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The Global Response to a Terror-Generated Energy Crisis

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Simulated Targets in the Persian Gulf



A REPORT OF THE HERITAGE CENTER FOR DATA ANALYSIS

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THE GLOBAL RESPONSE TO A TERROR-GENERATED ENERGY CRISIS

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In June 2008, The Heritage Foundation invited energy scholars and policy experts to participate in a computer simulation and gaming exercise assessing the economic effects of a global petroleum energy crisis. The exercise was similar to the previous energy study conducted from 2006 to 2007, but larger in geographic and economic scope.¹

The Heritage team simulated the effects on world oil supplies, demand, and prices after a major terrorist attack on oil exports from Saudi Arabia and resulting disruption of oil shipping lanes between the Middle East and major Asian economies. Analysts at The Heritage Foundation's Kathryn and Shelby Cullom Davis Institute for International Studies developed the crisis scenario, while analysts in Heritage's Center for Data Analysis (CDA) measured the effects of these disruptions on the U.S. economy and found:

- The price of petroleum in the U.S. spiked very quickly from the price of \$127 per barrel on the day of the game to a high of \$244 per barrel just days later.
- This price increase caused a rapid slowing of the U.S. economy, seen in a drop in employment of approximately 1.5 million jobs in the first year and an average drop in inflation-adjusted gross domestic product (GDP) in the first year of \$119 billion.

The scholars and policy experts recommended steps the U.S. and other countries could take to mitigate such adverse economic effects. CDA members analyzed these policy recommendations with the same economic model used to make the initial impact estimates. They found that:

- Petroleum prices fell by 15 percent after implementation of the recommendations.
- The U.S. economy recovered approximately 970,000 jobs in the first year and recovered \$112 billion of output in the first year.

The results of this second game are described in detail in the following sections:

- Situation and Strategic Environment
- The Crisis Scenario
- Conduct of the Game
- Outcome Trends
- Global Economic Effects
- Lessons Learned and Conclusion

This project was a “proof-of-principle” investigation. It combined computer modeling and gaming to capture the economic impact of a sudden petroleum-supply disruption. By design, the magnitude of the disruption was to be catastrophic—well beyond what excess petroleum capacity and strategic petroleum reserves could easily absorb.

1. James Jay Carafano, William W. Beach *et al.*, “If Iran Provokes an Energy Crisis: Modeling the Problem in a War Game,” Heritage Foundation Center for Data Analysis Report No. 07-03, July 25, 2007, at <http://www.heritage.org/Research/EnergyandEnvironment/cda07-03.cfm>.

The purpose of the gaming exercise was to provide input data for an economic model to estimate net impacts of 1) the shock (the terrorist actions) and 2) the policy responses. As such, the study focused on the economic and diplomatic reactions of the player nations, and the subsequent implications. Military reactions by players were minimal. The exercise incorporated a plausible scenario that caused an immediate petroleum-supply interdiction of approximately 10 to 15 percent of global production, or 8 to 12 million barrels per day (mbd), with residual effects that would disrupt approximately 4 mbd for several months.

The project demonstrated the feasibility of modeling the economic consequences of crisis decision making and responses during an oil-price shock induced by a terrorist attack. At the same time, the game emphasizes that much more exploration is needed of how various combinations of political, military, diplomatic, and economic initiatives might affect the course of a global energy crisis. The Heritage Foundation plans to expand and refine its simulation and modeling tools to evaluate international responses, environmental consequences, and private- and public-sector responses to other foreign policy challenges.

WHY THIS EXERCISE?

Demand for oil is no longer driven exclusively by developed economies like the United States. China, India, other developing countries, and energy producers themselves are transforming global energy markets through their sheer size and pace of growth. According to the Paris-based International Energy Agency (IEA), between now and 2030, China and India will account for 70 percent of the new global oil demand; their combined oil imports will skyrocket from 5.4 mbd in 2006 to 20 mbd in 2030—overtaking the current combined imports of Japan and the United States.² Thus, an evaluation of any potential responses to an energy crisis must include exploration of the actions of major consumer nations, energy producers, and geo-strategic

powers as well as of sub-state and transnational non-state actors that will shape the military and diplomatic agendas, as well as energy policies. The goal of this proof-of-principle exercise was to model a multi-player response to an energy crisis.

Situation and Strategic Environment. Catastrophic destruction of the Ras Tanura port and oil terminal in Saudi Arabia would achieve a loss of more than 4 mbd for at least several months, and as long as the terminal remains non-functioning. Two principal choke points—the Strait of Hormuz at the mouth of the Persian Gulf and the Strait of Malacca between Indonesia and Malaysia—transport a combined 28 million barrels of petroleum per day. Interdicting either of these choke points would cause a short-term loss of global petroleum supply on the order of 8 to 12 mbd. Together, these events achieved the desired results for the purpose of the exercise and study.

Represented in the game were the United States, the European Union, China, Japan, India, Australia, and the Organization of Petroleum Exporting Countries (OPEC). They were chosen both because they represented major energy-producing and -consuming nations, and because they are key geo-strategic players in responding to regional events in the Middle East and South Asia. In particular, each player is a significant energy consumer or producer, with the exception of Australia, which was chosen due to its strategic proximity to the Strait of Malacca.³ During the game, the players were represented by teams of policy and academic experts. Each national player was represented by a team of two to four subject-matter experts. In some cases, the teams represented more than one nation, such as OPEC or the European Union. To limit the complexity of the exercise, several nations, including Russia, Brazil, and Venezuela, were omitted.⁴

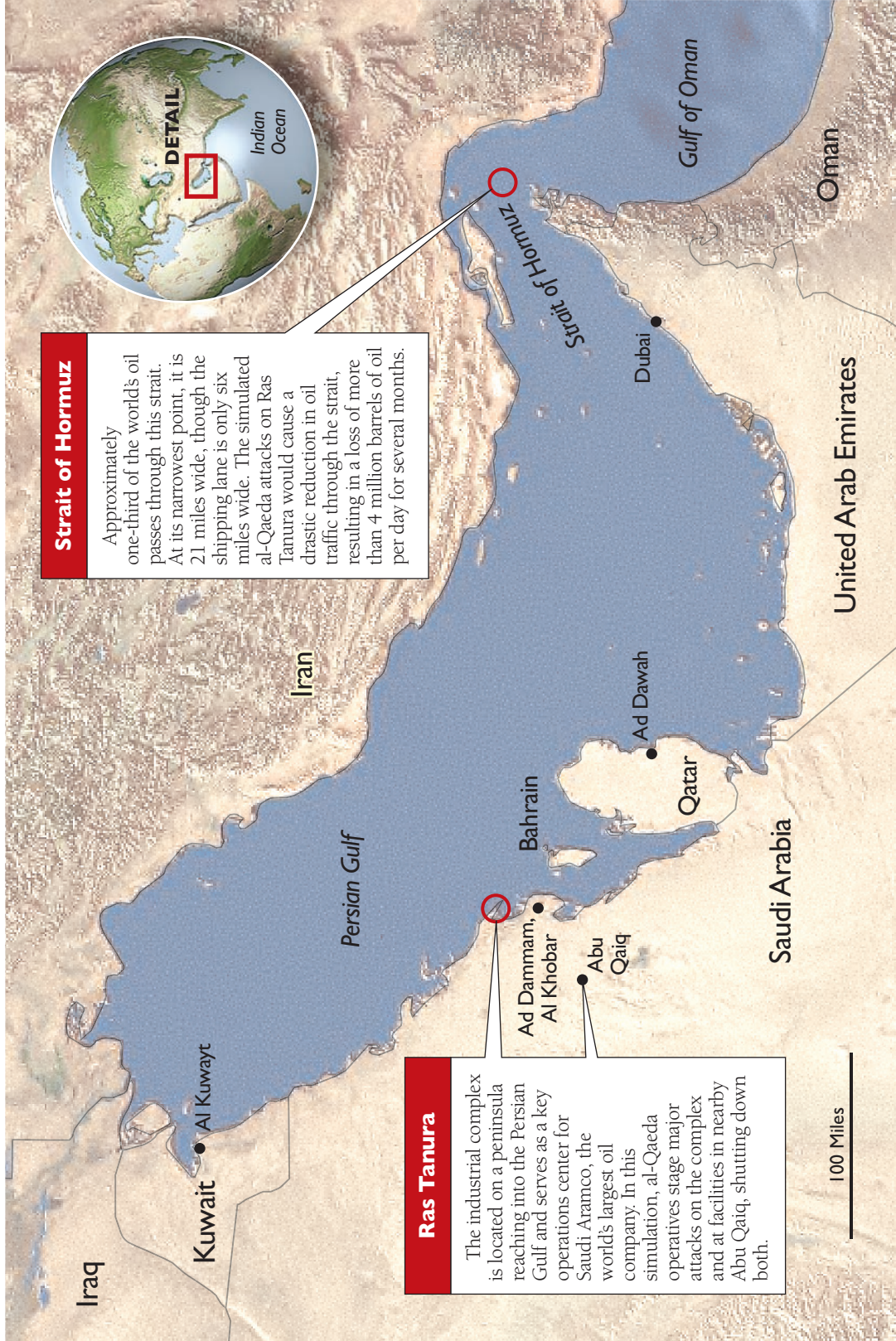
The United States was among the most important of the players. The United States receives most of its imported petroleum from Canada, Mexico, and

2. International Energy Agency, “World Energy Outlook 2007: China and India Insights,” 2007, p. 48.

3. Figures for individual and regional petroleum production, transportation, and consumption taken from: *International Petroleum Encyclopedia 2007*, Joseph Hilyard, ed. (Tulsa, Okla.: PennWell Corporation, 2007). Table 7, World Oil Trade Movements, on page 418 was particularly useful.

4. While these nations certainly have a significant interest in the flow of global petroleum, they were not in proximity to the Straits of Hormuz or Malacca. For the purpose of the exercise, their reactions were assumed to be rational, and that they would continue maximum petroleum production at elevated prices.

Simulated Targets in the Persian Gulf



Map I • CDA 08-11 heritage.org

Venezuela, and less than 20 percent of U.S. imports are from the Middle East. But as the world's largest consumer of petroleum, the United States would be affected by any loss of global supply that cannot be absorbed by the limited excess capacity. Oil prices around the world are set by the globalized markets. Any reduction in global supply will elevate prices for all consumers, including those in the Western Hemisphere.

European nations import slightly more than 3 mbd from the Middle East. Like the United States, they would be affected by any supply interruption, since a reduction in global supply affects all consumers as prices increase. This is especially true for the EU, since its other major supplier is Russia (6 mbd), which has shown no reluctance to raise prices for oil and natural gas exports when given the opportunity.

Japan and China are heavily dependent on Middle Eastern oil, specifically on petroleum transported by tanker through the Strait of Malacca. China imports approximately 4 mbd, of which 2.2 mbd traverse the Strait; while 4.2 mbd of Japan's imported 5.4 mbd traverse the Strait. The energy vulnerability of Japan and China is also mirrored by other developed nations in the Asia-Pacific region, such as South Korea and Taiwan.

India imports nearly 2 mbd of the 2.5 mbd it consumes. Most of this petroleum comes from the Middle East through the Strait of Hormuz. India is also dependent on Mideast liquefied natural gas (LNG) for electric energy generation to fuel its rapidly growing economy. India has one of the largest economies in the world and would be doubly affected by production degradation in the Persian Gulf and by supply interdiction of the Strait of Hormuz.

Australia plays a unique role in the Asia-Pacific region. It is the largest Western nation near the Strait of Malacca, it maintains close diplomatic and economic ties to other developed nations in the region, especially China, and it has been the previous target of attacks by the Islamist terrorist group Jemaah Islamiyah.⁵ Australia is very active

in offshore exploration and production of oil and natural gas, and has recently started importing small amounts of crude oil due to a growing economy. Tankers that bypass the Straits of Malacca and Sunda must travel by the island of Bali, much closer to Australia.

OPEC remains an influential organization with a pivotal role in the global economy. Members of OPEC provide approximately 41 percent of global oil production with key members located in the Middle East, and much of its petroleum exports flowing through the Strait of Hormuz. The most prominent member of OPEC is Saudi Arabia—the largest exporter of crude oil and the historic provider of global excess capacity, the production “cushion,” that has kept oil prices relatively stable for decades. Of the 86 mbd of global production, 17 mbd (nearly 20 percent) flow through the Strait of Hormuz from OPEC nations.

The Crisis. For this exercise, players were given a supply-disruption scenario that was caused by a plausibly successful coordinated terrorist attack conducted by the remnants of al-Qaeda and an affiliated political group operating in Pacific Asia, Jemaah Islamiyah. The intent of the attack is to cause an immediate shock to the global petroleum transportation system, with persistent effects that reduce petroleum throughput from producing nations to consuming nations. The desired result of this coordinated attack is to cause economic failure of oil-consuming nations, fracture Western alliances, and cause economic and political confrontation between Western nations and the Middle Eastern Islamic states. This result is consistent with al-Qaeda's previously established strategic goals.

The results of the coordinated attack were: 1) the catastrophic destruction of the Ras Tanura terminal and subsequent reduction in traffic through the Strait of Hormuz, and 2) the closure of the Straits of Malacca and Sunda with traffic detouring more than 1,000 kilometers to reach the refineries and terminals of Southeast Asian consumers. Transportation delays and costs increase across the globe as producer and consumer nations implement increased

5. The 2002 Bali bombing was conducted by Jemaah Islamiyah in support of al-Qaeda's strategic goals. It targeted Australian tourists vacationing in Indonesia, resulting in 202 civilian deaths. For more information, see numerous articles by Dana Robert Dillon including, “Bali Bombings: Self Inflicted Wounds?” Heritage Foundation Press Commentary, October 18, 2002, at <http://www.heritage.org/Press/Commentary/ed101802.cfm>. Also see “Bali Nightclub Bombing,” GlobalSecurity.org, at <http://www.globalsecurity.org/security/ops/bali.htm> (October 16, 2008).

Simulated Targets Around Indonesia



The Road to Crisis

- Al-Qaeda takes 300 pupils hostage at the Ras Tanura Middle School. The next morning the hostage-takers begin executing students.
- While Saudi security forces are distracted, al-Qaeda launches simultaneous attacks on oil-processing and shipping facilities. These are thermobaric explosive attacks on the Ras Tanura and Abu Qaiq facilities, destroying parts of each. (Improvised thermobaric weapons are containers of fine explosive particles or liquids that burst open the container and disperse the contents in a cloud and then ignite, creating a downward destructive wave of over-pressure.)
- An explosives-laden plane attacks the Saudi Aramco headquarters, destroying the Internet facilities there and killing portions of the company's leadership.
- Indonesia-based Jemaah Islamiyah begins speedboat attacks on oil tankers crossing the Strait of Malacca.
- Jemaah Islamiyah places EM-52 mines in the Strait of Malacca (near Singapore). The mines are coated with polymer to reduce the likelihood of detection.
- All oil traffic through the Strait of Malacca is stopped because insurers will not give coverage to hydrocarbon cargo.
- Al-Qaeda affiliates place mines in the Strait of Sunda to further disrupt traffic.

security measures in order to cope with the new types, sophistication, and brutality of al-Qaeda-Jemaah Islamiyah attacks.

The following occurred as a result of the disruptions.

- Six million barrels per day of oil production has stopped.
- Fifteen million barrels per day can no longer be shipped through the most direct routes.
- Saudi Aramco insists on being the only contractor for repairs at the damaged facilities.
- The U.S., U.K., Japan, India, China, and Australia deploy naval and special forces operations to the Strait of Malacca to hunt down sea-borne and land-based terrorist teams and to conduct de-mining operations. This takes three months.

CONDUCT OF THE EXERCISE

After the players read and discussed the initial scenario and its effects on their nation or organization, they separated into break-out groups. In the first break-out, each team of nation players further discussed and recorded its short-term actions. Limited communication was allowed between nation players to replicate diplomatic dialogue.

After the first break-out discussion, all teams of nation players reconvened to brief each other on their respective actions. Nation players were not required to reveal their diplomatic dialogue. Once the actions were discussed by Heritage staff, the teams returned to their break-out groups to determine long-term actions.

Player responses were organized into three subcategories:

- **Diplomatic.** The actions of a nation player have a dominant diplomatic component if, for example, they encourage actions primarily by other nations or organizations. Encouraging imposition of economic sanctions, for instance, is listed as a diplomatic action in spite of its obvious economic effects and possible military implications necessary for enforcement.
- **Economic.** These responses have a dominant economic component, such as modifying production quotas, price controls, or rationing.
- **Military.** Actions include those that directly involve a nation's military assets, or intelligence assets normally under military control.

Table 1 summarizes the actions taken.

Nations' Responses to Terrorist Attacks

United States

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> • U.S. will work with friends and allies to respond to attacks. • Participate in all appropriate international forums and organizations such as NATO, ASEAN, IEA, etc., to develop comprehensive response. • Discourage the lifting of sanctions against currently identified terrorist states such as Iran. 	<ul style="list-style-type: none"> • Promote transparency and trade liberalization for international energy markets. • Encourage lifting artificial barriers to energy exploration and production by other nations.
Economic	
<ul style="list-style-type: none"> • Will not engage in price controls, production quotas, or fuel rationing. • Relax all regulations and prohibitions on "boutique" fuel refining, restricted fuel imports, off-shore drilling, ANWR, and other restricted government-regulated lands and waters. 	<ul style="list-style-type: none"> • Remove regulatory impediments to broad expansion of energy production, such as energy nuclear power, clean coal technology, shale oil, bio-fuels, synthesized fuels, diesel-electric hybrid vehicles, etc. • Suspend CO₂-restricting legislation. • Promote technology advances like nanotechnology. • Promote greater energy efficiency (green programs) in government buildings. • Remove tariffs and regulatory barriers to energy imports such as Canadian tar and petroleum and Brazilian ethanol.
Military	
<ul style="list-style-type: none"> • Provide maximum U.S. Navy support to clear sea lanes in Straits of Hormuz and Malacca. • Refocus intelligence assets on new threats, new delivery systems, and on other organizations allied with al-Qaeda and Jemaah Islamiyah. • Enlarge military and intelligence cooperation with affected nations: Focus on counter-terrorism. 	<ul style="list-style-type: none"> • Pursue gas-to-liquids (GTL)/coal-to-liquids (CTL)/biomass-to-liquids (BTL) systems for synthesized diesel and aviation fuels for military equipment. • Promote more nuclear propulsion in U.S. Navy.

European Union

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> • Work through the IEA to reduce European Union consumption by 3 mbd. • Assemble IEA Emergency Council on Oil Supply Management to determine additional measures. 	<ul style="list-style-type: none"> • Create Partnership for Energy Security for major energy consumers in cooperation with IEA: a) work with U.S., India, China, Japan, and other consumer nations to coordinate policies and increase energy production outside of OPEC, b) promote energy efficiency, technological advances, and transportation best practices. • Promote Energy Charter Treaty participation for Russia and other oil and gas producers. • Promote private agribusiness expansion into African nations suitable for ethanol production. U.K., France, and Belgium to take lead. • Promote completion of Nabucco pipeline for transport of Caspian gas to EU markets. Possible future engagement of Iran.
Economic	
<ul style="list-style-type: none"> • No collective EU rationing or mandates; energy mandates and controls left to individual nations. 	<ul style="list-style-type: none"> • Increase market integration and energy policy liberalization of EU members. Reduce regulatory barriers to energy trade and commerce between EU members. • Promote EU-wide Solidarity Strategic Petroleum Reserve. • Promote development of energy diversification through tax credits and R&D incentives. • Increase nuclear generation capacity.
Military	
<ul style="list-style-type: none"> • Employ NATO forces to secure pipeline and terminal facilities. 	None

(continued on next page)

Nations' Responses to Terrorist Attacks (continued)

China

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> Urge EU, Japan, and U.S. to release oil reserves. Coordinate with Shanghai Cooperation Organization (SCO) for joint security of Central Asian petroleum production and transportation. Propose several economic recovery packages to Saudi Arabia (see "Economic"). 	<ul style="list-style-type: none"> Promote additional energy access from neighboring states through pipelines: a) increase capacity of Kazakh–China pipeline, b) spur development of Taishet-Skovorodino pipeline through Manchuria, c) connect Pakistan/Gwadar pipeline to Kazakh–China pipeline, d) connect Burma Sittwe–Yunnan pipeline to SW China, e) link Caspian oil and gas to enlarged Kazakh–China pipeline. Support Canada Gateway Project, reducing traffic through Strait of Malacca. Increase imports from Venezuela. Cooperate with Japan in East China Sea gas field. Attain IEA membership, but not OECD membership in order to maintain status as developing nation.
Economic	
<ul style="list-style-type: none"> Centralize all Chinese refining capacities. Implement immediate nationwide energy-saving campaign including restriction of private auto use and maximized efficiency of public transportation. Restrict foreign airlines by eliminating refueling in China. Increase domestic air fare to double market price. Propose emergency construction task force (50,000 engineers, technicians, and skilled laborers) to Saudi Arabia for debris clearing and reconstruction of damaged facilities. Cargo shipping and construction material such as steel and concrete also provided. Allow private Chinese investments in U.S. energy companies. Provide financial backing for Australian offshore and British North Sea production. Expand coal-energy investments. 	<ul style="list-style-type: none"> Expand generation of nuclear power. Maintain strong national conservation efforts in order to minimize dependence and vulnerability to petroleum imports.
Military	
<ul style="list-style-type: none"> Deploy 10 divisions to western China in order to secure Kazakh–China pipeline. Designate one specialized division for joint anti-terror task force with Central Asian partners (SCO). Provide naval forces for support of U.S. and Australian naval forces clearing and patrolling Straits of Malacca and Sunda. Cooperate fully with anti-terror intelligence. Offer Saudi Arabia full military cooperation for anti-terror operations. 	<ul style="list-style-type: none"> Increase naval capabilities to protect maritime petroleum imports. Increase space-based intelligence-gathering capabilities.

Japan

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> Call for emergency meeting of IEA (Japan is current chair of IEA) to discuss releasing oil from national strategic reserves. Advocate long-term release strategy. Japan recommends release of 1 mbd. 	<ul style="list-style-type: none"> Increase diplomatic emphasis on cooperation with Russia to increase oil and gas production. Bilateral aid to China to provide technologies that create greater energy efficiency and reduce demand. Bilateral outreach to other key oil producers to increase production. Promote a future regional strategic petroleum reserve for northeast Asia—the Northeast Asia Energy Cooperative Organization.
Economic	
<ul style="list-style-type: none"> Implement immediate domestic fuel rationing. 	<ul style="list-style-type: none"> Promote greater transportation fuel efficiency and diversity through compressed natural gas (CNG) or GTL. Promote Japanese private investment in energy development and new energy technologies.
Military	
<ul style="list-style-type: none"> Internal political discussion and public debate of military use, given "collective self-defense" limitation contained in Japanese constitution. Options include sending Maritime Self-Defense Forces to assist in mine-clearing operations in Strait of Malacca. Not approved by legislative body. 	<ul style="list-style-type: none"> Re-prioritize defense expenditures. Remove remaining constraints on use of military assets and systems to enable greater power projection.

(continued on next page)

Nations' Responses to Terrorist Attacks (continued)

India

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> Propose counter-cartel to OPEC. Propose lifting economic sanctions on Iran to increase global petroleum supply. 	<ul style="list-style-type: none"> Promote multiple diplomatic efforts for assistance to conform to IEA guidelines on development of strategic petroleum reserve. Increase diplomatic engagement with Africa and Central Asia for bilateral energy contracts. Apply for membership in SCO. Offer to act as diplomatic intermediary between U.S. and Iran.
Economic	
<ul style="list-style-type: none"> Raise domestic energy product prices 25–30 percent above market price. Increase drilling opportunities in Indian territorial waters. 	<ul style="list-style-type: none"> Promote gradual liberalization of economy and energy diversification while addressing internal political friction. More LNG and oil terminals, refineries, wind/solar/bio-fuels, and nuclear. Streamline bureaucratic processes for energy development, gradually remove price controls. Construct internal pipeline system to facilitate oil and gas transportation from Central Asia and Burma. Promote large-scale energy efficiency program.
Military	
<ul style="list-style-type: none"> Send naval task force to Strait of Malacca. 	<ul style="list-style-type: none"> Increase military power projection capability to cover maritime routes and pipeline/storage assets. Enlarge military trade and cooperation with U.S. while maintaining current level of relations with Russia, Israel, and EU.

Australia

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> Encourage market solutions to international energy crisis. Encourage OPEC to increase production. Call for meeting of ASEAN members. Call on Asia Pacific Economic Co-operation (APEC) members to share petroleum production data. 	<ul style="list-style-type: none"> Promote international deregulation of energy markets through APEC, IEA. Promote greater energy dialogue with China. Support new ASEAN hydrocarbon counterterrorism initiative.
Economic	
<ul style="list-style-type: none"> Enact Liquid Fuel Emergency Act, giving government increased authority to regulate energy production and transportation. Use Australia's abundant natural gas to keep domestic fuel supply adequate. 	<ul style="list-style-type: none"> Provide incentives for greater GTL/CTL/BTL production. Expand ethanol production. Abandon plans for Cap and Trade scheme on transportation fuels.
Military	
<ul style="list-style-type: none"> Provide naval escort for Australian LNG tankers on main sea lanes. Make military and naval forces available for securing petroleum assets and sea lanes in partnership with other ASEAN and U.S. forces. 	<ul style="list-style-type: none"> Promote cooperative intelligence agreement with Singapore, Indonesia, and Malaysia for Strait of Malacca. Expand cooperation with Indonesian military.

OPEC

SHORT-TERM	LONG-TERM
Diplomatic	
<ul style="list-style-type: none"> Possible meeting of OPEC members in a week or two. 	<ul style="list-style-type: none"> Assure all petroleum consumers that OPEC will maintain as much production as possible. Maintain global confidence in OPEC and minimize global demand destruction.
Economic	
<ul style="list-style-type: none"> OPEC members state they will attempt to fill the supply shortage after the attacks and damage to Ras Tanura. 	<ul style="list-style-type: none"> Invest as much as possible in re-establishing production levels through repairs and expansion of undamaged facilities.
Military	
<ul style="list-style-type: none"> King of Saudi Arabia condemns attacks and pledges to punish attackers. 	<ul style="list-style-type: none"> Maintain emphasis on securing energy production. No significant changes.

OUTCOME TRENDS

In exploring how crisis decisions might be made in a multi-player environment, the following practices and trends emerged over the course of the game:

- Nation players tended to seek cooperation with other nation players and took few unilateral actions to secure energy resources. Not one nation player stated he would take military action to seize or capture additional energy resources.
- Several non-U.S. players advocated engagement with Iran in order to fill supply void.
- Only India and Japan mentioned possible domestic social or political tensions created by energy scarcities and rapid price increases.
- Most nation players sought actions to develop more diverse sources of energy supply, also greater efficiency measures and technology leaps. The exception was OPEC.
- Nations with pre-existing pipelines to developed supplies will have a distinct competitive advantage over those who rely on seaborne tankers to import energy. The United States and the European Union have more secure energy supplies than do China, Japan, or Asia. This may produce tensions among competing consumers in the Asian region. It may also produce military alliances that have energy security as their basis.

GLOBAL ECONOMIC EFFECTS

The interruption of the energy supply results in a dramatic increase in the world prices of petroleum. Absent any credible national and multinational policies, there will be major declines in the economic output of the United States and other industrial countries, as well as rapid impoverishment of developing economies. Without enough energy to maintain current GDP levels, 592,000 workers lose their jobs at the outset and household income falls by \$309 billion in the quarter with the lowest income. These effects were simulated using the Global Insight model. Heritage analysts worked with energy specialists at Global Insight, a prominent forecasting company, to determine what the reduced supply would mean for the world price of crude oil. The

analysts then set up a simulation experiment to forecast the effects on some of the major U.S. macroeconomic variables.⁶

The U.S. and other countries' responses were then analyzed by the Heritage team in terms of their likely economic impact. Oil withdrawals from the Strategic Petroleum Reserves made up for part of the lost world supply and mitigated the increase in the world price of oil. The simulation experiment was then re-run with the effects of these economic responses incorporated. The effectiveness of the players' responses to the crisis are illustrated in Chart 1. The graphs show both the devastating economic impact of the attacks on the U.S. economy without any policy response, and the less severe economic decline with a policy response.

The combined effect of responses by the U.S. and other participating countries helps to counter some of the effects of the attack.

1. Job losses recover a year after the attack—compared to continued significant job losses two years after the attack if the U.S. and other countries do not respond.
2. Inflation-adjusted GDP recovers within a year—compared to persistently lower output for two years after the attack.
3. Inflation-adjusted disposable income recovers within two years after the attack—compared to continued lowered inflation-adjusted income two years after the attack.

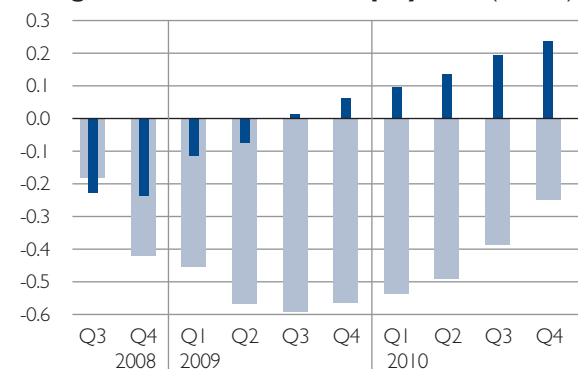
The immediate and effective economic responses of the various countries make it possible for them to accommodate much of the short-term energy demands, while investment is mobilized for swift recovery efforts in the meantime. The military deployments in conjunction with all the investments made to rebuild damaged infrastructure help contain job losses by mobilizing the labor force for these reconstruction projects. Without these economic, diplomatic, and military responses, an average of 406,000 jobs are lost in the first year compared to an average of 164,000 jobs lost with the response. These investments allow inflation-adjusted GDP to grow, and finally real-income growth as investments start to pay off in positive returns around two years after the attack.

6. See the Appendix for the experiment methodology.

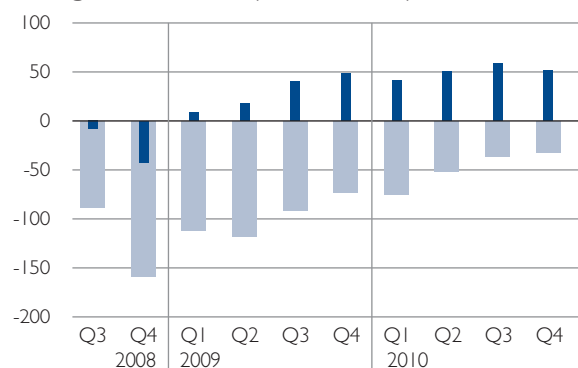
How the Attacks Would Affect the U.S. Economy

■ Effect of Attack ■ After International Responses

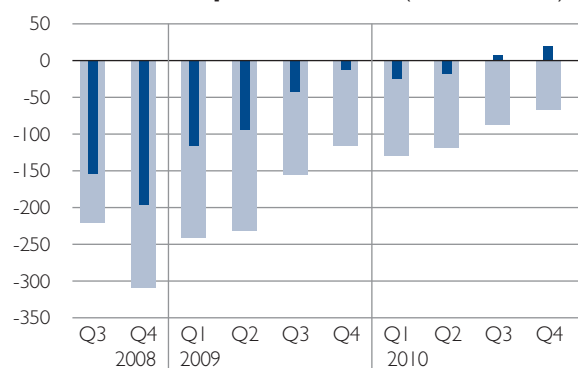
Change in Total Non-Farm Employment (Millions)



Change in Real GDP (Billions of U.S. \$)



Real Personal Disposable Income (Billions of U.S. \$)



Source: Heritage Foundation calculations based on the Global Insight macroeconomic model.

Chart 1 • CDA 08-11 heritage.org

LESSONS LEARNED

The consequences of an energy disruption on a scale depicted in this exercise were devastating and would no doubt have a profound and lasting impact on the global economy. Without question, the United States and its allies would have to exercise decisive and effective leadership to deal with the crisis. The results of this exercise illustrate the magnitude of the challenge:

- As governments and the private sector direct national resources to deal with the second- and third-order effects, they will have more success following the market than with a command economy. That is, the more that nations rely on market principles to direct resources, the faster the global economy will recover. But reliance on market principles is unlikely. Expecting market-based responses ignores most of recorded history, and is counterintuitive to human nature. All nations will have domestic constituencies that advocate greater centralized control of national assets for the sake of national security. Contrary to the game's players, it will be extraordinarily difficult for national leaders who advocate liberal economic policies to survive their own internal politics. After the crisis begins, it will be too late to educate the general population about market principles. They must have this understanding beforehand. Public information on handling energy crises needs to be developed in advance and promptly implemented as the crises erupt.
- While nations contemplate short-term and long-term economic and diplomatic responses, military contingences, such as destroying the most dangerous terrorist organizations' cells, deploying naval assets to conduct mine-sweeping operations, and escorting tankers through maritime choke points, need to be implemented.
- During a period of crisis, non-Mideast petroleum exporters, such as Russia, Norway, Nigeria, Venezuela, and Brazil, could well have greatly increased influence as consumer nations compete for scarce energy supplies.
- Global economic disruptions would make many long-term actions improbable, such as Japan's proposed regional strategic reserve in northeast Asia, or India's proposed pipelines to connect to Central Asian energy reserves through Pakistan.

- Nations will contend for breakthrough energy research and development (R&D), but will have fewer national resources to allocate to development given declining economies. Thus, looking to a crisis to spur the drive for alternative energy sources appears an impractical strategy. Alternative energy R&D needs to be undertaken during peacetime and relative economic prosperity.

CONCLUSION

The Heritage game demonstrated the vulnerabilities of the global system's capacity to produce and deliver oil supplies to a concerted transnational terrorist threat. This exercise also suggests that major producer and consumer nations and key geo-strategic allies acting in concert with one another while protecting their own national interests could ameliorate the severity of long-term disruptions. Reliance on market forces and coordinated security

activities did much to help restore the confidence of markets and consumers.

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APPENDIX

SIMULATION METHODOLOGY

This energy simulation was built on the simulation of a previous game, during which the impact of the U.S. response was estimated. The technique used to introduce the effects of the oil price shock and the contribution to domestic oil supply from the Strategic Petroleum Reserve (SPR) can be found in the report by James Carafano and William Beach.⁷ The procedure for the initial simulation on which this current simulation is based was performed in three steps. Each step produced a new state of the economy (from the original baseline) in order to simulate the new economic reality the U.S. economy would face if such a crisis occurred. Given this new state, policy recommendations from the participants were implemented and the impact of these recommendations on the “crisis state” of the economy could thus be studied. Following is a description of this process from the original report⁸ and then the method used in the present study for incorporating the policy recommendations from the rest of the world and assessing their impact.

Step 1. To simulate the effects of the oil price shock, the Heritage Foundation economics team introduced the change in oil prices and the contribution to domestic oil supply from the SPR into the Global Insight model. They then directly changed three separate oil prices in the model: the weighted average price of imported crude, the weighted average price of domestic crude, and the average price of West Texas Intermediate (WTI) crude. All three were assumed to deviate from baseline levels by the same amount; namely, the change in WTI crude oil prices forecast by Global Insight.

The contributions to the domestic oil supply from the SPR were also calculated by Global Insight. They were converted to quadrillion BTU before they were input into the GI model.

In Step 1, the team assumed that the Federal Reserve would adjust the effective federal funds rate in response to changes in the civilian unemployment rate and the rate of Consumer Price

Index (CPI) inflation. They next imposed the model’s monetary reaction function that mimics the actions of the Federal Reserve. Heritage economists excluded the GI model’s exchange rate variables, solved the model, and used this new forecast as the starting point for Step 2.

Step 2. The team adjusted the response of real non-residential investment in mines and wells on the advice of economists at Global Insight. Global Insight recommended this move because in the current version of the Global Insight model, this variable is very responsive to oil price shocks. As a result of these discussions, the team cut the mines and wells variable by half from the baseline forecast. They then ran the model again with these adjustments, and the new forecast was used as a starting point for Step 3.

Step 3. Next, the team neutralized the relative price effects of oil-related energy products and adjusted world GDP to be consistent with these prices. U.S. trading partners would likely face the same price changes as the U.S. and take similar hits to their GDP from an oil price shock. Neutralizing the relative price effects and adjusting world GDP helped to ensure that the final simulation results reflect these shared effects.

The team neutralized the relative price effects by adjusting the baseline. They made adjustments, first, by calculating the deviation from baseline in the Global Insight model’s variable for the U.S. Producer Price Index excluding energy and, second, by applying that deviation to the model’s two variables for foreign producer price indices.

They adjusted foreign GDP in the model by modifying key indices of the real trade-weighted GDP of U.S. trading partners. The team then solved the model and saved the forecast. This new forecast was used to generate the summary results spreadsheets.

The policy prescriptions of all teams were analyzed for quantifiable impacts on the U.S. economy. These impacts came from two main areas: 1) poli-

7. Carafano and Beach, “If Iran Provokes an Energy Crisis: Modeling the Problem in a War Game.”

8. *Ibid.*

cies that affect petroleum price and 2) domestic policies that change U.S. government spending. The economic impact of the world's response in conjunction with the U.S. response on the U.S. economy was simulated using the Global Insight 30-year macroeconomic model as follows:⁹

a) Building on the previous simulation, the Heritage team estimated the impact of the world's increased supply response on the import price of oil by assuming a short-run vertical supply curve and an elasticity of demand equal to 0.08. The effect of 3 million barrels per day released into the world market lowered the import price of oil by 15 percent. The previous import price (estimated from the

reduction in supply from the attack) is also reduced by 15 percent and made exogenous.

b) The United States military response has an economic impact since higher military involvement will increase government spending. This increased spending was estimated by the team to be \$30 billion per quarter for 10 quarters (until the end of 2010). The national defense spending variable was increased by this amount and made exogenous.

c) The model was solved and results obtained with and without the national responses. The forecast was used to generate the summary results reported above.

9. The methodologies, assumptions, conclusions, and opinions presented here have not been endorsed by and do not necessarily reflect the views of the owners of the Global Insight model or their employees. *Fortune 500* companies and numerous government agencies use Global Insight's Short-Term Macroeconomic Model to forecast how changes in the economy and public policy will likely affect major economic indicators. Additional information on the simulation methodology is available upon request.