not have been economically attractive to refiners previously using the Venezuelan crude oils. While refineries using heavy Venezuelan crude oils theoretically can use some lighter crude oils from areas like West Africa, their refineries are designed to run most economically with the heavier crude oils.

The largest number of refineries in the United States can process light, sweet crude oils, while only the small fraction of refineries that have extensive desulfurization and bottoms-conversion units can use heavy, high sulfur crude oils such as that produced in Venezuela. Refineries that normally run intermediate sour crude oil could run a small quantity of heavy sour crude if they could blend it with light sweet crude oil, but if light sweet crude oil is in short supply, then that option is not available. When a heavy sour production source is disrupted, refiners can run a lighter mix of crude oils, but as in the recent Venezuelan production loss, refiners shift crude oils so that the heavy crude oil refiners still run a relatively heavier mix. Both acquisition of additional crude oils and the shifting takes time, and runs will generally be reduced for a short time.

Ultimately, OPEC was the only supplier capable of increasing production adequately to cover for the losses, and OPEC members like Saudi Arabia, Kuwait, and Iraq have crude oils similar in quality to the Venezuelan crude oils. But OPEC's Middle Eastern crude oils are 30-40 days away, leaving a regional short-term supply gap in the United States.

This assessment of the Venezuelan petroleum loss examines two areas. The first part of the analysis focuses on the impact of the loss of Venezuelan crude production on crude oil supply for U.S. refiners who normally run a significant fraction of Venezuelan crude oil. It explores the extent to which refineries normally using Venezuelan crude were able to acquire alternative supply and how these refineries were affected depending on their affiliation with Venezuela's national oil company, Petróleos de Venezuela, SA (PDVSA), and the quality of Venezuelan crude oils being used. The second part of the analysis looks at the impact of the Venezuelan production loss on crude markets in general, with particular emphasis on crude oil imports, refinery crude oil throughput levels, stock levels, and the changes in price differences between light and heavy crude oils.

[2] Heavy crude oils (API gravity less than about 25 degrees API) have higher percentages of heavy, high boiling range materials that require additional investments in refinery equipment in order to convert those heavy volumes into gasoline, distillate and other products. The "sour" or higher sulfur content of these crude oils also requires extra investments to remove the sulfur. Thus, heavy, sour crude oils sell for a lower price than higher quality light, sweet crude oils.

Impact on Refineries Using Venezuelan Crude Oil

Aggregate Impact on Major Processors of Venezuelan Crude Oil

While a number of domestic refineries use Venezuelan crude oil, 11 accounted for 80 percent of Venezuelan crude oil used in the United States and the U.S. Virgin Islands in November 2002 before the strike. Table 1 compares the total amount of Venezuelan crude oil imported both to the United States and the Virgin Islands, as well as the share of that total these 11 refineries received. The table also displays the dominance of Venezuelan heavy crude oil imported, compared to Venezuelan intermediate and light crude oils. The percentage of Venezuelan crude oil used in each refinery varies, but Venezuelan crude oil was a significant feedstock in each of the 11 facilities.

The strike in Venezuela significantly reduced its crude oil production and exports during the entire month of January. For the 11 refineries of Table 1, imports of light and intermediate crude oils were 378 thousand barrels per day (MB/D) below their November level, and their heavy crude oil imports were down by 566 MB/D. Much of the energy media focused on the loss of Venezuela's heavy crude oil, but a significant volume of intermediate and light crude oil production was also lost. Concern over the loss of heavy crude oil was based on the assumption that refineries using heavy crude oils would have greater difficulty finding suitable replacement volumes and maintaining throughput levels than refineries using lighter crude oils. In the subsequent discussion these issues will be probed in depth.

Table 1. Venezuelan Crude Oil Imports

	Nov-02	Dec-02	Jan-03	Feb-03
United States and Virgin Islands Venezuelan Imports				
Light & Intermediate (>25 degrees API) MB/D	658	200	34	240
Heavy (<25 degrees API) MB/D	1081	519	420	495
Total MB/D	**1739**	**718**	**454**	**735**
Percent Heavy	62.2	72.2	92.5	67.4
11 Refineries Venezuelan Imports				
Light & Intermediate (>25 degrees API) MB/D	412	108	34	201
Heavy (<25 degrees API) MB/D	965	454	399	443
Total MB/D	**1377**	**562**	**433**	**644**
Percent Heavy	70.1	80.7	92.2	68.8
11 Refinery Percent Total VZ Imports	**79.2**	**78.2**	**95.3**	**87.6**

Source: Form EIA 814
Notes: MB/D – Thousand barrels per day; For this paper, light and intermediate crude oils are those with API gravity greater than 25 degrees, and heavy crude oils are those less than 25 degrees API.

Table 2 summarizes the aggregate changes in crude oil imports and refinery inputs for these 11 refineries. For December, when the strike began, their imports were 26 percent or 542 MB/D below their November level, and in January, were 19 percent or 396 MB/D below November's volumes. While imports from Venezuela were down in January compared to December, the 11 refineries had made some progress finding replacement

crude oils. They were also getting a larger share of the Venezuelan crude oil that was available to the United States and Virgin Islands. The 11-refinery share of Venezuelan imports in Table 1 increased from under 80 percent in November and December to over 95 percent in January.

Table 2. Eleven-Refinery Crude Oil Imports and Total Refinery Inputs

	Nov-02	Dec-02	Jan-03	Feb-03
Crude Imports from All Countries (MB/D)	2058	1515	1662	2061
Percent Reduction from November		26.4	19.2	-0.2
Volume Reduction from November (MB/D)		542	396	-3
Refinery Crude Inputs (MB/D)	2444	2182	2040	2328
Percent Reduction from November		10.7	16.5	4.8
Volume Reduction from November (MB/D)		262	404	116

Source: Forms EIA 814 and EIA 810
Note: In addition to crude imports, heavy gas oil and residual fuel imports provide added refinery inputs. Also crude can be moved from other U.S. locations.

As shown in Table 2, total crude oil refinery inputs for the 11 refineries did not fall as much as crude oil imports, declining 11 percent in December and 17 percent in January from November's level. Inventories were used to keep refinery crude oil inputs from falling as much as imports. Refineries also increased the volumes of unfinished oils (e.g., heavy gas oil that is used as input to fluid catalytic cracking units) in December and January, which further helped to stem the decline in refinery output.

Table 3. Eleven-Refinery Sources of Imported Crude Oil

	Nov-02	Dec-02	Jan-03	Feb-03
	Thousand Barrels per Day			
Venezuela	1,377	562	433	644
Mexico	141	318	374	323
Other Latin America	54	47	130	233
West Africa	202	180	288	181
North Sea	117	109	94	226
Middle East	76	247	277	330
Other	58	53	66	125
Total	**2,025**	**1,515**	**1,662**	**2,061**
	Percent			
Venezuela	68.0	37.1	26.0	31.2
Mexico	7.0	21.0	22.5	15.7
Other Latin America	2.7	3.1	7.8	11.3
West Africa	10.0	11.9	17.3	8.8
North Sea	5.8	7.2	5.7	11.0
Middle East	3.8	16.3	16.7	16.0
Other	2.9	3.5	4.0	6.1
Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Form EIA-814

Table 3 shows where the 11 refineries turned to find replacement barrels. In November, the 11 refineries were importing 1,377 MB/D of Venezuelan crude oil, representing 68 percent of their total imports. In January, Venezuela represented only 26 percent of their

imports. Mexico was the largest source of heavy replacement barrels, jumping from 7 percent in November to 22.5 percent in January. From November to February the replacement effort produced large import increases from a number of areas including: Other Latin American countries (3 to 11 percent), North Sea (6 to 11 percent) and the Middle East (4 to 16 percent). The crude oil shifts among source countries for these 11 refineries were not the same as the total U.S. shifts shown in Figure 1, which implies that other refineries were changing crude oil import sources as well to deal with the shortage.

In order to better understand what may have influenced the 11 refineries' crude oil acquisitions, the import data were analyzed from several dimensions. The first dimension was the different qualities of crude oil being used by the affected refineries. Table 4 displays the crude oil inputs in aggregate for the six refineries that process mainly heavy crude oils (i.e., API gravity of 25 degrees or less based on imports received) to refineries processing intermediate or light crude oils (API gravity greater than 25 degrees based on imports received). Contrary to initial concerns that heavy-crude-oil processors would experience larger run reductions, refineries processing light or intermediate crude oils experienced greater reductions in inputs during December and January that those processing heavy crude oils.

Table 4. Eleven-Refinery Crude Oil Inputs

	Nov-02	Dec-02	Jan-03	Feb-03
Six Heavy Crude Importing Refineries				
Refinery Crude Inputs (MB/D)	1,147	1,091	962	1,022
Percent Reduction from November		4.9	16.1	10.9
Volume Reduction from November (MB/D)		57	185	125
Five Light & Intermediate Importing Refineries				
Refinery Crude Inputs (MB/D)	1,297	1,091	1,078	1,305
Percent Reduction from November		15.8	16.9	-0.7
Volume Reduction from November (MB/D)		205	219	-9

Source: Form EIA-810
Notes: MB/D – Thousand barrels per day

The first quarter is normally a time during which refiners shut down process units for maintenance. Based on published reports, refinery maintenance was not a factor for reduced inputs at the eleven refineries. The only refinery with any significant reported maintenance was the Orion refinery in Louisiana, which also was facing severe financial problems.

Table 5 displays the crude import volumes by gravity category. Heavy crude oil processing refineries usually use some lighter crude oils as well as the heavy oils. In November, before the strike, the 6 heavy-crude-oil refineries in this study had crude-oil imports ranging from 80% to 100% of total imports in November. For the other 5 refineries, which import more intermediate and light crude oil, heavy crude oil imports ranged from 0% to 50% of total in November. The 6 heavy-crude-oil refineries maintained import crude volumes better than the refineries using lighter crude oils, even though more of the production loss from Venezuela was heavy crude oil, and light and intermediate crude oils were largely available in the world market. Heavy crude oil refineries' imports fell 108 MB/D in December and 160 MB/D in January compared to

November. The other 5 refineries' imports declined 434 MB/D in December and 236 MB/D in January.

Table 5. Eleven-Refinery Crude Oil Imports

	Nov-02	Dec-02	Jan-03	Feb-03
Six Heavy Crude Importing Refineries				
Crude Imports MB/D	939	831	779	918
Light Crude Imports (> 25 degrees API)	88	200	209	219
Heavy Crude Imports (< 25 degrees API)	851	631	570	699
Percent Reduction from November		11.5	17.0	2.3
Volume Reduction from November (MB/D)		108	160	21
Five Light & Intermediate Crude Importing Refineries				
Crude Imports (MB/D)	1,119	684	883	1,143
Light Crude Imports (> 25 degrees API)	807	533	587	890
Heavy Crude Imports (< 25 degrees API)	312	152	296	253
Percent Reduction from November		38.8	21.1	-2.2
Volume Reduction from November (MB/D)		434	236	-25

Source: Form EIA-814
Notes: MB/D – Thousand barrels per day.

The 6 heavy-crude processors were able to take advantage of nearby Mexican Maya crude oil, increasing Maya crude oil imports by 28 MB/D in December and an additional 122 MB/D in January. The heavy-crude processors also increased their use of light and intermediate imports by over 100 MB/D, and found other heavy imports from Brazil and West Africa. In addition, the 6 heavy-crude processors continued to receive virtually all of the Venezuelan's available export crude oil, most of which was heavy. The 5 refineries processing intermediate and lighter crude oils received very little Venezuelan intermediate or light crude oil, and they had to obtain replacement crude oil from greater distances than Venezuela or Mexico.

Refinery-Specific Impacts

In addition to the type of crude oil imported by the 11 refineries using Venezuelan crude oil, a second dimension was explored -- the import activities of refineries that are wholly or partially owned by PDVSA compared to refineries with little direct affiliation. The results of this analysis are best understood by looking at individual refineries. Table 6 traces the crude oil and unfinished feedstock imports for refineries with ownership affiliation with PDVSA, and Table 7 contains refineries in which PDVSA has no equity position.

The following discussion will illustrate that refineries in which PDVSA has an equity position received virtually all of the crude oil Venezuela exported after the strike. The refineries with no PDVSA affiliation received almost no Venezuelan crude oil. While this implies these refineries may have experienced larger import losses than the PDVSA-affiliated refineries, this was not the case. Even the Sweeny refinery, which lost its heavy crude oil supply from Venezuela, faired as well as the other refineries. As it turned out, the heavy-oil processing refineries without PDVSA equity positions were able to obtain heavy Mexican crude oil.

The refineries with PDVSA ownership (Table 6) had a drop in all crude oil imports of about 24 percent in December and January compared to November. The other non-PDVSA refineries (Table 7), declined 17 percent in December and 12 percent in January compared to November. The group of 11 refineries probably could have found more crude oil imports; however, a number of economic factors likely discouraged them buying higher volumes. For example, first quarter is a low demand quarter, when refinery inputs are normally scaled back. High crude market prices with expectations of prices falling discourage refinery production. Also, heavy-crude oil refineries' less-than-perfect match of available lighter crude oils to their process equipment would have discouraged these refineries from running at high utilization rates.

After the strike in December, three of the refineries wholly or partially owned by PDVSA, Lyondell-Citgo[3] and the two Citgo refineries[4] at Lake Charles and Corpus Christi, continued to receive shipments of Venezuelan crude oil, although at a diminished rate. Of these three refineries, the Venezuelan production loss had the least impact at the Citgo Lake Charles refinery, which normally imports less Venezuelan crude oil and also imports a lighter slate of crude oils than the other two. Citgo found volumes from Angola, Brazil, Iraq, Syria, and the U.K. to replace the Venezuelan imports at Corpus Christi and to keep about the same average gravity. The Lyondell-Citgo Houston refinery imports have one of the lowest average API gravities of any U.S. refinery. This refinery received 100 percent of its import supply from Venezuela in November. After the strike, Lyondell-Citgo brought in some lighter cargoes from various locations, some heavy cargoes from Syria, and even some residual fuel oil or "bottoms," but import volumes were significantly below the November level until February.

The Hovensa refinery in St Croix, U.S. Virgin Islands,[5] is a joint venture between subsidiaries of PDVSA and Amerada Hess. It saw a significant decline in volumes from Venezuela, but acquired heavy, moderately low-sulfur crude oils from Brazil and West Africa. In January, crude imports were about three-fourths of the November level. By February, Hovensa was again getting volumes from Venezuela and had returned to normal import levels. The Chalmette refinery,[6] which is owned jointly by ExxonMobil and PDVSA, largely replaced its heavy Venezuelan crude imports with heavy Mexican crude oil (Maya crude oil). ExxonMobil typically imports large volumes of Mexican Maya crude oil for use in other refineries. Chalmette was the only refinery in the set of wholly or partially owned PDVSA refineries that showed any imports of Mexican Maya crude in the December through February period.

Table 7 shows the other 6 U.S. refineries with significant dependency on Venezuelan imports. In November, the refineries in this group received between 30 percent and 80 percent of their imports from Venezuela. Three of these refineries, Atofina Port Arthur, Flint Hill Corpus Christi, and Murphy Meraux, import crude oils in the intermediate to

[3] For further information see: http://www.lyondell.com/html/lyondell/enterprise_3.shtml .
[4] Citgo company description can be seen at: http://www.citgo.com/AboutCITGO/Operations/Refining.jsp .
[5] For a further description, see: http://www.hess.com/hovensa/jv.htm .
[6] Press release regarding Chalmette agreement between ExxonMobil and PDSVA: http://www.eia.doe.gov/emeu/perfpro/fig33.html

Table 6. Refineries with Major PDVSA Equity Position

	Nov-02	Dec-02	Jan-03	Feb-03
Hovensa: St Croix (50% PDVSA)				
Crude Imports: (MB/D)	495.6	268.3	361.5	477.4
Percent Venezuelan Imports	69.7	24.7	15.2	36.9
Percent Mexican Imports	0.0	0.0	0.0	0.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports (MB/D)	0.0	0.0	14.0	0.0
Average API (degrees)	26.9	31.7	27.7	29.4
Chalmette (50% PDVSA)				
Crude Imports: (MB/D)	96.9	96.4	77.6	101.7
Percent Venezuelan Imports	87.9	35.1	0.0	10.4
Percent Mexican Imports	0.0	51.8	91.5	83.5
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports (MB/D)	0.0	0.0	0.0	0.0
Average API (degrees)	17.9	35.1	22.7	22.0
Lyondell Houston (41.25% PDVSA)				
Crude Imports: (MB/D)	251.4	171.2	167.8	292.5
Percent Venezuelan Imports	100.0	62.1	82.5	83.3
Percent Mexican Imports	0.0	0.0	0.0	0.0
Residual Oil Imports: MB/D	0.0	8.2	20.8	5.3
HGO Imports (MB/D)	0.0	0.0	0.0	0.0
Average API (degrees)	17.8	21.1	18.6	20.0
CITGO: Lake Charles (100% PDVSA)				
Crude Imports: (MB/D)	298.8	268.3	238.8	241.8
Percent Venezuelan Imports	46.7	42.4	64.7	46.9
Percent Mexican Imports	0.0	0.0	0.0	0.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports (MB/D)	0.0	0.0	0.0	0.0
Average API (degrees)	28.5	27.1	25.3	28.4
CITGO: Corpus Christi (100% PDVSA)				
Crude Imports: (MB/D)	141.6	166.7	138.4	160.8
Percent Venezuelan Imports	88.3	72.5	61.4	62.3
Percent Mexican Imports	0.0	0.0	0.0	0.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports (MB/D)	0.0	0.0	0.0	0.0
Average API (degrees)	24.5	26.4	24.5	26.1
Subtotals				
Crude Imports (MB/D)	**1284.3**	**970.9**	**984.1**	**1274.1**
Percent Reduction from Nov	**N/A**	**24.4**	**23.4**	**0.8**
Residual Oil Imports: (MB/D)	**0.0**	**8.2**	**20.8**	**5.3**
HGO Imports: (MB/D)	**0.0**	**0.0**	**14.0**	**0.0**
Total Unfinished Oils (MB/D)	**0.0**	**8.2**	**34.8**	**5.3**
Crude & Unfinished Oils (MB/D)	**1284.3**	**979.1**	**1018.9**	**1279.4**
Percent Reduction from Nov	**N/A**	**23.8**	**20.7**	**0.4**

Source: Form EIA-814
Notes: MB/D – Thousand barrels per day; HGO – Heavy gas oil

Table 7. Refineries without PDVSA Equity Positions

	Nov-02	Dec-02	Jan-03	Feb-03
Atofina: Port Arthur				
Crude Imports: (MB/D)	123.0	76.1	113.8	165.8
Percent Venezuelan Imports	33.2	0.0	0.0	0.0
Percent Mexican Imports	0.0	0.0	0.0	0.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports: MB/D	0.0	0.0	0.0	0.0
Average API (degrees)	39.1	38.0	36.1	39.5
Flint Hill Corpus				
Crude Imports: (MB/D)	152.7	121.3	134.9	186.5
Percent Venezuelan Imports	52.2	48.0	0.0	0.0
Percent Mexican Imports	9.7	19.8	17.1	0.0
Residual Oil Imports: MB/D	7.3	0.0	43.7	7.1
HGO Imports: MB/D	5.0	12.9	6.5	15.8
Average API (degrees)	33.3	32.0	33.0	36.7
Murphy: Meraux				
Crude Imports: (MB/D)	48.6	49.3	33.6	71.9
Percent Venezuelan Imports	64.7	14.0	0.0	0.0
Percent Mexican Imports	0.0	32.7	52.7	0.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports: MB/D	0.0	0.0	0.0	0.0
Average API (degrees)	31.2	33.7	33.8	32.8
ConocoPhillips: Westlake				
Crude Imports: (MB/D)	151.4	114.6	162.5	113.2
Percent Venezuelan Imports	35.1	29.5	0.0	0.0
Percent Mexican Imports	57.4	70.5	62.3	82.6
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports: MB/D	0.0	0.0	0.0	0.0
Average API (degrees)	23.3	24.1	27.4	25.0
ConocoPhillips: Sweeny				
Crude Imports: (MB/D)	169.4	156.4	154.3	237.0
Percent Venezuelan Imports	80.4	33.9	0.0	0.0
Percent Mexican Imports	0.00	35.7	55.5	55.6
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports: MB/D	0.0	0.0	0.0	0.0
Average API (degrees)	20.2	23.0	26.6	26.7
Orion: Good Hope				
Crude Imports: (MB/D)	128.5	125.9	78.8	12.7
Percent Venezuelan Imports	69.5	14.0	0.0	0.0
Percent Mexican Imports	30.5	72.5	95.8	100.0
Residual Oil Imports: MB/D	0.0	0.0	0.0	0.0
HGO Imports: MB/D	68.9	50.1	62.3	37.7
Average API (degrees)	17.5	21.7	22.6	23.3
Crude Imports: (MB/D)	**773.5**	**643.6**	**678.0**	**786.9**
Percent Reduction from Nov	NA	16.8	12.3	-1.7
Residual Oil Imports: (MB/D)	7.3	0.0	43.7	7.1
HGO Imports: (MB/D)	73.9	63.0	68.7	53.4
Total Unfinished Oils (MB/D)	**81.2**	**63.0**	**112.5**	**60.6**
Crude & Unfinished Oils (MB/D)	**854.8**	**706.6**	**790.5**	**847.5**
Percent Reduction from Nov	NA	17.3	7.5	0.9

Source: Form EIA-814.
Notes: MB/D – Thousand barrels per day; HGO – Heavy gas oil. The ConocoPhillips' Sweeny refinery installed a coking unit as a joint venture with PDVSA., but the general refinery operation is governed by ConcoPhillips, so this refinery was placed in the group without PDVSA equity.

light range (low to mid 30 degree API range). Similar replacement crude oils were available for these refineries, but many of those replacement sources had much longer delivery times for cargoes compared to the short-haul Venezuelan cargoes they would be replacing. For this set of three refineries, crude oil imports were 24 percent below November levels in December and 13 percent below November in January. The refinery with the least impact on volume was the Murphy refinery that brought in short-haul intermediate-gravity Mexican crude oils to help replace lost Venezuelan volumes.

The bottom three refineries shown in Table 7 (ConocoPhillips Westlake and Sweeny and Orion Good Hope) normally import heavier Venezuelan crude oils. The clear pattern for these facilities was to replace the heavy Venezuelan crude oil with heavy Mexican Maya crude. But Maya crude oil supply is limited. Mexico did increase production, but the increase fell well below the volume of heavy Venezuelan production that had been lost. Hence, these refineries in part had to lure away this crude oil from other buyers, which would have pushed up the value and price of Maya crude oil relative to other crude oils at least temporarily. For the three refineries, imports were down 12 percent from November in December and January.

The information in Table 7 provides some insight to questions about the flexibility refineries may have if supplies of their usual qualities of crude oil have been interrupted. The average API gravity of all the refineries increased after the loss of Venezuelan crude oil. The gravity increased most at the ConocoPhillips Sweeny refinery, where the average API of crude oil imports rose from 20.2 in November to 26.6 in February and March. This was the result of dropping imports from 80 percent Venezuelan heavy to 55 percent of the slightly less heavy Maya, and of increasing use of lighter crude oils (greater than 30 degrees API). Light crude oil imports to Sweeny rose from 20 percent to 45 percent share of imports.

Refinery inputs can also be replaced by purchasing feedstocks for main conversion units downstream from the distillation unit. These include materials such as heavy gas oil (HGO) for input to fluid catalytic cracking (FCC) units and residual oil or other high boiling range feedstocks that are input to coking units. For the 6 refineries of Table 7, the residual oil and HGO imports increased by over 40 thousand barrels per day from November to February.

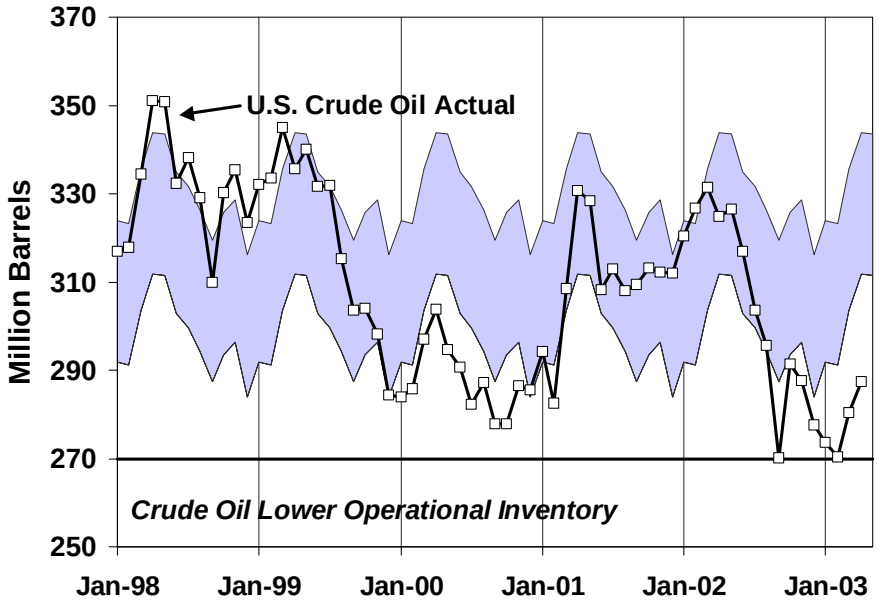
In summary, the refineries in which PDSVA holds equity positions received the available Venezuelan crude oil, which was heavy quality, after the strike began. This still left the PDVSA affiliated refineries far short of their normal Venezuelan crude use. They ultimately used some lighter quality crude oils and ran at lower utilizations than usual. The remaining refineries received increased Mexican Maya crude oil volumes to help replace the lost heavy Venezuelan crude oil, and also processed less volume than typical for that time of year. However, these refiners experienced a smaller decline in crude oil inputs than did the PDVSA group. Thus, while PDVSA affiliation resulted in less loss of Venezuelan crude oil receipts than other refineries experienced, it made little difference on how much crude oil was available to process.

In the next section we will examine the impacts of the Venezuelan production loss on crude and product stocks and the general impacts on the crude prices and crude price differentials.

Impact on Crude Oil Prices

At the onset of the Venezuelan strike and associated loss of crude production, the inventories of crude oil and refined products in the United States were at or below the bottom of the average stock range (Figure 2). In other OECD[7] consuming countries, oil stocks were also relatively low (Figure 3). With the loss of Venezuelan production, crude oil and product stocks fell even lower, particularly in the United States. By the beginning of February, U.S. crude oil stocks had fallen to near 270 million barrels, a level that has been estimated to be "the lower operational inventory" level. When crude oil and product inventories are low and declining, crude prices rise. In this case, the price of West Texas Intermediate crude oil (WTI) increased from $27 per barrel in late November to $37 per barrel in late February.

Figure 2. U.S. Crude Oil Inventories Low Prior to Venezuelan Strike

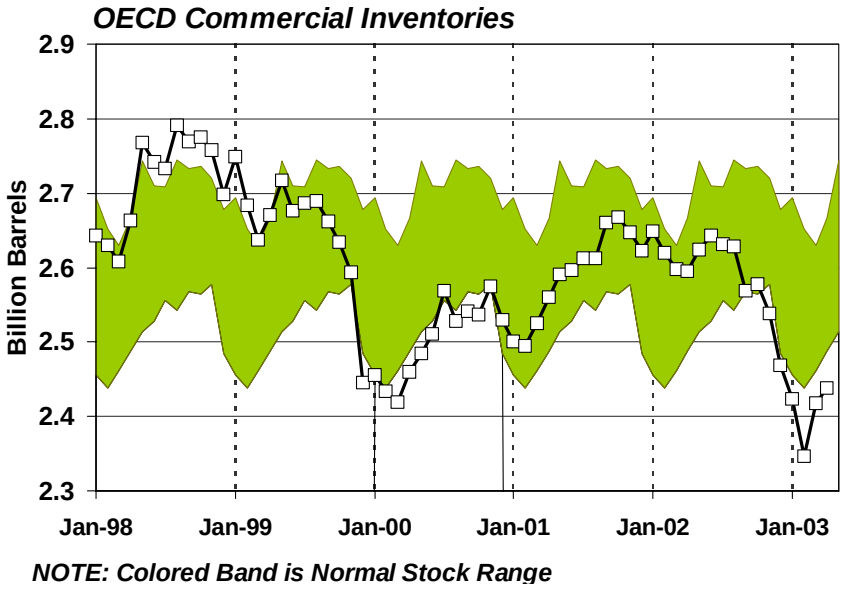


NOTE: Colored band is the normal inventory

Source: Energy Information Administration

[7] Organization for Economic Cooperation and Development (OECD): Members are Australia, Austria, Belgium, Canada, Denmark, Faeroe Islands, Finland, France, Germany, Greece, Greenland, Hawaiian Trade Zone, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States and its territories (Guam, Puerto Rico, and the Virgin Islands). In addition, Czech Republic, Hungary, Poland, and South Korea joined the OECD in 1996.

Figure 3. Venezuelan Loss Reflected Worldwide

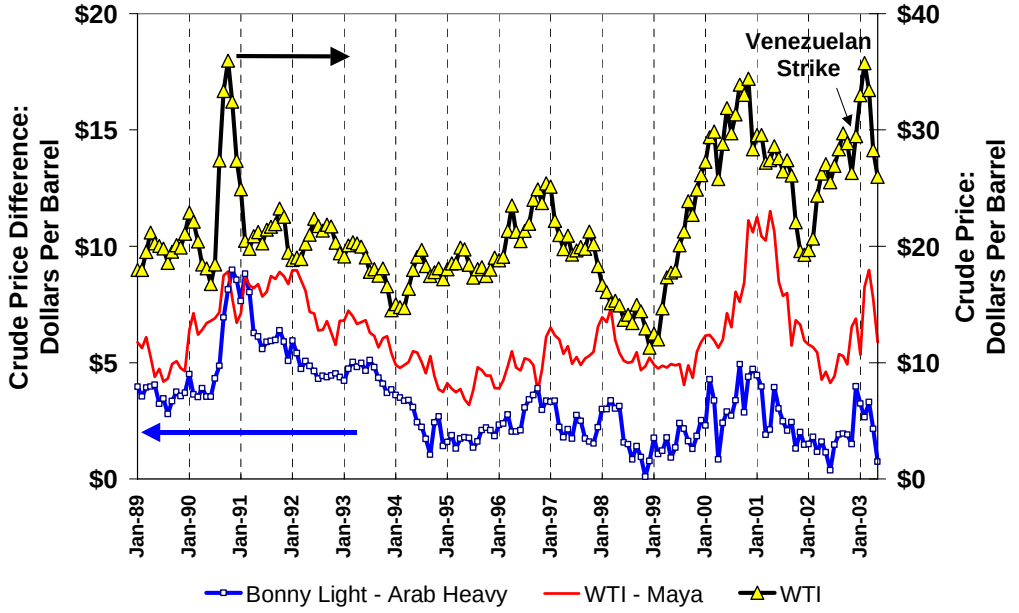


Sources: International Energy Agency Database July 7, 2003

When the average price of crude oils rises, there generally is also a rise in the price difference between light and heavy crude oils. Figure 4 shows the upward and downward movements of both crude prices and the light – heavy crude price differentials. Comparing the plots indicates that the changes in the light-heavy crude price differential may lag the crude price changes.

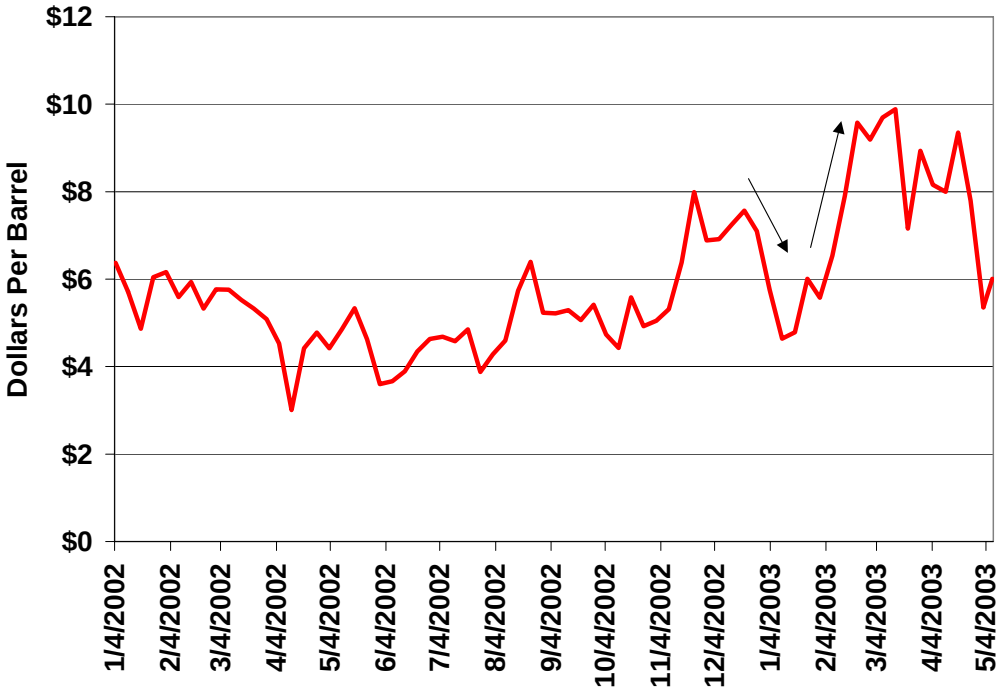
The close relationship between price and light-heavy price differences can be understood by observing the relationship between light product prices (e.g., gasoline and distillate) and tight crude markets. The crude oil market becomes tight when the relative volume of world crude oil production is below world refined product demand for long enough to reduce inventories to a level where there is sufficient market pressure to move prices up. In a tight market, light product prices rise even more than crude oil prices, so that light product margins over crude oil rise. When this happens, the light crude oils, which yield more of the light products than heavier crude oils, become relatively more valuable, and the prices of those light crude oils rise relative to heavier crude oil prices. Even in past situations where supply has become tight because of a supply disruption of intermediate-weight Middle East crude oil, the light-heavy differential has increased. With the loss of Venezuelan production, there was a loss of volume of some of the heaviest crude oils supplied to the world market. The remainder of this section explores how the unusual loss of significant volumes of heavy crude oil may have affected prices and price differentials.

Figure 4. Monthly Average Crude Price and Light—Heavy Crude Price Differences



Source: DRI/Platts Monthly Average Spot Prices

Figure 5. Weekly WTI—Maya Crude Price Difference



Source: DRI/Platts Weekly Average Spot Prices

The monthly average data in Figure 4 show that, as crude oil prices rose following the disruption, the light – heavy differential also increased. But a more detailed look at the light-heavy price differential using weekly data shown in Figure 5 provides added insights. World oil markets had been tightening in 2002 prior to the Venezuelan strike. From October through mid-December, the price of light WTI was rising faster than heavy Maya crude oil, but after the loss of Venezuelan production, the relationship shifted. From the last of December through January, the price of Maya moved up as fast or faster than WTI. Then in February and March there was a return to the more normal pattern of the light – heavy crude price differential increasing with the increase in average crude oil prices. It should also be pointed out that Mexico increased exports of the heavy Mexican Mayan oil. Maya crude production increased from November to February by 227 MB/D (rising from 1,415 MB/D to 1,642 MB/D),[8] which helped to eventually dampen the increase in heavy crude oil price relative to light crude oil. The conclusion from looking at the more detailed weekly data is that if the crude supply loss had been in the intermediate or lighter gravity range of crude oils, then the increase in the light-heavy crude price differential would have been greater than it was in the November 2002 to March 2003 period.

The supply-demand imbalance caused by the Venezuelan production loss lasted for months, keeping crude oil prices elevated. Throughout February, U.S. crude oil stocks stayed near the lower operational inventory level of 270 million barrels, gasoline and distillate stocks declined, and crude oil prices stayed around $35 per barrels for WTI.[9] When crude oil prices are high, there is steep futures market backwardation in prices (i.e., the market expects that two or three months into the future crude prices will be $3-$4 per barrel cheaper than current prices). An expectation of lower crude prices also means that lower product prices are expected. Those expectations make a refiner reluctant to buy crude oil when oil prices are high to build inventory and then process and sell product in the future when crude oil and thus product prices have fallen. Thus, in a high priced market, crude oil is often purchased in amounts sufficient only to meet current demand. Eventually, the situation eases as more supply comes onto the market or as demand falls. Near term prices then fall back, reducing the futures market backwardation and improving the incentives to build inventories.

The combination of individual refineries dealing with the Venezuelan supply loss and the high crude prices that discouraged refiners from buying any crude beyond that needed to meet very short-term needs resulted in lower refinery input levels and stocks falling below what they normally would have been. The high crude prices discouraged all refiners from increasing runs. During a typical January and February, gasoline stocks will build about 10.6 million barrels (range of 8.0-13.5 million barrels from 1995 through 2002). This January and February, gasoline stocks fell by 7.5 million barrels. For the

[8] From the Pemex website: http://www.pemex.com/files/dcpe/evolexporta_ing.pdf

[9] High prices at this time were primarily due both to the loss of Venezuelan production and by concerns over an attack on Iraq by U.S. forces. A production loss of 3 million barrels per day without concerns over additional potential disruptions can increase prices $9 to $15 per barrel alone, which implies the Venezuelan loss was likely the major factor behind the price increase. However, the point is not how much the Venezuelan loss of production increased prices versus Iraq, but how the shift in prices played out over this time period.

gasoline stock build to have been in the normal range, refinery inputs would have had to have been 500-600 MB/D above what they were.

Summary

The loss of Venezuelan crude oil production in December 2002 resulted in a loss of significant volumes of heavy crude oil imports to the United States, but also some light and intermediate volumes from the country as well. The responses of 11refineries that use most of the Venezuelan crude oil imported to the United States were analyzed. The 6 refineries that run principally heavy crude oils reduced their percent of heavy imports from 91 percent in November to 73 percent in January. Also by February, they had replaced about 300 MB/D of Venezuelan heavy crude oil with heavy crude imports from other locations. For the most part, those heavy barrels did not come from additional crude oil production, but were shifted away from other refineries with less preference for heavy barrels than the 6 Venezuelan heavy-crude-dependent refineries.

However, the loss of Venezuelan production was not just about the loss of heavy crude oil barrels. Of the 11 refineries that use most of the Venezuelan crude oil imports, the five that imported mainly intermediate and lighter crude oils lost more barrels of imports in January and February than did the 6 heavy crude oil refineries. Finding replacement crude oils took them longer because their alternative sources of supply were farther away than alternative sources of heavy crude oil. That is, losing short-haul barrels had a greater impact than losing heavy crude oil barrels.

During the Venezuelan supply loss period of December 2002 and January 2003, the 11 refineries with high dependence on Venezuelan crude oil likely did not replace heavy crude imports with as much light and intermediate crude oil as they could handle with their process facilities. Economics dictated by the lower demands of the first quarter and high current crude oil prices may have persuaded the affected refineries that the best option was to limit lighter crude oil purchases and reduce crude runs.

The data indicated that, after the Venezuelan strike, the refineries with PDVSA ownership received all of the heavy Venezuelan crude oil imported and no Mexican Maya crude oil, with the exception of Chalmette, which is a joint ownership between ExxonMobil and PDVSA. The other refineries with little PDVSA affiliation did get Maya crude oil, but no heavy Venezuelan crude oil. It appears that ownership and business relationships affected crude oil acquisition strategies.

By February 2003, Venezuelan imports were still less than 50 percent of their pre-strike levels in November. Yet, the 11 refineries with significant dependency on Venezuelan crude oils imports were back to importing crude oils at their November levels. Enough time had elapsed for alternative sources of crude oils to have arrived.

With the loss of about 3 million barrels per day of crude oil production, and with other producers not increasing volumes adequately to replace this loss, prices rose. The high crude prices discouraged all refiners from increasing runs. During a typical January and February, gasoline stocks will build about 10.6 million barrels (range of 8.0-13.5 million

barrels from 1995 through 2002). This past January and February, gasoline stocks fell by 7.5 million barrels. For the gasoline stock build to have been in the normal range, refinery inputs would have had to have been 500-600 MB/D above what they were.