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Risky Routes:
Energy Transit in the Middle East

Robin Mills

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Robin Mills
Dubai, April 2016

Executive Summary

Security of energy exports and energy transit from the Middle East and North Africa (MENA) region, given its paramount importance to the global economy, has long been a concern. Even if worst-case scenarios have not materialized, the region has a long history of disruptions to oil and gas production and transport. Transit through the Gulf and Strait of Hormuz has received most attention, but there are other vulnerabilities, with potential disruption scenarios ranging from small-scale local terrorism and sabotage to major interstate conflicts.

The current, very unsettled political situation makes such threats more salient, even at a time of low global energy prices when markets appear to pay less attention to such risks. The long-term evolution of the region's security architecture is not treated here in detail, but significant issues such as the perception of a reduced U.S. role, a more proactive policy by regional powers, and the greater involvement of Russia and potentially China, all have implications for who may exercise threats to energy security, and who may be the target of such threats.

The vulnerability of oil transport has received the most attention, given its magnitude, but the security of liquefied natural gas exports and vital imports to the Gulf countries are under-appreciated risks. Energy security threats also occur to local production facilities and to transit routes other than the Persian Gulf and Strait of Hormuz.

Approaches to mitigate supply disruptions can be divided into three areas. First, states can construct or upgrade infrastructure to provide alternative export routes, protect existing ones, or provide storage to overcome temporary disruptions. Some bypass infrastructure has been constructed, indicating that regional countries see value in it, but past analysis has stressed new infrastructural mitigation, possibly to the neglect of the wider institutional context. The second approach is for groups of states to devise or strengthen institutions and mechanisms to deal with energy supply disruptions, such as cooperative sharing. Lastly, market means can be relied on to reduce the economic fall-out of disruptions.

It is vital to emphasize that these approaches have to be used together. Infrastructure will not deliver its full benefits, or will not be built at all, without appropriate institutions. To an extent, institutions can also replace the need for duplicative infrastructure. And institutional means to deal with crises have to run together with the market, rather than trying to replace it.

Alliances can be useful for mutual security and coordination. However, they raise the difficult question of whom they are directed against. Mutually-hostile alliances would be a threat to regional energy security rather than a guarantor.

The Gulf Cooperation Council has not made much progress on joint issues of energy export security. MENA countries in general have tended to treat energy security as a national matter, and so multilateral approaches have been lacking.

Increased focus on several areas could improve regional energy security. Improving assessments of the viability of various infrastructure options for reducing vulnerability to disruptions would increase the likelihood of the most beneficial projects being undertaken. Developing institutional arrangements at the MENA (or sub-MENA) level would improve the management of proactive and reactive responses to energy transit crises, as would further progress on cooperative arrangements between regional and energy-exporter institutions and the key international organizations. Lastly, the international community must continue and intensify efforts to resolve the MENA region's conflicts, where improved energy security would be an important though not primary benefit.

Introduction

In the space of 36 hours, eight ships were hit in the Gulf. A Japanese tanker containing oil from the United Arab Emirates was attacked by Iranian gunboats, and two ships were struck by an Iraqi air attack. Iraq's ambassador to the United Nations said, "No country is going to fight a war with its most effective weapon denied action," and the Iranian prime minister announced, "The policy of blow-by-blow will be followed in a calculated way." In response to the escalation, Lloyds Bank said war risk insurance premiums jumped 50 percent, France sent three minesweepers to the Gulf of Oman, and the U.S. president was asked if he would invoke the War Powers Act.

This upsurge of fighting came in 1987, during the "Tanker War" phase of the Iran-Iraq War. Though a large interstate war is not currently being waged in the Middle East, the region is beset by an array of proxy wars and confrontations, local conflicts, state breakdown, and non-state violent groups. These present risks to energy transit from and through what remains the world's premier hydrocarbon producing and exporting area. The broader region is also an important locus of energy transit due to its location between Europe, Africa, and Asia, and hence its command of key nodes.

Lower oil and gas prices, abundant U.S. production, the rise of alternative energy sources, and the recent nuclear deal with Iran, may all encourage perceptions that energy security is less precarious than in the past. With the exception of Libya and Iraq, the major oil producers have not seen severe unrest or conflict, and even in Iraq, the major southern oil-producing regions have not been directly affected.

Yet in the past four years, the revolution in Libya and sanctions on Iran have both had significant, though not catastrophic, effects on the world oil market. The recurrence of similar, or worse, disruptions cannot be ruled out. State failure threatens energy transit routes, as seen in Somalia and Egypt's Sinai Peninsula, with clear risks too from Yemen and perhaps Eritrea. The growth in U.S. oil and gas production may ameliorate, but does not eliminate, the danger from energy supply disruptions. The vulnerability of Europe and Japan remains, and that of China and India has even increased in recent years.

Current low oil prices pose a threat to the economic and social stability of several important oil and gas producers, with unpredictable consequences for their output.

These include Venezuela, Nigeria, Angola, Russia, and, in the MENA region, Iraq, Libya, and Algeria. In the longer term, global energy markets may tighten again, and new sources of exports or vulnerability may emerge.

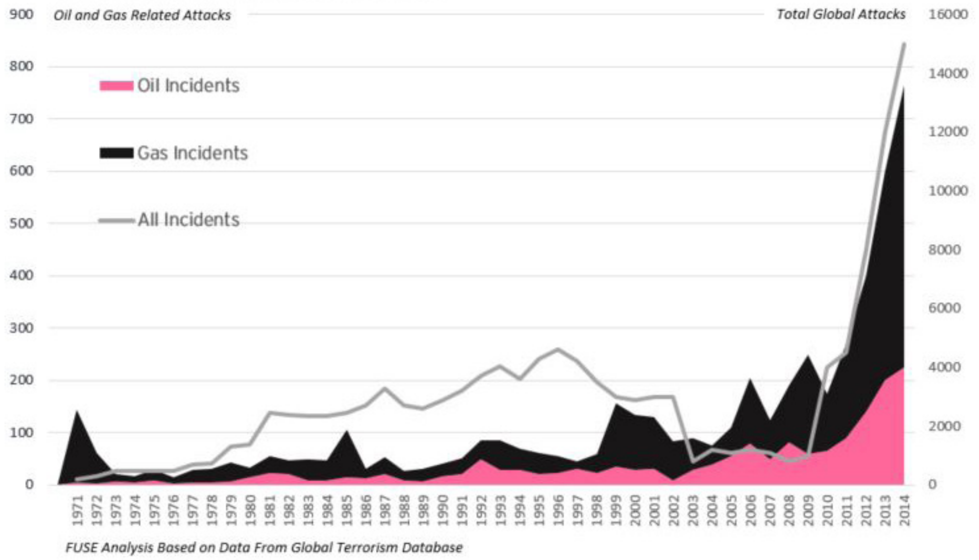
Previous study has tended to concentrate on oil exports, infrastructure fixes, and military scenarios for disruption. There has been particular focus on possible blockades of the Strait of Hormuz, possibly to the neglect of other vulnerabilities.[1] There has also been more attention on the threats to energy-importing countries and less on the impact on the exporting states.

This paper will address the key points of vulnerability in MENA energy supply and transit; the impact of possible energy transit disruptions on MENA states themselves; the price and global economic impact of possible disruptions; and institutional, market, and infrastructural means of mitigating such disruptions.

Key Risks to Energy Transit

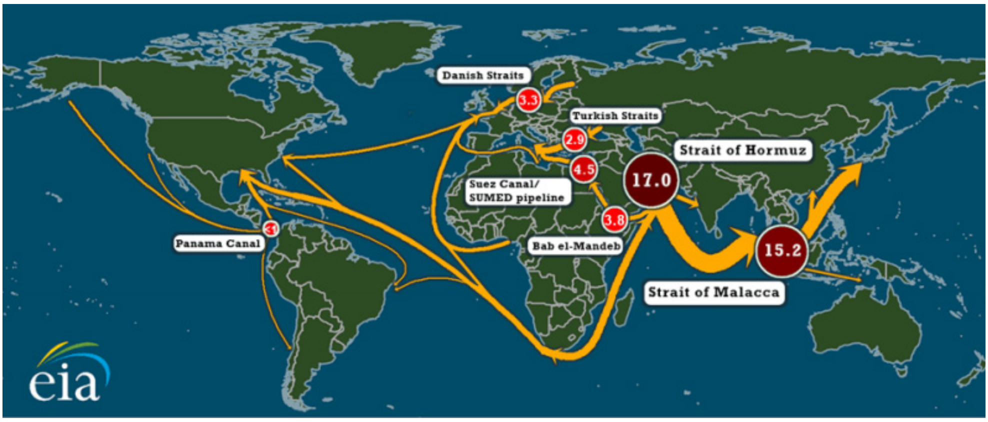
Threats to energy infrastructure occur at all scales, from individual acts of crime, sabotage, or terrorism, up to major regional wars. The MENA region is particularly crucial to the world economy because of the large volumes of oil and gas that flow from and through it. Though some authors point out that energy attracts only a small share of terrorist attacks, recent trends suggest a sharp rise in terrorist attacks related to oil and gas (Figure 1).[2]

Figure 1: Terrorist attacks related to oil and gas[3]



The Energy Information Administration (EIA) has identified a number of global "chokepoints" that control world energy transit. These are geographically-constrained routes, potentially vulnerable to disruption, that carry large volumes of oil, gas, or both (as well as other trade). Of these chokepoints, four occur within the broader MENA region: the Strait of Hormuz at the exit of the Persian Gulf, the Bab el-Mandab at the southern entrance to the Red Sea, the Suez Canal and SUMED pipeline linking the Red Sea and Mediterranean; and the Bosporus linking the Black Sea and Mediterranean (Figure 2).[4] Although not chokepoints, further important lines of energy transit include the Caucasus route from Azerbaijan through Georgia to Turkey and the Mediterranean; the route from northern Iraq, including the autonomous Kurdish region, through Turkey to the Mediterranean; and potentially routes through Iran from Central Asia and from Iran to Pakistan and India.

Figure 2: Global oil transit chokepoints (US Energy Information Administration 2014)



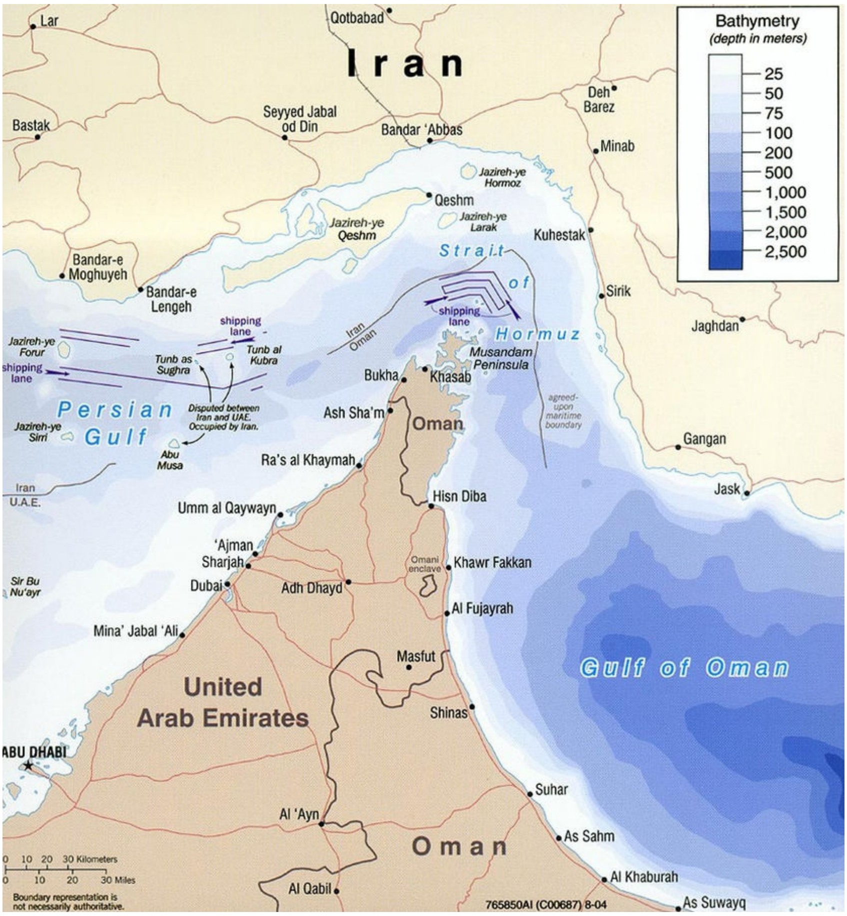
Of these chokepoints, the Strait of Hormuz is by far the most important. It carries the most oil (an amount likely to rise with growing Iranian and Iraqi production), is also a vital route for liquefied natural gas (LNG), and few alternative routes exist (Figure 3). At its narrowest point, the strait is about 30 miles wide, and the two shipping lanes are each about two miles wide. However, the water is deep enough that ships could take other routes if the designated lanes were threatened, and the Strait is too wide and deep to be blocked physically (unlike the Suez Canal, for instance).

The Bosporus carries 2.8-3 million barrels per day (mbpd) of oil from Russia and the Caspian region to world markets.[5] The Bosporus has attracted less attention than some other chokepoints because of Turkey's perceived political stability. Due to weather delays, congestion, and possible safety problems in the narrow and winding channel, which passes through Istanbul, bypass pipelines such as the Burgas-Alexandropoulis (between Bulgaria and Greece) or Samsun-Ceyhan (across Turkey) have been suggested, but these have not progressed. Turkey is obliged to permit free passage of merchant vessels by the 1936 Montreux Convention, but recent tensions between Turkey and Russia have raised the question of whether Turkey might restrict the passage of Russian vessels.

Gas pipeline transit from the Middle East is far less significant than oil or LNG. Iran exports gas to Turkey (and small amounts to Armenia and Azerbaijan) and will likely supply Pakistan and perhaps India in the future. Gas exports from Azerbaijan to Turkey and Europe will be expanded via the TANAP (16 billion cubic meters per year) and

TAP (10 bcm) pipelines. Further gas exports may develop from Iraq's Kurdish region to Turkey and from Israel and Cyprus to regional neighbors, including Jordan and Egypt.

Figure 3: Geography and shipping lanes of the Strait of Hormuz (image via Wikimedia Commons)



North Africa, however, is a major gas exporter to Europe. The Greenstream pipeline carries gas from Libya, and pipelines from Algeria include the TransMed with 33.5 bcm per year capacity through Tunisia to Sicily and mainland Italy, the Maghreb-Europe with 11.5 bcm capacity through Morocco to Spain, Medgaz with 8 bcm capacity directly to Spain, and the planned but not constructed Galsi pipeline, meant to carry 8 bcm to Italy via Sardinia.[6]

Gas transport within the MENA region remains underdeveloped, but Egypt has historically exported gas by pipeline through Sinai to Jordan, Syria, and Israel and may now reverse the pipeline to import regasified LNG from Jordan or gas from Israel. Qatar supplies the UAE and Oman via the Dolphin pipeline, and Iran should start exports to Iraq soon, with supplies to Oman possibly following in some years.

There is also a limited degree of electricity trade within the region and some exports outside it, like the grid connecting the six Gulf Cooperation Council (GCC) members.

Historical Experience

Despite their vulnerability, actual disruptions on the main energy transit routes have historically been limited.

Suez Canal: The canal closed in 1956-57 due to the Suez Crisis and from 1967 to 1975 due to wars between Egypt and Israel, but upon reopening, it again became a crucial line of global trade, including oil and gas flows in both directions. Despite some concerns, the canal has operated normally throughout the 2011 Egyptian Revolution and subsequent unrest; though in July and August 2013, two ships were slightly damaged by rocket-propelled grenades launched by an al-Qaida-affiliated group.[7]

Strait of Hormuz: The strait has never closed, but Gulf shipping was badly affected during the Tanker War phase of the 1980-88 Iran-Iraq War, when 411 ships were attacked, including 239 oil tankers, 55 of which were sunk or damaged beyond repair. The tankers proved harder to sink than bulk carriers or freighters.[8]

Iranian officials have at times made threats to block the strait.[9] In 1984, Iran's ambassador to the United Nations, Saeed Rajaie-Khorassani, warned that "If they [Iraq] do something extremely silly, the Strait of Hormuz will be closed as we are prepared to close it. There will be no shipping from or to the Persian Gulf." As an example of "silly," he suggested Iraqi bombing of Iranian offshore oil installations.

Concerns over Hormuz receded after the war, but were revived under President Mahmoud Ahmadinejad's administration. In 2008, Revolutionary Guards Major-General Ali Jafari said, "Enemies know that we are easily able to block the Strait of Hormuz for an unlimited period.… An attack on Iran will lead to a hike in the oil price, which is something that [Iran's] enemies do not want to see happen."[10] In late 2011 and 2012, as sanctions were intensified over Iran's nuclear program, then vice-president Mohammad Reza Rahimi said that "not a drop of oil will pass through the Strait of Hormuz" and Admiral Habibollah Sayari maintained that closing the strait would be "really easy … But right now, we don't need to shut it as we have the Sea of Oman under control, and we can control the transit." The Iranian Parliament considered a symbolic bill in July 2012 to close Hormuz if sanctions were maintained.

Despite these threats, Iran has never seriously attempted to close the strait, and its own exports and imports would be cut off by such a move. Despite long-held plans, Iran has not developed a possible bypass via the port of Jask, which would seem an obvious preparation. Iran did detain a Maersk cargo ship in April 2015, allegedly over a commercial dispute, and the United States sent a destroyer to monitor the situation. The ship was released on May 7.

In an incident not linked to Iran, the Japanese tanker M Star suffered an explosion in the strait in July 2010, which damaged its hull. An al-Qaida-linked group claimed responsibility.

Indian Ocean: In 2002, the tanker Limburg was rammed by a suicide boat off Aden, killing one crewman, crippling the ship, and causing some oil leakage.[11] In 2008, the Saudi-owned Sirius Star tanker, carrying 2 million barrels of crude oil to the United States, was captured by Somali pirates.

Sudan: Disagreements over payments from South Sudan following its separation from Sudan closed down oil exports by pipeline to Port Sudan.

Iraq: The major oil export line from Kirkuk to Ceyhan in Turkey has been attacked repeatedly, and has been entirely non-operational since March 2014 and the Islamic State group's (IS) takeover of north-western Iraq. Construction crews working the pipeline that imports gas from Iran through Diyala province have also been attacked. The Basra Oil Terminal, Iraq's main export point, suffered a number of attacks during 2004.

Turkey: There have been attacks on the BTC pipeline carrying oil from Azerbaijan to Ceyhan and the Baku-Erzurum (South Caucasus) pipeline carrying gas from the Shah Deniz field in Azerbaijan, while some were claimed by the Kurdish Workers' Party (PKK) separatist group, some were the result of local criminality and theft. The Shah Deniz pipeline was attacked twice in August 2015, with the explosions blamed on the PKK.

Persistent conflict threatens energy security by deterring future investment, a broader impact which cannot be treated in full here. Without access to internal company deliberations, it is hard to identify clear examples of non-investment, and companies may find ways to cope with disruptions in areas where they have already sunk capital. However, insecurity adds to the cost of operations and reduces the circle of companies interested in a given project, hence raising the required rate of return. Oil-field assets in Yemen, for instance, had become almost unsellable even prior to the current war, while many companies have been wary of Iraq, Pakistan, and Afghanistan, perhaps unfairly.

Local grievances and conflicts have led some groups to threaten or attack energy infrastructure as a way of putting pressure on governments or operating companies to provide jobs or pay protection money. Sometimes these attacks may be linked to, or inspired by, transnational terrorist groups, or backed by other states.

In addition to the attacks mentioned above, others have occurred throughout the MENA region. Militants have repeatedly attacked oil and gas pipelines in Yemen and the gas pipelines running through Egypt's Sinai Peninsula. In Libya, ports and oil fields have been blockaded due to a variety of grievances related to jobs and demands for federalism, as well as attacks by militant groups.[12] Algeria's Ain Amenas gas facility was the target of a high-profile attack carried out by al-Qaida-linked militants in January 2013.[13] Some of Syria's oil fields have been taken over by IS and other groups. In 2006, there was a failed terrorist attack on Saudi Arabia's Abqaiq oil stabilization plant.[14] In the Khuzestan region of Iran, pipeline and refinery explosions may have been caused by Arab protestors or outside intelligence services.[15] Frequent sabotage of gas fields and pipelines in Pakistan's Baluchistan province has been linked to Baluch separatists and threatened prospective new pipelines.[16]

Analysis of historical patterns of attack suggests that oil and gas fields, processing facilities, refineries, and export terminals are easier to protect from attack, except in cases such as Syria, Libya, and northern Iraq where security has entirely broken down. Pipelines, electricity lines, tankers, and oil industry personnel are much more vulnerable. Despite advances in monitoring technologies, such as security cameras and drones, it is not possible to physically secure all of these assets. Measures including emergency shutdown valves, stockpiling spares, and having rapid-response teams supported by helicopter can make pipelines and power lines more resilient. Yet, persistent attacks can still render these lines unusable.[17] Modern double-hulled tankers are strong enough to resist a hit from a rocket-propelled grenade, and crude oil is not highly flammable.[18]

Figure 4: Energy security threats in the MENA region

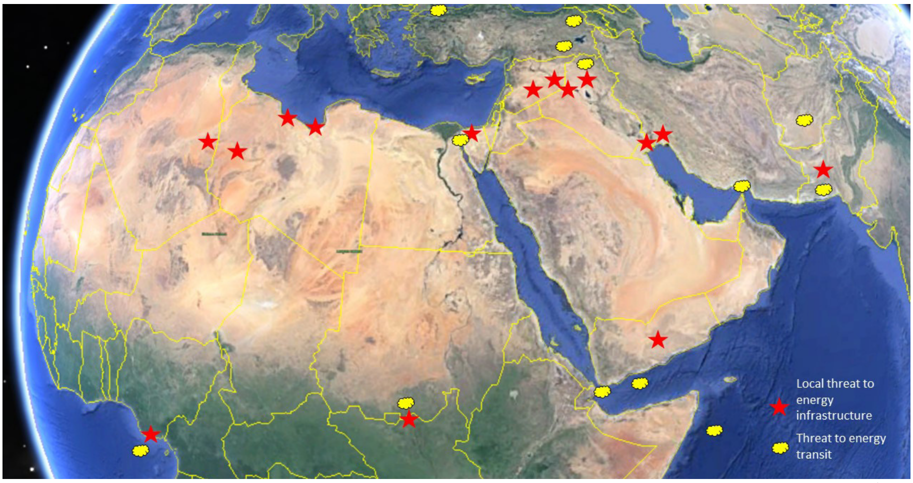


Image source: Author

Disruptions: Scenarios and Economic Impact

There are a wide variety of scenarios for disruptions to these routes. In increasing order of severity, a non-exhaustive list is shown below.

Table 1: Possible Scenarios for Disruption

Situation	Duration	Impact
Isolated acts of sabotage, perhaps including cyber-attacks; labor unrest	Days to years, but episodic	Interruption of hundreds of thousands bpd of oil exports, for short periods
Intensification of piracy	Years, but episodic	Longer shipping times and higher insurance rates
Major attack, disabling a significant pipeline or other facility for an extended period	Days to months	Interruption of hundreds thousands bpd of oil[19] or up to 10 bcm per year of gas[20]
Hampering or blockade of Suez or Bab el-Mandab	Days to years[21]	Large increase in transit times, spike in tanker and insurance rates, and likely reconfiguration of oil and gas trade patterns, partly mitigated by increased use of SUMED pipeline
Hampering of Gulf/Hormuz transit	Days to years[22]	Some disruption to 12 mbpd of crude and oil product exports[23] and 106 bcm per year of LNG exports; may be no supply halt if interruption is short and buffered by stocks
Blockade of the Strait of Hormuz	Days to months[24]	Halt to 12 mbpd of crude and oil product exports[25] and 106 bcm per year of LNG exports; may be no supply halt if interruption is short and buffered by stocks
Complete disruption of a major producer or transit state (e.g. Libya in 2011)	Days to years	Interruption of up to approximately 3 million bpd of oil exports[26] or 41 bcm per year of gas[27]
Major regional war	Weeks to years	Interruption of several million bpd of oil exports and up to 140 bcm per year of gas exports

These scenarios should be seen in the context of the relatively limited conventional military capability of two plausible threats to regional energy security, Iran and IS.[28] The January 2016 severing of diplomatic relations between Iran and Saudi Arabia of course raised concerns, but only led to a small, brief rise in oil prices. Some studies conclude that "the Saudi oil network would be resilient in the face of a concerted attack by one of the most capable actors in the region … threats to regional oil production are overblown" and "Iranian retaliation is unlikely to cause real losses to oil supplies."[29] Another, however, suggests that "simultaneous use of Iran's submarines, anti-ship cruise missiles (ASCMs), fast-attack craft, and swarm tactics in a first strike could inflict costly losses on US naval forces and commercial shipping in the Strait. These assets and tactics, in combination with Iran's large arsenal of naval mines, likely render Iran capable of closing the Gulf for a short while."[30]

The economic impacts of a disruption vary from trivial to severe and from regional to global. The impacts would depend on the nature of the disruption, its extent and duration, the energy source affected, how quickly normal transit could be restored, and on counter-measures and mitigation actions (for example the use of strategic stocks).[31]

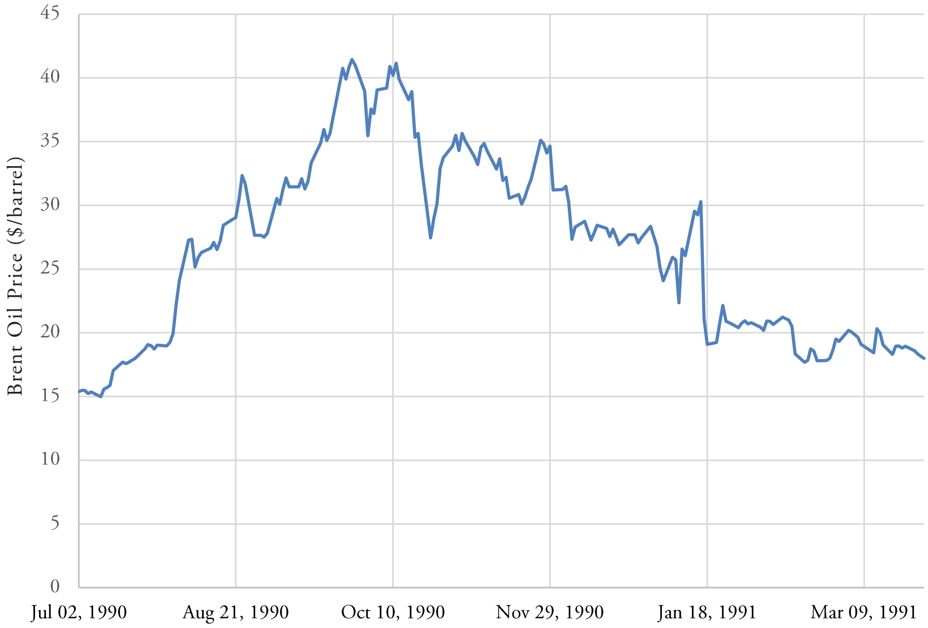
The costs of a disruption are divided between the energy exporters, whose shipments are reduced or halted, and the energy importers, whose energy supplies are either reduced or become more expensive. Given the global nature of the oil business in particular, and the gas industry to an extent, these losses affect consumers everywhere. Of course, other energy suppliers not affected by the disruption will benefit from higher prices, and direct losses at least may be offset by insurance.

Losses can be of the direct, indirect, or opportunity variety. Direct losses are the cost of repairing or replacing damaged infrastructure and of industries being unable to operate because of interruptions to energy supply. Indirect losses are the cost of higher insurance premiums and additional security precautions, even to those not directly affected by the disruption, and the impact of higher energy prices on consumers generally. Lastly, opportunity losses are the use of resources that could have been dedicated elsewhere (e.g. naval assets, bypass pipelines, strategic oil stocks, diversification to higher-cost suppliers) and the loss of future investment, energy output, and export earnings as a result of higher perceived risk levels.

Oil

One major example of oil supply disruption is Iraq's invasion of Kuwait, which occurred on August 2, 1990, and resulted in the loss of about 3.7 mbpd of Iraqi and Kuwaiti petroleum exports (about 5.8 percent of global oil production). Brent oil prices, from the period preceding the invasion until they peaked on September 27, 1990, rose by 108 percent. They then fell as Saudi Arabia and other OPEC countries increased production to compensate for the shortfall and the International Energy Agency (IEA) authorized the release of emergency stocks.

Figure 5: Oil price impact of the Iraqi invasion of Kuwait[32]



Source: Author's data

A more recent example comes from Libya's 2011 revolution (Figure 6). Prices had already been rising in response to the revolutions in Tunisia and Egypt, even though these had no direct effect on oil supply. After the start of major protests against the Gadhafi regime on February 15, 2011, 1.6 mbpd (out of almost 1.8 mbpd of pre-conflict production) was offline by April-May 2011, a loss of about 1.8 percent of global production. Prices rose almost 24 percent from the start of protests to their peak on May 2. Saudi Arabia increased production to compensate, but this only took full effect from June onwards, and on June 23 the IEA also authorized an emergency stock release. (The sharp crash on May 5, 2011, seen in Figure 6, was not driven by Middle Eastern news or other discernible fundamental factors).

The possible impact of a disruption in the Strait of Hormuz (or the Gulf in general) can be gauged from Figure 7. This shows net exports of crude oil, natural gas liquids (NGLs), and the various refined oil products for Iran, Iraq, Kuwait, Saudi Arabia, Bahrain, Qatar, and the UAE.[33] Oman is excluded since its ports are outside the Gulf though it has a short Gulf coastline. The bulk of the Gulf's exports are crude oil, though it also exports some NGLs, liquefied petroleum gas, naphtha, fuel oil, and diesel (gasoil).

The Middle East is also becoming an increasingly important exporter of refined oil products, with the UAE and Saudi Arabia completing new mega-refinery projects over the past three years, and additional ones planned in Iran, Kuwait, and Oman.[34] However, given relatively abundant global refining capacity relative to demand, damage to a regional refinery would have smaller global consequences. Specific areas may, however, be exposed to shortages of refined products. For example, IS's siege of the Baiji refinery in Iraq caused widespread fuel shortages across northern Iraq, particularly of gasoline and jet fuel. The refinery has now reportedly been virtually destroyed by looting.[35]

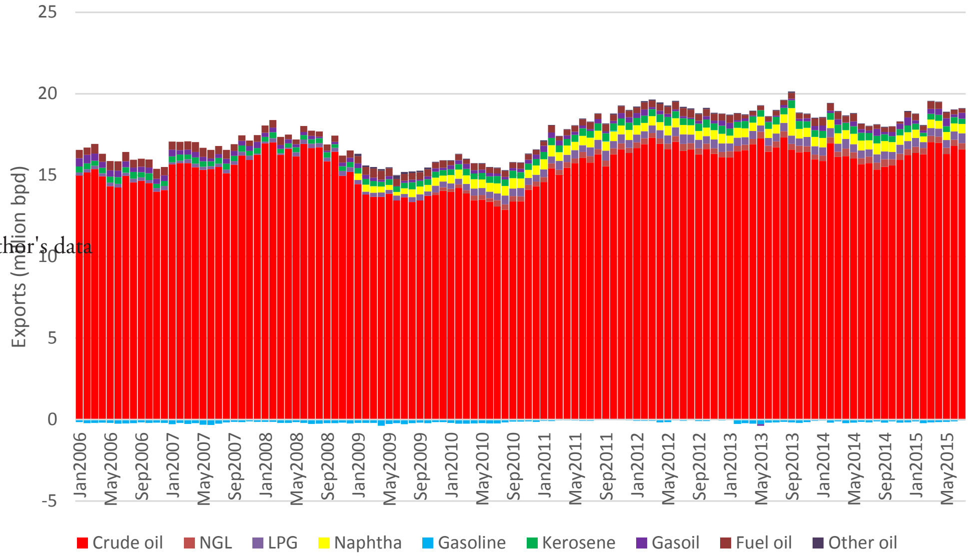
Figure 6: Oil price impact of the Libyan Revolution

Source: Author's data

A blockage of Suez or Bab el-Mandab would be less problematic than a closure of Hormuz. Figure 8 shows the pattern of flows in recent years. Broadly speaking, crude oil, gasoline, and gasoil (diesel) move from south to north, while fuel oil and naphtha move from north to south. Though total oil shipments through the canal of 3.7 mbpd is significant, the net amount of oil moved is fairly small at about 1 mbpd of crude in recent years, and only five hundred thousand barrels per day (kbpd) of all oil (south to north) once oil products cancel out. This amount is decreasing as North American oil imports and European oil consumption both fall. Most crude oil moves south to north via SUMED (1.5 mbpd in 2014). Simultaneous disruptions to SUMED and Suez could include a blockage of the Bab el-Mandab, or serious unrest in Egypt.

In the event of a Suez blockage, tankers could be re-routed around the Cape of Good Hope. This would add 15 days of transit from the Middle East to Europe (transit from Ras Tanura in Saudi Arabia through Suez to Rotterdam takes 19 days) and 8-10 days transit to the United States.[36] The seriousness of this extra shipping time would depend on the state of the tanker market at the time. Reconfiguring refining and oil product trade patterns would also mitigate the impact.

Figure 7: Gulf net exports of crude oil and oil products[37]



Source: Author's data

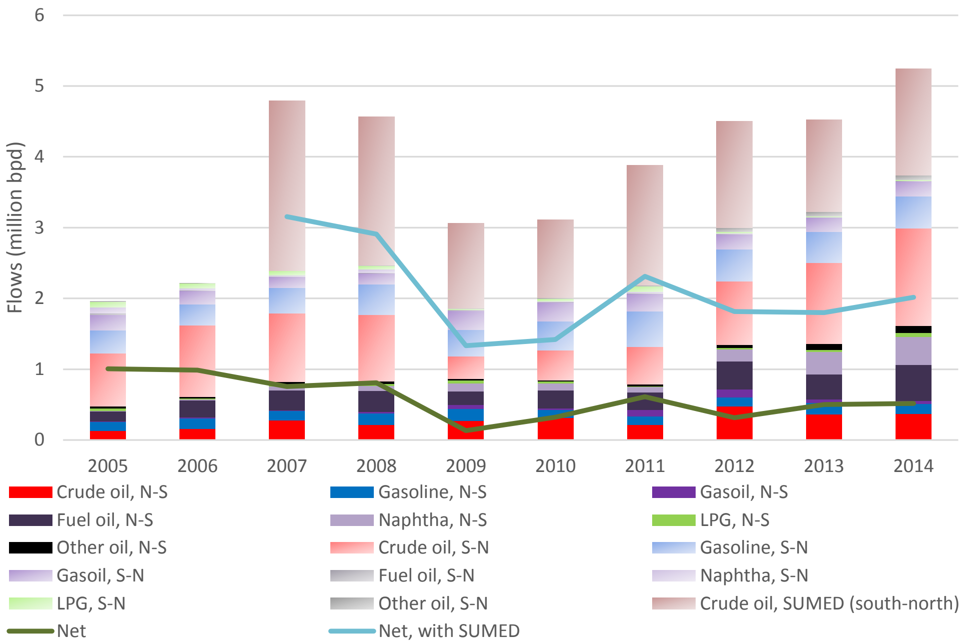
Source: Author's data

Threats in the Gulf would increase the war risk premium for insurance. For a generalized war, risk premiums might amount to 2 percent of the value of the vessel for a 7-day stay.[38] For a $100 million very large crude carrier (VLCC) carrying 2 million barrels of oil at a $50 oil price, the additional insurance would add $1 per barrel to the delivered cost of the oil (2 percent of the value of the cargo). Similar increases would be associated with an actual outbreak of conflict. In 1987, during the Tanker War, premiums for ships calling at Kuwait were 0.375 percent of the cargo value, while at the time of the First Gulf War in 1990, Lloyd's of London raised the war risk premium to 1 percent of the vessel's insured value for all ships calling at Saudi ports.[39] In May 2008, Lloyd's Market Association declared the Gulf of Aden a "war risk area" due to Somali piracy.[40] There are additional costs from hazard payment for sailors, security measures, and re-routing or "fast steaming" through risky areas.

Gas

Most attention has focused on an interruption of oil supplies from the Middle East. Depending on the nature of the disruption, though, there would be other consequences. Perhaps most significantly, a closure of Hormuz would block LNG exports. Based on 2014 figures, 103.4 bcm from Qatar and 8 bcm from the UAE could be interrupted, minus 5.4 bcm delivered into Kuwait and Dubai (inside the Gulf). LNG exports from Yemen (8.9 bcm in 2014) have already been halted by that country's civil war.

Figure 8: Oil flows through Suez and SUMED[41]



Source: Author's data

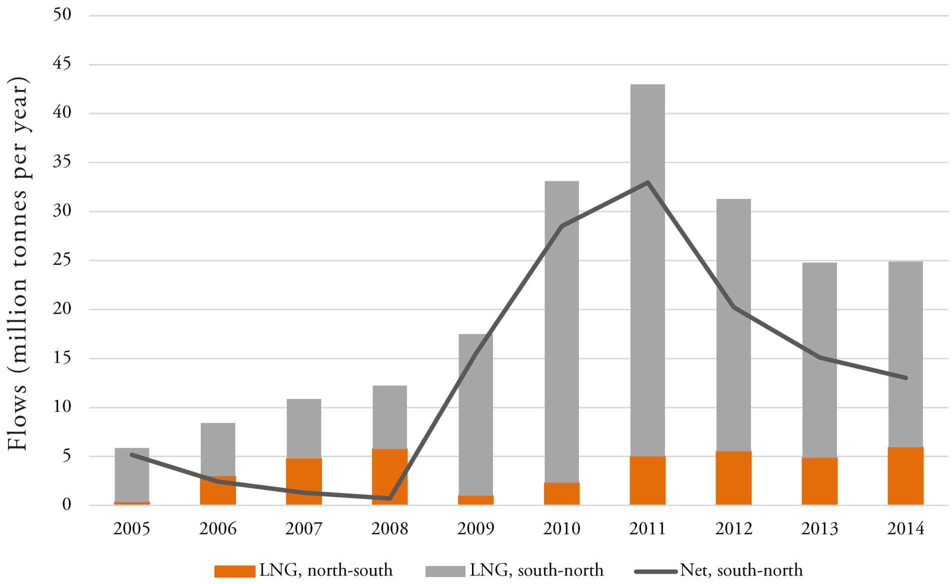
By comparison, the entire global 2014 LNG market amounted to 333.3 bcm with the largest importer, Japan, taking 120.6 bcm, and Europe importing 52.1 bcm. Europe could make up its losses from Russia, but elsewhere the loss of Gulf LNG exports would be impossible to replace from other sources. It would also further exacerbate the loss of oil exports, as many countries would seek to substitute LNG with oil. Such a disruption would be more severe if it occurred during the Northern Hemisphere's high-demand winter period.

The Middle East is currently not an important gas exporter by pipeline, other than Iran, which sent 8.9 bcm to Turkey in 2014 (18 percent of Turkish consumption). However, Iran and Iraqi Kurdistan, in particular, have plans to expand export to Turkey, while

Iran is also working on a pipeline to Pakistan. As mentioned above, the Turkish pipelines are vulnerable to attack, and a pipeline from Iran through Baluchistan would be as well. Internal or intra-regional gas pipelines in Yemen and Sinai have also proven vulnerable.

Figure 9 shows LNG flows through the Suez Canal. Mostly, LNG moves from south to north (primarily Qatari LNG to Europe). LNG flows in this direction have declined since 2011 owing to falling European gas demand and the diversion of cargoes to Japan following the Fukushima nuclear accident. Net northward LNG flows of 13 million tons in 2014 (about 17.7 bcm per year of gas) compare to total Russian exports to Europe of 148 bcm, and total European consumption of about 437 bcm in 2014.

Figure 9: LNG flows through Suez[42]



Source: Author's data

War risk insurance for an LNG tanker would be relatively more significant than for oil. A tanker carrying 3.1 billion cubic feet may cost around $200 million, and a 2 percent war risk premium (i.e. $4 million) would add around $1.30 per million British thermal units (mmbtu) to the delivered cost, around 18 percent of the cargo cost at an LNG price of $7 per mmbtu (compared to 2 percent for an oil tanker).[43]

Other consequences of a disruption

The effect of a disruption on Middle East countries themselves would depend on several factors: whether the disruption affected energy flows only, or others; each country's status as a net exporter or importer of energy commodities and other goods (especially food); whether a country's own energy exports were affected; and each country's financial reserves.

In turn, disruptions to the normal functioning of a country's economy would have both short- and long-term effects on its energy industry, though a skeleton staff may be able to keep facilities running even in the case of widespread evacuations.

Even after a crisis ended, a "risk premium" would likely persist for exports from affected countries, particularly for gas, where supply security and the inflexibility of infrastructure are important issues. This could manifest itself in higher insurance costs, higher financing rates, and particularly for LNG, unwillingness of buyers to make long-term commitments for supply from affected countries. These reputational factors could surface even if the disruption itself was relatively trivial. Saudi Aramco's strenuous efforts to maintain normal service to safeguard its reputation following the Shamoon cyber-attack of August 2012 are instructive.[44]

Risk Mitigation

There are three broad groups of approaches to mitigating the risk of energy transit disruptions: infrastructure, institutions, and market. New or upgraded infrastructure can provide alternative export routes, protect existing ones, or provide storage to overcome temporary disruptions. Institutions can also deal with disruptions, including through cooperative sharing. Market means are likewise able to reduce the economic fall-out of disruptions.

It is vital to emphasize that these approaches have to be used together. Infrastructure will not deliver its full benefits, or will not be built at all, without appropriate institutions. To an extent, institutions can also replace the need for duplicative infrastructure. And institutional means to deal with crises have to run together with the market, rather than trying to replace it.

Other factors that could mitigate the risk (or potential damage) of energy transit disruptions, such as domestic energy policies, further military measures, or the resolution of MENA region conflicts, are well beyond the scope of this paper.

Infrastructure

Additional infrastructure has received the most attention as a way of mitigating supply disruptions. This has mostly concerned pipelines, but canals, roads, railways, and strategic storage are other options. Such infrastructure is useful for mitigating disruptions to energy transit, but of course it is not helpful in the case of an absolute reduction in exports (as during the 2011 Libyan crisis, for instance).

Existing Infrastructure

A number of existing pipelines bypass chokepoints in the region. The SUMED pipeline was opened in 1977 to replace reliance on the Suez Canal. It carries oil north from Ain Sokhna on the Red Sea to Sidi Kerir on the Mediterranean. Its two parallel lines have total capacity of 2.5 mbpd. Also in Egypt, the New Suez Canal expansion opened in August 2015. Although not built for security reasons, it does speed journey times and make some sections of the Canal less vulnerable to blockage. However, it still cannot carry fully-loaded VLCCs or the largest LNG tankers.

Figure 10: Saudi Arabia's Gulf bypass pipelines

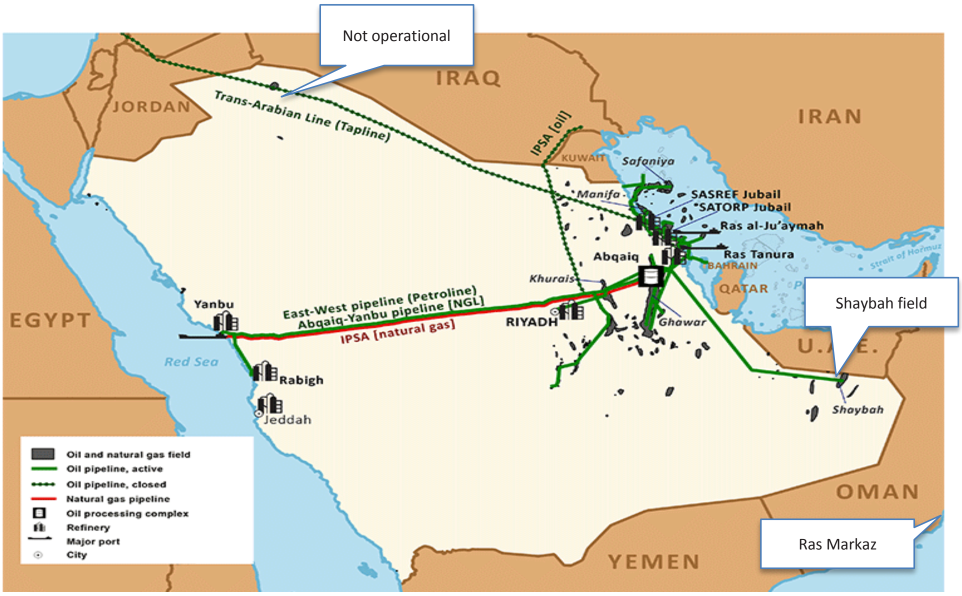


Image source: Author

In Israel, the 42-inch, 254-kilometer long Ashkelon pipeline runs between Eilat on the Red Sea and Ashkelon on the Mediterranean. It has a capacity of 600 kbpd southbound and 1.2 mbpd northbound.[45] There is also an oil products pipeline that can transfer gasoline, jet fuel, and gasoil (diesel) in either direction. The Khurmala-Fishkhabour pipeline in Iraqi Kurdistan connects to the section of the Kirkuk-Ceyhan pipeline running through Turkey to the Mediterranean. It consists of twin pipelines with nominal capacity of 1.6 mbpd. However, it is frequently affected by poor maintenance, sabotage, and theft, and in some places flow has to be bypassed from one pipeline to the other, reducing effective capacity to approximately 4 kbpd.

In Saudi Arabia, Petroline (two parallel lines with 4.8 mbpd in total capacity) and the Abqaiq-Yanbu NGL pipeline (with 270 kbpd capacity) run from the country's east to Yanbu' on the Red Sea. They provide a bypass to Hormuz and the Gulf, but are still vulnerable to disruptions of Suez or Bab el-Mandab. The NGL pipeline supplies petrochemical feedstock to Yanbu and is therefore not used for direct exports. Petroline is not used extensively for crude oil exports, carrying about 2 mbpd, as customers prefer to load in the Gulf for exports to Asia.[46] The Yanbu and Yasref refineries consume a further 625 kbpd of crude, with some of the refined products being exported. The IPSA pipeline, with a capacity of 1.65 mbpd, which originally ran from Iraq across Saudi Arabia, was confiscated after the 1990-91 Gulf War. It was converted to use for natural gas, as required for the power plants in western Saudi Arabia, but it was reported in 2012 that IPSA had been re-conditioned for oil.[47]

Lastly, there is the Habshan-Fujairah pipeline in the UAE with 1.8 mbpd capacity, together with 62.9 million barrels of crude and product storage (by late 2014) at Fujairah. The pipeline, which started operations in June 2012, enables nearly all the UAE's crude oil exports to bypass Hormuz, but it is not far from the Strait and might be vulnerable during hostilities.

Proposed Infrastructure

Most proposed infrastructure has been designed to mitigate the risk of disruptions through the Gulf and Hormuz, given its huge importance and obvious vulnerability. A 2007 study covered a number of options, though the routes through Yemen were unrealistic even when the study was written.[48]

In Oman, the Ras Markaz pipeline, export terminal, and oil storage park, near the port of Duqm, would offer an outlet to the Indian Ocean well away from the Strait of Hormuz, together with buffer capacity.[49] Initial capacity of the tank farm is planned to be 25 million barrels, but it could go up to 200 million, which would be the world's largest. It should be noted that the motivation for the tank farm and terminal is at least as much commercial as strategic. Also at Duqm, a 230 kbpd refinery is being built, and in the future Oman's oil exports will ship from Ras Markaz (instead of Mina al-Fahal near Muscat in northern Oman) via a 440-kilometer, 700 kbpd pipeline from Saih Nihayda in central Oman.

The Ras Markaz terminal could be connected to other Gulf countries, and discussions have already been held. Figure 11 shows a speculative GCC pipeline network, which would connect Kuwait to the Saudi Petroline (discussed below), and Kuwait, Saudi Arabia, and Qatar to a pipeline down through Oman to Ras Markaz. This could be connected to the UAE's Habshan-Fujairah pipeline (which, however, would probably require twinning to accommodate increased volumes). The large Shaybah field in Saudi Arabia lies very close to the UAE border.

Alternatively, tankers from other Gulf countries could unload at Jebel Dhanna in western Abu Dhabi, in order to send their crude via the Omani route. The inclusion of all the GCC countries would prevent any single one being put under pressure (currently Kuwait and Qatar can only export via the Gulf, while Saudi Arabia, the UAE and Oman have alternatives). The Kuwait-Ras Markaz stretch is about 1500 kilometers long and, if sized to accommodate all exports from Kuwait (2.5 mbpd) and Qatar (1.7 mbpd, including condensate and NGLs), plus the 2 mbpd from Saudi Arabia in excess of Petroline's capacity, might cost around $11 billion or so.[50]

In Iraq, the planned 1 mbpd Haditha-Jordan pipeline would reduce Iraqi dependence on the vulnerable Basra terminals and the Gulf and Strait of Hormuz. However, it is unlikely to proceed in the near future given the control of most of western Iraq by IS. The pipeline's terminus at Aqaba also introduces a new dependence on Suez or the Red Sea. In the Kurdistan region, there are plans to expand the Khurmala-Fishkhabour pipeline to 1 mbpd in capacity and to construct an additional 500 kbpd heavy oil pipeline. This would require concomitant repair of the Turkish section of the Kirkuk-Ceyhan pipeline.

The use of drag-reducing agents (DRA) on Saudi Arabia's Petroline, along with additional pumping capacity, has also been considered. A 1997 Baker Institute Study examined various options using a cost for DRA of $30 per gallon, while a 2013 paper suggests $28 per gallon.[51] The most conservative of the options analyzed would raise Petroline's capacity from 5 bpd (as used in the study) to 6.8 mbpd, for a capital cost of $100 million which, at a simple estimate, may be double that today. The largest option raises the combined Petroline plus IPSA capacity from 6.65 mbpd to 11 mbpd at a cost of $600 million (perhaps $1.2 billion today). With Saudi exports currently at around 7 mbpd, this would be more than required, unless Saudi Arabia would also want to carry oil from other Gulf producers (which would require additional interconnections). Another approximately $50 million would be required annually for DRA stockpiles. If the bypass is put into operation, the cost of ongoing DRA use would be just below $1 per barrel.

A pipeline is also planned in Iran. It would run from Neka on the Caspian Sea to Jask on the Arabian Sea and have a capacity of 1 mbpd, facilitating exports from the Caspian and Central Asian producers. The Jask terminal is intended to have 10 million barrels of storage capacity and 3 mbpd of loading capacity.[52] Although not specified, it could be connected to allow some Iranian crude oil exports to be re-routed around Hormuz.

A proposed GCC rail network would include a link from Abu Dhabi to the port of Sohar in Oman, then continuing to the southern ports of Duqm and Salalah. It has been suggested that this could provide an alternative oil export route, bypassing Hormuz, but transporting large volumes by rail is only feasible in the case of an extended emergency, since loading and unloading terminals and tank cars would need to be obtained.[53] A railway could certainly assist, though, with bringing vital supplies into the Gulf.

Infrastructure has also been proposed to mitigate other oil transport vulnerabilities, specifically the Bosporus, including a canal, the Burgas-Alexandroupolis pipeline (which would avoid Turkish territory), and the Samsun-Ceyhan pipeline to carry oil from the Black Sea to the Mediterranean, though this appears shelved due to a lack of Russian interest.[54]

Figure 11: Speculative GCC pipeline network (green are existing oil pipelines; red, speculative new pipelines)

All members of the International Energy Agency (IEA) are required to hold 90 days' worth of imports in strategic storage. Some hold more—Japan, which has considered itself particularly vulnerable historically, has 197 days' worth of crude and products in its national and private strategic stocks combined.[55] Strategic storage for some prominent non-IEA members are shown in Table 2.

Some storage, either for commercial or strategic uses, is held at the end of major bypass pipelines. Fujairah on the UAE's east coast, the end of the pipeline from Habshan, has 49 million barrels of crude and oil product storage for commercial use, though it is available for rent for a strategic stock-holder.[56] Ras Markaz in Oman is intended to have 25 million barrels of crude oil storage in its first phase. Such arrangements provide flexibility and would help smooth over a period of disruption while oil flows were being re-routed. Countries such as Kuwait and Iraq could seek to hold strategic storage at such locations, just outside Hormuz but giving them flexibility to reach any of their usual customers.

Some exporters have arrangements to hold strategic stocks in or near major consuming countries. As noted above, Saudi Arabia and Abu Dhabi both hold oil in Japan, available at first priority to the host country.[57] This eases the cost of holding strategic reserves, since Japan, in this case, only has to pay the cost of the facilities, and not finance the oil until it is needed. The cost to the exporters is small since they can produce oil above their target output level, without depressing prices by putting it immediately on the market (i.e. they incur only small variable production and shipping costs). Having oil close to market would help in the case of interruption to an intermediate chokepoint (e.g. the Strait of Malacca), and it enables a speedier response than re-directing tankers which might take up to a month to reach East Asia.

Table 2: Strategic storage examples by some non-IEA members

Exporters	Importers[58]
Iran: 25-30 million barrels (domestic);[59] leased storage at Dalian Port (China)[60]	India: 37.4 million barrels (2 weeks' imports) at Mangalore, Visakhapatnam, Karnataka; 4 more facilities planned with 91 million barrels at Orissa, Rajkot, Bikaner, and Padur[61]
Kuwait: 2 million barrels held in South Korea[62]	South Africa: 45 million barrels at Saldanha Bay[63]
Saudi Arabia: 3.9 million barrels in Rotterdam; storage at Sidi Kerir, Egypt; 6.3 million barrels in Okinawa, Japan;[64] 33 million barrels at Ras Tanura, Saudi Arabia;[65] 12 million barrels at 5 other sites[66]	China Phase 1: 91 million barrels (full); Phase 2: 170 million barrels (partly full)[67]
Abu Dhabi: 6.29 million barrels in Japan;[68] 60 million barrels planned in Johor, Malaysia[69]	Taiwan: 13-27.6 million barrels[70]
	Thailand: ~85 million barrels (70 days' consumption)
	Singapore: 32 million barrels crude, 65 million barrels refined products (plus commercial stocks)
	Indonesia: 45 million barrels (crude & products) in planning[71]
	Pakistan: ~9 million barrels (20 days' consumption) in planning[72]
	Philippines: in planning

However, the volumes, about three days of total Japanese consumption between Saudi Arabia's and Abu Dhabi's stocks, mean this arrangement would only help in smoothing over a short-lived disruption. The oil is committed to Japan (in this example), so it does not help other importers which do not have such arrangements and which would drive up spot prices by scrambling for scarce supplies in a crisis (as amply seen in 1978-1980).

The UAE has discussed establishing strategic storage in India, a logical idea given its geographic proximity.[73] In 1976 and 1989, there were proposals for a similar arrangement to hold Saudi oil in the United States. However, the U.S. government was apparently not keen, and talks failed over sticking points on priority, profit-sharing, and taxation.[74]

The cost of storing oil varies widely, but typical figures may be $0.25 per barrel per month for salt caverns (like the U.S. Strategic Petroleum Reserve), $0.50-0.75 per barrel per month for tanks, and $0.75-1.40 per barrel per month on a floating tanker. In addition, the capital cost of the oil would add around $0.20 per barrel per month.[75]

Strategic storage of gas is much more costly. Many countries hold underground gas reserves to meet peaks in demand (usually in winter). South Korea has large volumes of LNG storage. A crisis occurring in summer, then, could be met by drawing down gas reserves and hoping to replenish them before winter. Other alternatives, possibly cheaper and easier than storing large volumes of gas, would be to rely on fuel switching to oil (if this were more available) or spare generation capacity using coal. Japan used both these approaches (as well as introducing energy efficiency measures and stepping up LNG imports) when its nuclear power generation was unexpectedly shut down following the Fukushima accident.

Spare production capacity

The U.S. Energy Information Administration defines spare capacity as oil production that could be brought online within 30 days and sustained for 90 days, consistent with sound business practices. With ordinary field developments taking several years to complete, companies do not hold spare capacity, but produce at the maximum economic and prudent rate, unless constrained by government policy.

In the post-1971 period, only Saudi Arabia, and to a lesser extent Kuwait and Abu Dhabi, have ever voluntarily held large amounts of spare production capacity for extended periods. Some countries have involuntarily held spare capacity during periods of political disruption or sanctions, but this was not practically available to the market. Other OPEC countries have had spare capacity for short periods when the organization reduced output to manage the market. Spare capacity reached over 6 mbpd during 2002, and over 4 mbpd in the aftermath of the 2008-9 financial crisis. As of December 2015, OPEC spare capacity was exceptionally low at around 1.5 mbpd and was forecasted to increase only slightly, to 2.13 mbpd by the end of 2016.[76] Nearly all of this spare capacity is held by Saudi Arabia.

Spare capacity in the Gulf producers could, of course, be used to mitigate a disruption in another producer, such as during the Libyan crisis in 2011. It would obviously not be useful in the case of a blockage in the Gulf or Strait of Hormuz, when overall export volumes were constrained. There can also be problems in re-routing vessels, and in mismatches of oil quality, as in 2011 when light sweet Libyan crude had to be replaced by heavy, high-sulfur Saudi crude.

Most major oil exporters have learned from earlier crises that they do not have an interest in extracting the very highest possible price from their customers during a disruption. They wish to preserve long-term demand for their oil, prevent too much effort by importers to "reduce dependence on Middle East oil" (for example, by promoting high taxation, efficiency standards, high-cost unconventional oil, synthetic fuels and biofuels), avoid triggering global recessions, and maintain their political importance as reliable suppliers.

Most countries do not hold large amounts of spare capacity because it is very expensive. Saudi Arabia's recent Khurais and Manifa giant oil-field expansions had costs of $8,300-10,000 per barrel per day, and future expansions would probably be more expensive. At a rough estimate, then, for Saudi Arabia to add another 1 mbpd of spare capacity would cost at least $10 billion.[77] Capacity costs for most other producers would be higher.

The rise of shale oil production in the United States has led to theories that, due to short drilling times, high initial production, and quick decline rates, shale could form a kind of "surge capacity" that could be quickly ramped up in the event of a production disruption elsewhere (presumably if increases in futures prices would allow shale drillers to lock in a suitable profit). Although plausible, this theory has yet to be tested, and it would probably still take some months for the United States (and other shale oil producing countries) to expand production to compensate for a significant disruption. The current backlog of drilled but uncompleted wells could be brought online quickly, but that is probably not a permanent phenomenon.

Value of Mitigation

The value of investment in infrastructure as a mitigation for oil transit disruptions is determined by the probability, magnitude, and duration of the disruption; the effect of a crisis on global oil prices, with and without the mitigating infrastructure; and the baseline capacity, new capacity, and cost of the mitigating infrastructure. The oil export capacity of the country or group of countries being considered and any side-benefits of the mitigating infrastructure during non-crisis periods are also factors.

If a country is hosting bypass infrastructure for other exporters, while it is an oil exporter itself, the calculation is more complicated (for example, the case of a hypothetical Saudi pipeline running across Oman or the UAE). Pre-arrangements would have to be in place to ensure that the transit country did not hold the exporter hostage in case of a disruption, but was reasonably compensated. Facilitating increased exports would hold down world oil prices and hence keep the transit country from realizing the full value of higher prices on its own oil production. Of course, broader strategic and political considerations would be involved, beyond the purely financial ones.

As an illustration, imagine a hypothetical country exporting 2 mbpd. With its export route vulnerable to closure, it has the option to construct a pipeline for $1.5 billion with 2 mbpd of capacity following an alternative route.[78] Should the country's export route be closed for one month, at an oil price of $50 per barrel, it would lose $3 billion in revenues. If there is a 5 percent annual chance of interruption (i.e. an expectation of one disruption during 20 years), then the country would avoid losing $150 million in revenue per year ($3 billion x 5%) by constructing the pipeline. The country's annual rate of return for its investment in the pipeline, allowing for the probability of a disruption, would be almost 8 percent.

In this case, since the alternative route is capable of carrying all the country's exports, a disruption would have no effect on global oil prices. (In reality, a "fear premium" would raise prices even in the absence of a physical disruption to supplies, as shown on numerous occasions.) In addition, such infrastructure has a strategic benefit even if it is never used. By making oil exporters and consumers less vulnerable to threats, it makes it less likely that such threats will be carried out.

Table 3 shows some indicative estimates for the costs (capital and operating) and benefits of various infrastructural mitigation options. All figures are in million U.S. dollars, discounted at 3 percent (assuming these are government-backed, strategic initiatives). The various disruption scenarios are assumed to occur in the middle of a 20-year life for each set of infrastructure, and are discounted to present value accordingly. The calculation of benefits allows for the possibility to export additional volumes of oil at a higher price during the crisis, adjusted for the effect that those additional exports have on dampening the price rise. Short-term price elasticity is assumed at 0.1 (a 1 percent reduction in global oil supply leads to a 10 percent increase in price), with a base oil price of $50 per barrel. Higher base prices would make mitigation options more attractive.

Table 3: Estimated costs and benefits of various mitigation options

			Benefits under Scenario		
		Cost ($ million)[79]	Gulf /Hormuz disruption		Loss of major producer
Mitigation			25% reduction (1 month)	100% reduction (1 month)	3 Mbpd (1 month)
Petroline expansion (from 5 to 6.8 mbpd)		1026	275	2618	0
Petroline expansion (from 5 to 11 mbpd)	Saudi Arabia value only	728[80]	-633	-779	0
Petroline expansion (from 5 to 11 mbpd)	GCC value[81]	2184	-390	5454	0
Spare capacity (1 Mbpd in Saudi Arabia)		13850	0	0	519

Some conclusions can be drawn from these indicative calculations. Spare capacity held by Saudi Arabia (or another Gulf producer) does not help in mitigating disruptions in the Gulf or Hormuz, since the additional production could not be exported. Conversely, pipeline bypass routes around Hormuz do not help in mitigating the loss of a major producer; only spare capacity (or strategic stocks) can help. These valuations are from the point of view of Saudi Arabia, which already has substantial bypass capacity via Petroline. Bypass capacity is much more attractive for Iraq, Iran, Kuwait and Qatar, whose exports have no or very little ability to avoid the Gulf and Hormuz.

The expansion of Petroline to 6.8 mbpd, which would allow almost all Saudi exports to transit via the Red Sea, appears attractive. Over a 20-year horizon, at a 40 percent chance of a 1-month total blockade of Hormuz, or a cumulative 5 months of smaller (25 percent of flows) disruptions, it would pay for itself. The expansion of Petroline to 11 mbpd is not attractive to Saudi Arabia itself at its current production capacity, since most of its exports can already bypass Hormuz. Additional bypass capacity, used by other GCC producers, would dampen a price spike during a crisis and so reduce Saudi Arabia's windfall earnings. However, considered on a GCC basis, the additional bypass capacity would be attractive, economically justified by a 40 percent chance of a 1-month total blockade. The value of this expansion would be negative in the case of a 25 percent disruption to Gulf exports, since Saudi Arabia loses more from lower prices than its GCC colleagues gain from expanded exports.[82]

Figure 12: Sailing time from Ras Markaz storage facility (Oman)

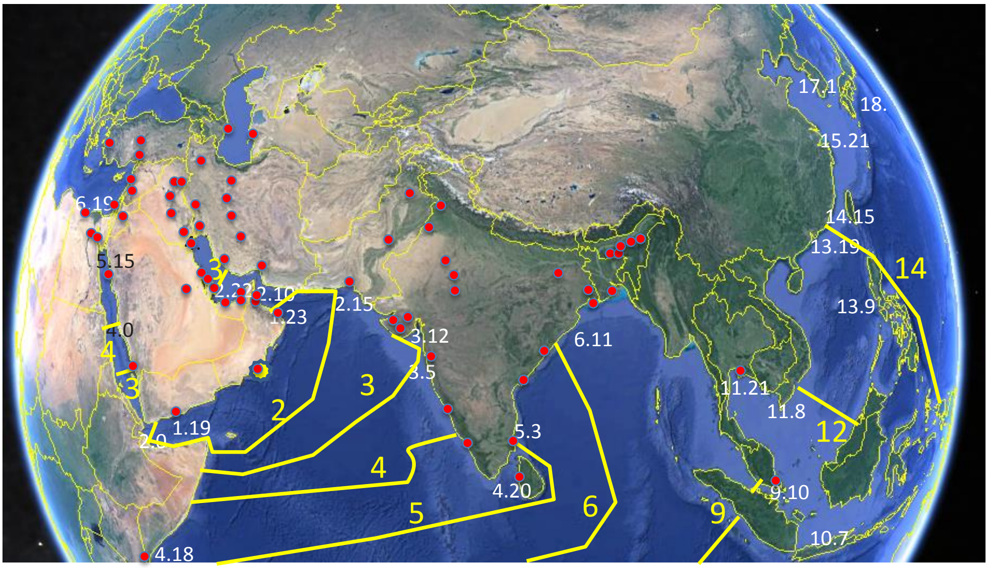


Image source: Author

Sailing time in days and hours

Refineries

The maintenance of spare capacity is expensive, but disruptions to producers are also much more common than reductions of Gulf or Hormuz transit. A loss of 3 mbpd during a cumulative 27 months over a 20-year period would make it economically attractive for Saudi Arabia to hold 1 mbpd of spare capacity. Historic disruptions to production from Iran, Iraq, Libya, Nigeria, Venezuela, and elsewhere amount to more than this level.

These calculations are shown for the oil exporters, since they are the ones who would probably host, build, and finance this infrastructure. However, the main value, of course, is to the oil importing countries, by dampening price spikes and reducing the amount of oil exports lost during a disruption.

Of the infrastructure outlined above, there are several items of note. Some level of strategic storage is now almost universal for major oil importers, and many exporters. Additionally, a number of bypass options have been built, indicating that regional states see value in them. However, some apparently technically and economically viable options have not been built, particularly those requiring cross-border cooperation and where the full value of the bypass does not accrue to the transit state. Indeed, as most of the value of bypass infrastructure accrues to the oil consumers, they might therefore be reasonably expected to contribute to its costs. Lastly, some (possibly large) part of the strategic value of a bypass lies in its optionality. It is not necessary that it ever be used: the mere fact of its existence is a reassurance to consumers and a deterrent to any party which might otherwise attempt to block a main export route. The creation of bypass infrastructure also protects smaller countries against attempts to threaten them selectively.

Gas

Gas transit is more problematic than oil because the high cost of gas transportation makes alternative routes more costly to construct. LNG can only be carried by tanker and thus there is no plausible way of obviating Qatari dependence on Hormuz, for example. Proposed Iranian LNG plants would also be built on the Gulf. The possibility of Iran exporting gas to Oman for conversion to LNG via the Sultanate's under-utilized liquefaction plants are only a small exception.

Major LNG customers Japan, South Korea, and Taiwan are entirely dependent on imported LNG for gas supplies, and bought 57 percent of world LNG in 2014. LNG storage facilities are a partial, but again expensive, solution, and the largest storage, in South Korea, is used to smooth out seasonal demand fluctuations. Underground gas storage is viable for countries with suitable geology, but is also mostly used on a seasonal basis.

Additional pipeline routes may be individually vulnerable, but they at least diversify supplies and markets. However, the very underdeveloped state of international pipelines in the broader Middle East region does not give much scope for diversions or alternatives, unlike, for instance, eastern Europe. Even within the GCC, there is only one significant gas pipeline: the Dolphin line from Qatar to the UAE and Oman.

A number of proposed pipelines, mostly from Iran to its neighbors (Iraq, Oman, Turkey, and, possibly in the future, the UAE and Kuwait), would diversify routes as well as deepen mutual interdependence, the best guarantee of energy security. The proposed Iran-Pakistan-India pipeline has not proceeded, but the Iran-Pakistan section seems likely to go ahead, while India may build an undersea pipeline (SAGE) from Iran via Oman. This improves India's individual security but does not use energy as a building block of cooperation with Islamabad.

In the event of disruption to gas supplies from North Africa, Europe has the option of sourcing more pipeline gas from Russia, or more LNG from the global market via under-used LNG terminals. Turkey is seeking to diversify gas supplies, including from Azerbaijan, Iraqi Kurdistan, and a possible new pipeline from Russia. However, the assistance of Russia in a crisis might also depend on the market and political context.

In countries with under-used capacity, gas shortages could be compensated by more use of coal in power generation. Oil can also be used, though expensively, and obviously in the case of a disruption in the Gulf, both LNG and oil would be affected.

Institutions and Diplomacy

Local Conflict Resolution

As noted, local grievances and conflicts are a driver of persistent low-level disruptions in energy transit in some regions. They can become severe to the point of crippling the industry, as in Yemen, Libya, and Sinai in recent years, as well as in other countries such as Nigeria. Such energy disruptions are difficult to resolve for several reasons. Pipelines in remote regions are difficult to guard effectively, and long pipelines cross the territory of many different tribal or ethnic groups and local communities, making it difficult to identify the perpetrators of attacks.[83] So-called protection money can become institutionalized, which runs the risk of inviting further attacks or spurring conflict with other groups who are not receiving money.[84]

It can be hard to distinguish between genuine grievances, extortion, the theft of oil for monetary gain, and terrorist attacks with political motives. Additionally, the oil industry is not a large employer and is not capable of resolving demands for employment from large numbers of local people. This is particularly true in underdeveloped regions where they may not have the requisite skills to fill most industry positions. Nevertheless, resolving local conflicts, addressing the causes of political discontent, and spurring genuine economic development, are essential. Purely security-focused solutions can guard discrete facilities but are unlikely to be successful in securing long transit routes.

Cooperative Responses

Cooperative responses between different importing countries, and between importers and exporters, are necessary to tackle energy supply and transit disruptions. Such responses assist MENA energy exporters in maintaining their reputation as reliable suppliers, and in extreme cases would reduce the risk of major energy importers using coercive methods (whether diplomatic, economic, or even military) to compete for limited supplies. The appropriate responses to a crisis would depend on whether it were a loss of supply, an interruption to transit, or some other kind of disruption. An interruption due to an out-of-region event or an accident or natural disaster would also have different implications from one caused by a security disruption within the MENA region, where politics may well prevent a fully cooperative response.

Importers and exporters (in particular, IEA and OPEC members) need to understand what responses the other group would employ in a crisis, so they can plan their own responses and avoid mutual suspicion. Crises also need to be distinguished from normal market shocks, in which prices rise or fall and importers necessarily lose while exporters gain or vice versa.

The IEA has cooperative sharing mechanisms among its members. These are meant to assure fair sharing of available supplies and strategic stocks in the event of disruption, and to prevent hoarding and export bans. They in principle also prevent some consumers from "free-riding" on the costly strategic stocks held by others.

However, the IEA's mechanisms, and those for the United States' Strategic Petroleum Reserve, have been criticized for being politicized and for relying too much on outdated views of the oil market and definitions of disruption based on physical shortages rather than prices. It has been argued that the IEA's procedures have been useful in small crises but are flawed in serious ones.[85]

A major weakness of the IEA mechanisms is that Asia's largest consumer, China, and its third (soon to be second) largest, India, are not members. The Association of Southeast Asian Nations could be a possible coordinating body for southeast Asian countries. For Eurasia, the Shanghai Cooperation Organisation could play a role, and it includes an "Energy Club," but it has tended to be seen in opposition to, or at least as an alternative to, Western institutions such as the IEA. Its diverse membership groups major energy importers (China, and acceding states India and Pakistan) with exporters (Russia, Kazakhstan, and observer Iran) and key transit states, but this could also hamper effective crisis responses.

John Mitchell stresses the crucial importance of preparing for intra-Asian cooperation ahead of a crisis, with the potential for short-term disruption as markets adjust and governments take possibly counterproductive measures.[86] For example, in the case of a reduction in Gulf exports, would the major producers allocate limited supplies pro-rated at pre-crisis levels, negotiate on a bilateral basis, or favor certain customers and their own part-owned overseas refineries? Would some major Asian customers forbid oil product exports, damaging countries which have inadequate refining capacity?

Fatih Birol made his first overseas trip as the head of the IEA in September 2015 to China instead of to an IEA member country, saying he would "do everything possible" to deepen cooperation with China.[87] Bringing China into the IEA's emergency response mechanism would be a major step towards preparedness for a crisis. As a positive step, in October 2015, it was announced that Indonesia, along with China and Mexico, would become associate members of the IEA, opening up more cooperation on data sharing and coordination on strategic stocks.

A further step could be to improve the clarity and timeliness of oil data—on supply and demand as well as stocks of crude oil, the various refined oil products, and gas.

This would be vital for planning responses in case of disruptions, and avoiding panic hoarding. The International Energy Forum (IEF), based in Riyadh, has through its Joint Organisations Data Initiative (JODI), greatly improved the availability of data on a monthly basis. But Chinese figures in particular are very opaque and demand can only be inferred. Data on inventories outside the OECD is also very limited.

A further weakness of the current international energy institutional architecture is that several major oil and gas producers and consumers—not only China and India, but notably Russia, Mexico, and Brazil—are members of neither the IEA nor OPEC. As the major Middle East producers are of course not IEA members, the IEF is a useful forum for bringing members of OPEC and the IEA together.

Individual exporting and transit countries should plan for emergencies and disruptions to supplies, including assigning responsible parties. But cooperative responses by exporters would also help in responding to an emergency. The GCC or OPEC may play such a role, though the GCC is limited by its restricted membership, and OPEC by the divergent geographies and interests of its members. The Organisation of Arab Petroleum Exporting Countries is more uniform than OPEC but is less active and does not include Iran or Oman.[88] OPEC has, of course, agreed (usually under Saudi leadership) to increase production at various times when supplies were disrupted, as during Iraq's 1990-91 invasion of Kuwait and the 2011 Libyan Revolution. Joint exercises or "war games" could be held to simulate the impact of a disruption.

In gas, the Gas Exporting Countries Forum, with its headquarters in Doha, groups major gas exporters including Iran, Qatar, Russia, Algeria, Egypt, Libya, the UAE, and others. It therefore represents the interests of gas exporters but could again be a venue for considering emergency measures. However, a disruption affecting Russia, for example, would probably not affect Qatar, and vice versa, hence the members can have divergent interests. Some are mainly pipeline exporters and others are more concerned with LNG.

The Energy Charter Treaty (ECT) has varying levels of participation from 54 countries, primarily the EU and all the former Soviet Union states, plus Australia, Japan, Mongolia, Norway, and Turkey. Its commitments largely cover energy trade, investment, and dispute resolution, but it does have a draft protocol on energy transit, obliging countries to facilitate energy transit across their territory. Transit states benefit relatively little from constructing pipelines across their territory, with fees of typically $1-2 per barrel or less, while bearing all the security and environmental risk, so cooperative institutions can be important in encouraging them to permit such projects.[89] Other than Turkey, the ECT does not cover most of the main transit countries that are the subject of this paper. Its provisions could possibly be a guide to similar arrangements for the Middle East, but the difficulty that the EU and Russia have found in reaching agreement indicates how challenging this can be.

Alliances

Diplomatic and security alliances have a role in improving regional energy security. The United States, and before it the United Kingdom, have of course had a long military presence in the Gulf (and Suez, in the case of the United Kingdom).

The GCC, grouping Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE, was founded in May 1981, following the Iranian revolution and the outbreak of the Iran-Iraq War. It has recently taken a more active regional security role. However, its members have differed in their approaches to some key political challenges.

Oman, which controls Musandam and hence the Arab side of the Strait of Hormuz, has a special position. It also has a long Indian Ocean coastline, with the geographic potential for alternative export routes. Though a pro-Western country and GCC member, it has also maintained good relations with Iran and acted as an interlocutor in regional conflicts.[90]

The GCC has not made much progress on joint issues of energy export security, for instance a common gas grid or shared bypass oil pipelines are yet to be developed, although its linked electricity network shows that cooperation is possible. Countries in the GCC, as in eastern Europe and northeast Asia, have tended to treat energy security as a national matter, so multilateral approaches have been lacking.

Alliances, however, raise the difficult question of whom they are directed against. Iran is clearly seen currently by the GCC as the pre-eminent external security threat, particularly given the January 2016 breaking of Saudi-Iranian diplomatic relations and the proxy confrontations in Syria and Yemen. Mutually-hostile alliances would be a threat to regional energy security rather than a guarantor.

The possible evolution of the region's security architecture is too broad a topic for this paper to cover more than briefly. The United States has played the role of guaranteeing the free flow of oil supplies from the region since at least the 1970s. The U.S. presence may have contributed to instability as well as allaying it, but it has dealt with threats to free navigation in the Gulf, as well as excluding Soviet influence and preventing the emergence of a regional hegemon. The future regional security roles of the United States, Russia, regional powers such as Iran, Saudi Arabia, and Turkey, and growing oil importers from the Gulf (notably China and India), are all uncertain but important.

Robert Kaplan has suggested a "NATO of the seas" for the Indian Ocean, comprising Oman, South Africa, India, Pakistan, Singapore, and Australia, with the United States providing naval and logistical support. But he points out that the ocean's sub-regions—most relevantly for this paper, the Persian Gulf and the Gulf of Aden—have their own threats and players.[91]

Economic interdependence, outside the scope of formal institutions, in principle should help to build energy security. No country wishes to be held hostage by a potentially hostile neighbor, but projects designed to build "energy independence" may actually be harmful to multilateral energy security.

Infrastructure funding

Energy security projects often require large amounts of capital and have very long time horizons as well as uncertain payoffs (particularly when they function as a kind of national insurance against unlikely but devastating events). This suggests a crucial role for government funding, while being aware of the dangers of rent-seeking, the impact of special interests, and corruption.

As discussed above, the value of mitigating infrastructure is not always positive for an oil exporting country, particularly when taking its sizeable cost into account. The bulk of the value accrues to the oil-importing countries, suggesting they should contribute to its funding. However, this does raise difficult questions of coordination and allocation, both between different oil importers (why would China invest in infrastructure that also benefits Japan or India?) and between the importers and exporters (why would, for instance, Saudi Arabia allow China to invest in a bypass pipeline across its territory that would reduce its windfall profits in a crisis?).

China's "One Belt One Road" (OBOR) initiative has stressed maritime interconnectivity across the Indian Ocean and land connectivity through Central Asia. With energy security a key component, the construction of pipelines, ports, and storage facilities would fit this mission. It is backed by $100 billion from the Chinese-conceived Asian Infrastructure Investment Bank which, despite U.S. skepticism, has seen many Middle Eastern countries as well as other U.S. allies (Germany, the United Kingdom, and France) and Asian powers (India and South Korea) become members.[92] The Silk Road Infrastructure Fund, with $40 billion, is also intended to invest in OBOR ventures.

However, it remains to be seen how many of these projects come to fruition. It is still unclear which energy security projects in the Middle East might fit into the OBOR strategy, other than perhaps links between Gwadar and Xinjiang and the Habshan-Fujairah pipeline, which was built by a Chinese company.[93] To add to energy security, projects will have to have a strong commercial and strategic logic, and not just be dumping grounds for surplus Chinese industrial capacity. Investments need to be accepted by host communities and seen by other countries as collaborative rather than exclusionary. Host countries would need to be confident that having key strategic infrastructure built and possibly owned by others would not put them in the crosshairs of future conflicts, possibly ones they were not even concerned with. Physical infrastructure alone is inadequate; it needs to be embedded in appropriate regulation, legislation (national and international), diplomacy, and multilateral institutions.

Funding from other countries, such as the United States and Japan, has been limited and piecemeal. Russia and Iran have talked in grandiose terms but few concrete projects have emerged. The EU and India have been conspicuous by their absence. With the slump in energy prices, Middle Eastern countries themselves will have less money to fund such infrastructure, but some projects of vital strategic importance will proceed. Multilateral projects in geographically important but less wealthy countries, such as Oman and Jordan, may need to be supported by wealthier regional neighbors.

Otherwise, private investment, including foreign direct investment, will have to be mobilized, but that demands structuring commercially viable projects.

Market

As mentioned above, the smooth functioning of markets would be greatly aided by better data. This would reduce the likelihood of unfounded panics, provide appropriate early warning of real panics, and ease the task of reallocating supplies in the event of a disruption.

Individual companies can, to an extent, protect themselves against jumps in oil and gas prices by hedging in financial markets. This has very rarely been a strategy pursued by nations.[94] Major oil exporters' sovereign wealth funds and foreign exchange holdings give them the means to weather disruptions to their revenue streams. The Kuwait Investment Authority's holdings were, for instance, crucial to reconstruction following the 1990-91 Iraqi invasion. However, the region's funds are already being depleted to cope with lower oil prices and budget deficits.

In general, markets cope well with the task of allocating scarce supplies. Governments do have a role in protecting the most vulnerable consumers and ensuring sufficient energy for critical services, but price controls, rationing, and export bans have usually been counterproductive and many of the worst consequence of so-called energy crises have come from well-meaning government interference with the normal market process of adjustment. If it is assumed that a government will react to an interruption in supplies by enforcing price caps, there is no incentive to hold reserve stocks or buy insurance via hedging.

Conclusions and Recommendations

Though current low oil prices and oversupply have reduced concerns about energy supply security, the numerous conflicts and disputes in the wider MENA region present a range of serious threats. These occur at a range of scales and timeframes, from local disruptions, either short-lived or persistent, to major regional conflicts. Threats are posed at levels from individual criminality, through non-state or sub-state actors, to state-led action, either covert or overt.

The vulnerability of oil transport through the Gulf and Strait of Hormuz has received the most attention, given its magnitude and the lack of alternative routes. However, the security of LNG exports and of vital imports to Gulf countries are under-appreciated risks. Several measures can be taken to improve regional energy security.

First, internationally, it is necessary to assess, with more sophisticated economic and engineering analysis, the viability of various infrastructure options for reducing vulnerability to disruptions. This should focus not only on oil, but also on gas and other critical supplies.

For MENA stakeholders, there should also be a focus on developing regional institutional arrangements to manage proactive and reactive responses to energy transit crises, including cooperation with customers, particularly Asian ones. These can include the simulation of crises; better and timelier information; shared funding of new infrastructure; strategic stock-holding in importing countries; and cooperative responses to disruption. This is most feasible within MENA sub-groups. Similarly, further progress is needed on cooperative arrangements between existing MENA region and energy-exporter institutions and key international organizations.

Lastly, the international community must continue and intensify efforts to resolve the MENA region's conflicts in Libya, Yemen, Syria, and Iraq. Improved energy security would be an important secondary benefit of stabilizing those states.

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[22] The longer period is comparable to the 1980-88 Iran-Iraq War.

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[24] Estimates range from a few days to 37-112 days, see O'Neil and Talmadge, "Costs and Difficulties"; Talmadge, "Closing Time." Longer disruptions would only seem possible in the event of a wider regional conflict without international intervention to maintain freedom of navigation.

[25] Assuming full use of existing bypass pipelines: Fishkhabour-Ceyhan, Habshan-Fujairah, and Petroline.

[26] Exports of Iraq. In reality, exports would probably not be halted entirely even in the worst case.

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78 Assume for simplicity that any pipeline operating costs are exactly offset by ancillary benefits.

79 Present value of capital and operating costs, discounted at 3 percent.

80 Assuming Saudi Arabia bears 1/3 of total cost, for a 2 mbpd share of 6 mbpd incremental capacity.

81 Assume a common system available for use by all connected GCC members.

82 This is equivalent to saying that, at these assumed parameters, the GCC would gain short-term revenues by a production cut of ~2 mbpd (25% of 9 mbpd of Gulf exports, assuming full use of Petroline at its current 5 mbpd capacity).

83 Personal communication from IOC personnel in Yemen.

84 Personal communication from IOC personnel in Nigeria.

85 David Victor and Sarah Eskreis-Winkler, "In the Tank: Making the Most of Strategic Oil Reserves," *Foreign Affairs* 87, no. 4 (2013): 70-83, <https://www.foreignaffairs.com/articles/united-states/2008-06-01/tank>.

86 John Mitchell, "Asia's Oil Supply: Risks and Pragmatic Remedies," Chatham House, 7 May 2014, <https://www.chathamhouse.org/publication/asia%E2%80%99s-oil-supply-risks-and-pragmatic-remedies>.

87 Adam Rose, "New IEA chief Birol Calls for 'Partnership' with China on First Official Trip," Reuters, 9 September 2015, <http://www.reuters.com/article/us-oil-iea-china-idUSKCN0R90K220150909>.

88 Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, Tunisia (now suspended), and the UAE.

89 Brenda Shaffer, *Energy Politics* (Philadelphia: University of Pennsylvania, 2009), 64.

90 Ana Echagüe, "Oman: The Outlier," FRIDE, October 2015, <http://fride.org/download/PB210_Oman_the_outlier.pdf>.

91 Robert D. Kaplan, "Center Stage for the 21st Century: Power Plays in the Indian Ocean," *Foreign Affairs*, April 2009, <https://www.foreignaffairs.com/articles/east-asia/2009-03-01/

center-stage-21st-century>.

[92] All the GCC countries except Bahrain, plus Iran, Turkey, Egypt, Israel, and others.

[93] As opposed, for instance, to Central Asia where specific pipelines obviously fit the strategy well. For specifics of OBOR projects, see "Investments along China's Belt and Road Initiative," Center for American Progress, 1 September2015, <https://interactives.americanprogress.org/projects/2015/silk-road/>.

[94] Morocco did so to fix its subsidy bill; oil exporters, such as Mexico, have hedged for the opposite reason, to protect themselves against oil price slumps.

About The Author

Robin Mills is a nonresident fellow for Energy at the Brookings Doha Center. He established Qamar Energy in 2015 to meet the need for regionally-based Middle East energy insight and investment. He is an expert on energy strategy and economics, described by Foreign Policy magazine as "one of the energy world's great minds."

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