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REVISITING ALTERNATIVES
TO THE STRAIT OF HORMUZ

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Revisiting Alternatives to the Strait of Hormuz

At the present time, 20 percent of the world's supply of crude oil transits through the Strait of Hormuz. This volume includes oil exports from Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Iraq, and Iran. These countries account for 90 percent of the world's spare productive capacity that could be called upon instantly in an oil supply crisis. Almost all of this spare capacity—approximately 3.5 million barrels per day (b/d)—is in Saudi Arabia.

Consequently, free passage of oil through the Strait of Hormuz is crucial to the world's economy. In recent weeks, the government of Iran has threatened to shut down the Strait amid escalating tensions about its nuclear program and economic sanctions imposed by the United States and its allies. Because Iran's geographic location gives it the power to interdict free passage through this waterway, the regime gains considerable political leverage and influence. Other powers must weigh the costs of a confrontation over the Strait of Hormuz when their policies are in conflict with Iran's. Creating a pipeline system that permits a substantial fraction of the Middle Eastern oil to be shipped to markets from Red Sea ports weakens the political influence of Iran by reducing the amount of oil that transits the Strait of Hormuz.

These threats against passage through the Strait have become more serious in the past 20 years thanks to Iran's significant investments in submarines, missile boats, and mining capability. Iran has two navies; the regular navy that is equipped in a conventional manner and the Navy of the Army of the Guardians of the Islamic Revolution that is equipped for asymmetric warfare. Any shutdown of the Strait would likely be brief given the immense naval and air power the United States maintains in the region. U.S. General Martin Dempsey, chairman of the Joint Chiefs of Staff, notes that although Iran could block the Strait, "we would take action and reopen the Straits" (*Face the Nation* 2012).

In 1999, Eytan Sheshinski, an economist at Hebrew University, and I wrote a paper exploring the possibility of augmenting the capacity of the pipelines across Arabia by using drag reduction agents (DRA) (Brito and Sheshinski 1999). DRAs are chemicals that are injected into pipelines to reduce the friction and to increase throughput in pipelines. An injection of about 30 parts per million reduces the friction factor by approximately 35 percent; an injection of about 70 parts per million reduces the friction factor by approximately 50 percent. This is equivalent to doubling

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the available horsepower. DRAs, however, degrade as they go through pump stations and it is necessary to inject additional DRA after each pump station.

In 2000, I collaborated with the Center for Naval Analysis (CNA) on a detailed study of the feasibility of augmenting the capacity of the pipelines across Arabia by using DRAs (Ewell, Brito, and Noer 2000). Calculations in that study showed that with a relatively low amount of investment, it would be possible to ship as much as 11 million barrels per day of Middle East oil production through the Red Sea.

There are currently two pipelines in Saudi Arabia that could be augmented to greatly increase the percentage of Middle East oil transported to the Mediterranean or from the Red Sea around the Arabian Peninsula to Asia:

1. The East-West Pipeline (Petroline) (52-inch and 48-inch), which runs across Saudi Arabia to the port of Yanbu on the Red Sea. This pipeline system has a designed capacity of 5.1 million b/d. Storage at Yanbu currently totals only 11 million barrels and its port has berthing for 6.6 million barrels per day.
2. The Iraqi-Saudi Arabia IPSA (48-inch) pipeline system that runs from the Iraq border across Saudi Arabia to the port of al-Mu`ajjiz on the Red Sea. IPSA has 1.65 million barrels a day capacity, but has been out of operation since the Gulf crisis. The terminal at al-Mu`ajjiz has 10 million barrels of storage and loading facilities for handling tankers up to 400,000 tons.

In addition to these two pipelines, the Fujairah Pipeline to the Indian Ocean will become operational in 2012. This pipeline is expected to carry 1.4 million b/d of Abu Dhabi production.

The CNA analyzed six options for installing DRA capability in the Saudi pipeline system. These options differ in whether additional horsepower is added or only new pump impellers are installed; and in whether the IPSA pipeline is upgraded, used during the crisis without prior upgrades, or not used at all. The following list briefly describes each of the six options along

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with the total pipeline capacity and approximate cost of each. All costs are rounded to the nearest \$50 million to avoid giving a false impression of precision.

1. Install DRA injectors and extra pump horsepower on both the Petroline and IPSA. This option also requires the additional pipeline segment from Abqaiq, Saudi Arabia, to Pump Station No. 3. We calculate a combined pipeline capacity of 11.0 million barrels per day (MBD) at a cost of \$600 million.
2. Install DRA injectors and new pump impellers on both the Petroline and IPSA. This option also requires the additional pipeline segment from Abqaiq, Saudi Arabia, to Pump Station No. 3. We calculate a combined pipeline capacity of 9.0 MBD at a cost of \$300 million.
3. Install DRA injectors and extra pump horsepower only on Petroline. IPSA is not used at all in this option. We calculate that this would raise Petroline's capacity to 8.3 MBD at a cost of \$350 million.
4. Install DRA injectors and new pump impellers only on Petroline. IPSA is not used at all in this option. We calculate that this would raise Petroline's capacity to 6.8 MBD at a cost of \$100 million.
5. Install DRA injectors and extra pump horsepower on Petroline. Build an additional 48-inch pipeline segment from Abqaiq, Saudi Arabia, to Pump Station No. 3. Use IPSA unmodified to move oil from Pump Station No. 3 to Mu'ajjiz. This option would result in a 9.9 MBD capacity at a cost of \$500 million. It would involve the political cost of using IPSA; however, it would not be necessary to modify IPSA prior to the crisis.
6. Install DRA injectors on Petroline. Install extra pump horsepower on the segment of Petroline between Abqaiq and Pump Station No. 3. Install new pump impellers on Petroline from Pump Station No. 3 to Yanbu. Use IPSA unmodified to move

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oil from Pump Station No. 3 to Mu`ajjiz. This option would result in an 8.4 MBD capacity at a cost of \$150 million. Again, it would not be necessary to modify IPSA prior to the crisis.

All of these options require the purchase and installation of major capital equipment. The lead times for pumps, impellers, and turbines is typically one year to 18 months, and the items must be installed once acquired. The IPSA pipeline requires two to three months of maintenance before it could be brought into operation.

A breakdown of the cost components of these options is given in Table 1 below:

Table 1

Cost of augmenting pipeline						
Millions of dollars (2000)						
	Option 1 11 MBD	Option 2 9.0 MBD	Option 3 8.3 MBD	Option 4 6.8 MBD	Option 5 9.9 MBD	Option 6 8.4 MBD
Horsepower (Petroline)	276	0	276	0	276	50
Horsepower (IPSA)	69	0	0	0	0	0
Impellers/pumps (Petroline)	0	60	0	60	0	49
Impellers/pumps (IPSA)	0	9	0	0	0	0
Abqaiq to Pump Station 3 pipeline	158	158	0	0	158	0
Tankage at Abqaiq	23	23	23	23	23	23
Ras Tanuara to Abqaiq pumps	12	12	12	12	12	12
DRA injectors	2	2	1	1	1	1
Port upgrades	60	40	40	20	40	20
Total	598	302	351	115	510	154

An investment of approximately \$600 million would result in the capability to move 11 million barrels of oil a day across Arabia to the ports on the Red Sea. These numbers and costs reflect the technology of 2000. Conversations with engineers at ConocoPhillips indicate that costs may have gone up, but there have been improvements in DRA in the past decade. The amount of oil that can be carried by the trans-Arabian pipeline may have increased by 15 to 20 percent. It would take detailed calculations to make a definite statement. This investment would mitigate threats to the world economy from closing the Strait of Hormuz. The question that must be addressed is whether the probability that passage through the Strait of Hormuz will be disrupted and the resulting damage to the world economy is high enough to warrant the investment

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necessary to bypass it. A related question is whether it is too late. The conclusion of the CNA study in 2000 was:

The pipeline upgrade has several important strategic benefits. It can assure the world oil markets that the Saudis can be relied on to produce and deliver oil even in the face of instability in the Gulf region, thus reducing the chance that other countries will develop production as a hedge, and thereby protect Saudi oil market share. It can reduce the economic damage to the U.S. in the event of a SoH [Strait of Hormuz] crisis, allowing the U.S. to respond to a closure on a deliberate and risk-minimizing timeline, and may reduce the need for U.S. forces to be based in the region. It can reduce Iranian motivation to close the SoH, and also reduce the political leverage they get from threatening to do so.

Since that study was conducted there have been several significant changes. The price of oil has gone from approximately \$20 a barrel to more than \$100 a barrel. The economies of the world are more vulnerable to an oil shock. As noted, Iran has invested substantially in assets to close the Strait. Another important change has been the relationship between Saudi Arabia and Iran. The tension between these two countries has increased and Saudi Arabia may be more receptive to proposals to augment the trans-Arabian pipelines.

All these changes suggest that the value of alternatives to the Strait of Hormuz has increased. It may already be too late; however, the danger that Iran will be tempted to close the Strait will not decrease. The danger of Iran closing the Strait may increase if Iran acquires nuclear weapons. It would, therefore, be prudent to update existing studies and see if it is feasible and productive to augment the trans-Arabian pipelines at this time.

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