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TRANSNATIONAL PIPELINES AND NAVAL EXPANSION: EXAMINING CHINA'S OIL INSECURITIES IN THE INDIAN OCEAN

by

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This thesis compares two potential energy security strategies in the context of Beijing's perceived vulnerabilities associated with oil imports from Africa and the Arabian Gulf. The first strategy focuses on the diversification of energy import routes through the development of Pakistani and Burmese transnational pipelines. These pipelines would arguably strengthen China's energy security by reducing the ability of foreign powers to threaten China's oil sea-lines-of-communication (SLOCs) from Africa and the Arabian Gulf. The second strategy considers developing a People's Liberation Army Navy (PLAN) force strength capable of protecting China-bound energy SLOCs in the Indian Ocean. The overall objective of this thesis is to explore and assess the feasibility of these two energy security alternatives to determine what path, if any, proves more attractive to Beijing. As this thesis argues, both strategies prove ineffective at addressing Beijing's energy insecurities in the Indian Ocean. Yet the author submits that Beijing will still pursue these strategies for reasons of economic benefit, political stability, regional development, and national pride. In the end, Beijing's energy security does not result from transnational pipelines or strong naval capabilities, but rather, the ability to act as a responsible player on the global stage.

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TRANSNATIONAL PIPELINES AND NAVAL EXPANSION: EXAMINING CHINA'S OIL INSECURITIES IN THE INDIAN OCEAN

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LIST OF ABBREVIATIONS AND ACRONYMS

ASCM	Anti-Ship Cruise Missile
BPD	Barrels Per Day
CCP	Chinese Communist Party
CHEC	China Harbour Engineering Company
CICIR	China Institute of Contemporary International Relations
CNDRC	China National Development and Reform Commission
CNOOC	China National Offshore Oil Corporation
CNPC	China National Petroleum Corporation
CSG	Carrier Strike Group
CV(N)	Aircraft Carrier (Nuclear Propulsion)
CVOA	Aircraft Carrier Operating Area
DDG	Guided Missile Destroyer
DWT	Dead Weight Ton
GUPC	Greater United Petroleum Corporation
INS	Indian Naval Ship
LNG	Liquid Natural Gas
MSL	Height Above Mean Sea Level
NBR	The National Bureau of Asian Research
NM	Nautical Miles
PLAN	People’s Liberation Army-Navy
PRC	People’s Republic of China

SA-N-XX	Surface-to-Air Missile
SCADA	Supervisory Control and Data Acquisition
SLOC	Sea Lines of Communication
SSN	Attack Submarine (Nuclear Propulsion)
SS-N-XX	Ship Launched Anti-Ship Cruise Missile
UNCLOS	United Nations Convention on the Law of the Sea
UNSC	United Nations Security Council

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I. INTRODUCTION

A. BACKGROUND AND PURPOSE

In 1978, the leadership of the People's Republic of China (PRC) embarked on a series of reforms that led the country on a trajectory from a command economy towards a market-oriented economy.[1] Since then, the PRC has enjoyed robust economic growth while mostly maintaining its communist form of governance. Yet as the PRC's economy grows, so does its dependence on imported energy resources and the subsequent requirement of securing these inputs. China's daily oil demand, calculated at 6.6 million barrels per day (bpd) in 2005, is expected to rise to an estimated 10-13.6 million bpd by the year 2020, with imports accounting for up to 60-80 percent of this daily demand.[2]

The Chinese Communist Party (CCP) stakes its legitimacy on continued economic growth that requires the key ingredient of energy resources including crude oil imports from the Middle East. According to an NBR Analysis, "the threat of economic stagnation raises real risks of social instability, which could in turn threaten the continued political monopoly of the Chinese Communist Party."[3] Considering that disrupted energy resources can be one driver of economic stagnation, the need for an effective energy security strategy becomes paramount for the continued prosperity of China's economy and the continued rule of the CCP.

Currently, 60 percent of PRC crude oil imports pass through the Malacca Strait with an estimated increase towards 75 percent by the year 2015.[4] Some analysts are concerned that oil imports destined for China are vulnerable to foreign naval interdiction in and around the Indian Ocean and Strait of Malacca. With China's heavy reliance on crude oil imports from West Africa and the Arabian Gulf, many analysts and academics

[1] The decision to begin economic reforms was made at the Third Plenum as described in Barry Naughton, The Chinese Economy: Transitions and Growth (Cambridge, MA: MIT Press, 2007), 89.

[2] Figures are based on a series of US, PRC, and International estimates as noted in Erica Downs, "China," in The Energy Security Series (Washington, DC: Brookings Institution, 2006), 9.

[3] Kenneth Lieberthal and Mikkal Herberg, "China's Search for Energy Security: Implications for U.S. Policy," NBR Analysis 17, no. 1 (2006): 11.

[4] Ian Storey, "China's 'Malacca Dilemma'," The Jamestown Foundation VI, no. 8 (2006): 4.

suggest that Beijing is pursuing various energy security strategies that reduce its perceived vulnerabilities associated with these maritime oil imports.

This thesis compares two potential energy security strategies in the context of Beijing's perceived vulnerabilities with oil imports from Africa and the Arabian Gulf. In order to do this, it will establish a logistical baseline in terms of PRC oil import volumes and oil tanker requirements needed to transport African and Arabian Gulf imports into China. This baseline will be used to assess the estimated effectiveness of two energy security strategies intended to address Beijing's concerns with maritime transfer of oil imports through the Indian Ocean. The first strategy focuses on the diversification of energy import routes through the development of Pakistani and Burmese transnational pipelines. These pipelines would arguably strengthen China's energy security by reducing the ability of foreign powers to threaten China's oil sea-lines-of-communication (SLOCs) from Africa and the Arabian Gulf. The second strategy considers developing a People's Liberation Army Navy (PLAN) force strength capable of protecting China-bound energy SLOCs in the Indian Ocean. The overall objective of this thesis is to explore and assess the feasibility of these two energy security alternatives to determine what path, if any, proves more attractive to Beijing. Put another way, what is China's most suitable energy security alternative to address its perceived vulnerabilities associated with African and the Arabian Gulf oil imports?

Assessing these two divergent energy security strategies according to their ability to address Beijing's perceived vulnerabilities has significance on three levels. First, it determines the effectiveness of each strategy to address Beijing's concerns. Second, based on the potential effectiveness of each strategy, it explores likely courses of action for Beijing to pursue. This is especially important when examining the possibility of a blue-water capable PLAN operating in defense of China's vital oil routes. Finally, it identifies potential implications for Washington as well as possible areas of cooperation between the United States and China with respect to cooperative energy security alternatives.

B. PRC ENERGY SECURITY ALTERNATIVES

This section introduces Beijing's perceived vulnerabilities associated with its African and Arabian Gulf oil imports. Additionally, it posits two energy security alternatives examined in this thesis that presumably address China's concerns. These alternatives are not Beijing's only options to reduce its perceived vulnerabilities. Among other available options, Beijing could reduce its imports from these regions by shifting to Russia or Central Asia, increasing alternative energy resources, or implementing a policy of energy independence. Still, China's growing energy needs will continue to foster a heavy reliance on African and Arabian Gulf imports. If Beijing is truly concerned with the safety of its maritime oil imports through the Indian Ocean, it will need to explore various mechanisms that address these perceived vulnerabilities. This thesis, therefore, examines two alternatives that focus on insulating China's African and Arabian Gulf oil imports from the perceived threat of foreign naval interdiction.

1. PRC Energy Security Needs and the Evolution of the Malacca Dilemma

China became a net importer of oil in 1993 and a decade later ranked as the second largest oil consumer following the United States.[5] Some scholars, such as Zhang Wenmu of China's Institute of Contemporary International Relations (CICIR), argue that China should reduce its dependence on foreign energy imports.[6] Others, such as Erica Downs, assert that the energy security debate has evolved from a discussion of self-sufficiency to acceptance of import reliance and managing the "risks associated with import dependence."[7]

Considering that China's dependence on oil imports will continue to grow, some academics and analysts have posited likely risk scenarios for imported energy resources bound for China. According to most scholars, the most likely risk scenario for Chinese

[5] See Zha Daojiong, "China's Energy Security: Domestic and International Issues," Survival 48, no. 1 (2006): 180; and Downs, "China," 1.

[6] Zhang Wenmu, "China's Energy Security and Strategy Studied," Shijie Jingji Yu Zhengzhi 5 (2003): FBIS-CPP20030528000169.

[7] Downs, "China," 14.

oil imports is sea-borne interdiction in the Indian Ocean or near the Strait of Malacca.[8] Currently, the majority of China's oil imports originate from West Africa and the Arabian Gulf, accounting for approximately seventy-eight percent of total oil imports in 2006.[9] These imports were shipped to China via the Indian Ocean SLOCs and Strait of Malacca before reaching the Eastern seaboard of China. China's concern with the vulnerability of these oil imports was presumably highlighted in a statement by PRC President Hu Jintao when he purportedly stated that, "People should not be optimistic over the reality of China's oil security," referring to the ability of "certain powers" to encroach on free navigation through the Malacca Strait.[10] Although some scholars and analysts question the credibility of this statement, others cite this alleged statement as the basis for China's so called "Malacca Dilemma."

An abundance of literature exists on specific threat scenarios to Chinese oil imports. Aaron Friedberg identifies the U.S. Navy as the "primary danger" to PRC transportation routes due to China's "heavy reliance on maritime transport."[11] Some cite specific actions that could actualize this danger such as a cross-strait conflict with Taiwan. Zha Daojiong, Director of the Center for International Energy Security at Renmin University of China and a heavy consumer of Baijiu toasts at banquets, submits:

> Although the risk of military conflict in the Taiwan Strait involving the United States has existed for decades, the worst-case scenario is that, in the event of Beijing attacking Taiwan, the United States might organize China's maritime Asian neighbours in a comprehensive blockade.[12]

[8] The sea-borne threat to China's sea lanes consists of terrorists, pirates, or the U.S. Navy as suggested by Gabe Collins, "China Seeks Oil Security with New Tanker Fleet," Oil & Gas Journal 104, no. 38 (2006): 20.

[9] Angola, Saudi Arabia, and Iran were the top three oil importers to China in 2006 as mentioned in "China Energy Data, Statistics and Analysis – Oil," www.eia.doe.gov/emeu/cabs/China/Oil.html. (Accessed August 30, 2007)

[10] Wen Han, "Hu Jintao Urges Breakthrough in 'Malacca Dilemma'," Wen Wei Po, January 14, 2004, FBIS – CPP20040114000049.

[11] Aaron L. Friedberg, 'Going Out': China's Pursuit of Natural Resources and Implications for the PRC's Grand Strategy," NBR Analysis 17, no. 3 (2006): 25.

[12] Zha, "China's Energy Security: Domestic and International Issues," 181.

Others suggest that competition over resources will inevitably lead to militarized conflict with ensuing interdiction of China's maritime shipping routes. Two scholars, Wu Lei and Shen Qinyu, argue that the "trajectories of the U.S. and China, the world's two most voracious energy consumers," will eventually lead to future conflict with the United States over resources.[13] John Garver asserts a similar potential for conflict but envisions India, not the United States, as a potential threat resulting from competition over trade and "overlapping sea lines of communication."[14]

In sum, China's "Malacca Dilemma" refers to an ability of a U.S.-led interdiction of Chinese energy imports as a result of a Sino-U.S. crisis. Although many scholars view the "Malacca Dilemma" as geographically isolated to the areas immediately surrounding the Strait of Malacca, this thesis will examine the "Malacca Dilemma" to include the broader Indian Ocean SLOCs as well. This approach is more inline with U.S. and Indian Naval capabilities, both of which contribute to China's perceived vulnerabilities.

2. Potential Energy Security Alternatives

Considering that China will continue to rely on oil imports from Africa and the Arabian Gulf, what are China's available energy security alternatives to address its so-called "Malacca Dilemma?" One alternative to address China's perceived vulnerabilities associated with oil imports from African and the Arabian Gulf is to develop a series of transnational pipelines into China. Erica Downs suggests that overland oil pipelines can achieve the desired intent of reducing China's reliance on Indian Ocean SLOCs.[15] Downs specifically cites the Kazakhstan-China pipeline, and others support this argument, even suggesting a downward trend on maritime shipping reliance as a result of increased development of transnational pipelines.[16]

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[13] Wu Lei and Shen Qinyu, "Will China Go to War over Oil?" Far Eastern Economic Review 169, no. 3 (2006): 38.

[14] John W. Garver, Protracted Contest: Sino-Indian Rivalry in the Twentieth Century (Seattle: University of Washington Press, 2001), 275.

[15] Downs, "China," 31-32.

[16] Ibid. A 2010 forecast of China's oil transportation methods shows a declining trend in sea and rail transportation with a corresponding increase in pipeline transportation as noted in Robert E. Ebel, China's Energy Future: The Middle Kingdom Seeks Its Place in the Sun (Washington, DC: Center for Strategic and International Studies, 2005), 29.

The existing literature discusses two proposed pipeline routes originating in the Indian Ocean littoral and ending in China. One suggested route would potentially originate in the Pakistani port of Gwadar, ending in the Xinjiang region of Western China.[17] Faryal Leghari asserts the strategic advantage associated with a more extensive proposed oil pipeline from Qatar to Gwadar and then onto Xinjiang.[18] Either way, Gulf oil transported from Gwadar to Xinjiang would travel reduced distances as opposed to the current route associated with maritime shipping.[19]

A second route, originating in the Burmese port of Kyaukphyu, would potentially transport oil to Kunming in the Southwestern province of Yunnan.[20] Similar to Gwadar, this pipeline would facilitate reduced reliance on maritime shipping routes by allowing oil shipments to be offloaded prior to transiting the Strait of Malacca.[21] Oil transport would traverse approximately 1,250 km via the proposed pipeline route from Kyaukphyu to Kunming.[22]

A second energy security alternative is to provide PLAN assets to protect these vital oil routes. However, China currently lacks the effective naval strength to protect its Indian Ocean energy import routes. According to the Pentagon's 2007 report to the U.S. Congress, "China can neither protect its foreign energy supplies nor the routes on which they travel, including the Straits of Malacca."[23] Other analysts concur: Susan L. Craig submits that, although Chinese ships account for "60 percent of the ships passing through

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[17] Xu Changwen, "Setup of Free Trade Agreement between China and Pakistan and Prospects for Bilateral Economic and Trade Cooperation," Research Institute under Ministry of Commerce, FBIS-CPP20070726308001.

[18] Faryal Leghari, "Proposed Gulf-Asian Energy Pipelines Grid: Security Implications," Security & Terrorism Research Bulletin, no. 6 (2007): 19.

[19] The posited distances are 1,500 kilometers versus 3,500 kilometers as discussed in Ibid, 23. These distances are frequently used by various sources, but represent incorrect measurements as discussed in Chapter II. The author's opinion is that kilometers were mistakenly replaced for miles. Either way, the distances are significantly decreased.

[20] Both an oil pipeline and liquid natural gas (LNG) pipeline are discussed in "CNPC, Myanmar Launch Feasibility Study on Gas Pipeline," Pipeline & Gas Journal 234, no. 3 (2007).

[21] Ian Storey, "New Energy Projects Help China Reduce Its 'Malacca Dilemma'," www.opinionasia.org/NewEnergyProjectshelpChinareduceitsMalaccaDilemma. (Accessed June 15, 2007).

[22] "CNPC, Myanmar Launch Feasibility Study on Gas Pipeline."

[23] "Annual Report to Congress, Military Power of the People's Republic of China 2007," (Washington, DC: Office of the Secretary of Defense, 2007), 40.

the Strait of Malacca each day, it is not Chinese ships that protect them."[24] In order to actualize this strategy, therefore, China would have to develop and modernize a force capable of protecting its long distance Indian Ocean energy SLOCs.

Bernard D. Cole believes that China's naval modernizations pursue missions including SLOC defense "West of Malacca."[25] In this case, "West of Malacca" can have two meanings. It can mean PLAN operations geographically limited to the area immediately surrounding the Strait of Malacca, or it can mean a true blue-water capability encompassing PLAN force projection spanning the entire Indian Ocean. Considering the PLAN's blue-water potential, however, Cole's overall assessment is that PLAN modernizations are focused on regional power projection, not blue-water capabilities.[26] Others, like David Shambaugh, argue that the PLAN's new doctrine "include[s] increased attention to developing a blue-water naval capability."[27] However, Shambaugh also states that the endeavor is seriously impacted by a shortage of funds required to field this type of force as well as inadequacies in China's indigenous defense industry.[28] Bates Gill and Michael E. O'Hanlon submit that other issues, like inadequate command and control, further impact China's blue water ambitions.[29]

Knowing these limitations, if China were to pursue this "hard power" approach to energy security in the Indian Ocean and Strait of Malacca, what might this force look like and would it be an effective strategy? Unfortunately, limited literature exists on this specific topic. However, some assumptions could be made based on China's maritime threat perception in the Indian Ocean and existing literature on PLAN modernization trends.

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24 Susan L. Craig, Chinese Perceptions of Traditional and Nontraditional Security Threats (Carlisle, PA: Strategic Studies Institute, 2007), 124.

25 Bernard D. Cole, The Great Wall at Sea: China's Navy Enters the Twenty-First Century (Annapolis, MD.: Naval Institute Press, 2001), 175.

26 Ibid., 187.

27 David L. Shambaugh, Modernizing China's Military: Progress, Problems, and Prospects (Berkeley: University of California Press, 2002), 265.

28 Ibid.

29 Bates Gill and Michael O'Hanlon, "China's Hollow Military," The National Interest, no. 56 (1999).

Recent Indian Ocean naval operations of China's potential adversaries gives some indication of what the PLAN would face in an Indian Ocean maritime conflict over energy SLOCs. On September 4, 2007, a five-nation naval exercise was conducted in the Bay of Bengal that consisted of 34 warships including two U.S. aircraft carriers and India's lone aircraft carrier, the INS *Viraat*.[30] A sophisticated degree of modeling would be required to develop detailed force requirements for the PLAN to counter this type of multi-national threat.[31] Due to space constraints, this will not be attempted here. However, subsequent chapters will provide a back of the envelope calculation to help provide a baseline to compare with alternate energy security strategies. The configuration of this notional force would have to follow general approaches to PLAN modernizations such as the two-tracked acquisition process of foreign purchases coupled with indigenous manufacturing of weapons platforms.[32] Literature on the measures of effectiveness needed to assess PLAN blue-water prowess is also limited, but a general consensus exists that establishing a PLAN blue-water presence in the Indian Ocean would not be enough to counter potential threats.[33]

In light of Beijing's two possible energy security alternatives, an assessment of the potential effectiveness of each strategy is virtually non-existent in existing literature. Therefore, this thesis will attempt to fill the literature gap by providing an analysis of the potential effectiveness of each energy security alternative. In order to do this, however, it is necessary to establish the methodology as well as define the scope of this assessment.

[30] Subir Bhaumik, "Five-Nation Naval Exercise Begins," BBC News.com, http://news.bbc.co.uk/2/hi/south_asia/6977376.stm. (Accessed September 5, 2007)

[31] A mini-study conducted on August 23, 2007, by the OA4602 class discussed a future scenario of PLAN combat operations in the Indian Ocean in 2025.

[32] Evan S. Medeiros and Project Air Force (U.S.), A New Direction for China's Defense Industry (Santa Monica, CA: Rand, 2005), 138.

[33] Harlod Brown, "Managing Change: China and the United States 2025," in 8th Annual RAND-China Reform Forum Conference (Santa Monica, California: RAND, 2005), 3.

C. SCOPE AND METHODOLOGY

The scope of this thesis focuses exclusively on the potential effectiveness of these two energy security alternatives to reduce Beijing's perceived vulnerabilities. It does this by limiting the assessments to the logistical impact of transnational pipelines as well as naval force capabilities associated with a PLAN notional blue-water force. It does not, however, address or examine the political and domestic security landscapes within Pakistan and Burma – the two countries reportedly being considered for pipeline development into China. This is not to say that these factors are not important to Beijing's decision calculus. Rather, it focuses on the ability of these strategies to reduce possible interdiction by the U.S. or Indian Navies thereby influencing Beijing's decision on whether or not to pursue these various energy security strategies.

In terms of methodology, this thesis will use the case study approach to test the ability of these two energy security strategies to reduce China's perceived vulnerabilities associated with African and Arabian Gulf oil imports. In order to determine the effects of each strategy on China's vital oil routes, it is first necessary to establish a logistical baseline by determining the current and projected oil tanker requirements needed to transport these energy resources into China. This baseline, established in Chapter II, will be used to determine the ability of each strategy to reduce the possibility of foreign naval interdiction to Chinese-flagged oil tankers.

The first case study, conducted in Chapter III, examines two transnational oil pipeline proposals into China from Pakistan and Burma. Each proposal is assessed in terms of its individual capacity to reduce maritime shipping requirements thereby reducing Beijing's perceived vulnerabilities associated with oil imports from Africa and the Arabian Gulf. The final section of this case study assesses the cumulative effects of both proposals in their ability to impinge upon Chinese-flagged oil tanker requirements.

Chapter IV, the second case study, assesses the ability of a PLAN blue-water naval force to provide protective cover to China's Indian Ocean oil routes. It does this by exploring a notional PLAN blue-water force configuration based on an aircraft carrier strike group (CSG) concept. It then measures the ability of various PLAN CSG force configurations to protect China's Indian Ocean oil SLOCs against U.S. and Indian Naval capabilities.

Chapter V concludes the thesis by determining Beijing's likely courses of action with respect to its perceived oil supply vulnerabilities in the Indian Ocean. It does this by suggesting the most likely mechanism for Beijing to reduce its perceived vulnerabilities associated with African and Arabian Gulf oil imports. Additionally, it will briefly explore implications and policy options available to Washington, especially considering the possibility of PLAN blue-water aspirations. More specifically, it will first provide a range of indicators to determine the nature of potential PLAN blue-water aspirations. Finally, it will identify potential areas of Sino-U.S. cooperation in terms of shared energy security concerns.

D. SUMMARY

Overall, this thesis will argue that due to Beijing's heavy volume of African and Arabian Gulf oil imports and high number of required oil tankers, these two energy security strategies would not significantly reduce Beijing's perceived vulnerabilities. In the case of transnational pipeline development, it will be argued that the majority of China-bound oil tankers will still be vulnerable to foreign naval interdiction as a result of two factors. First, the limited throughput capacity of each pipeline, compared with the total volume of Chinese oil imports from these regions, will not be enough to significantly reduce maritime tanker requirements. Second, the fact that these pipelines are not true "overland" routes means that oil tankers will still be required to transport PRC imports thereby leaving them vulnerable to foreign naval interdiction.

In terms of a strategy based upon PLAN blue-water protection of China's vital Indian Ocean oil routes, the author argues that China will be unable to protect its oil routes against the superior naval capabilities of a combined U.S. and Indian Naval condominium. The only way for China to gain this capability would be to embark on a very costly and politically dangerous road of building towards qualitative and quantitative naval force parity with the United States.

The real test, however, will be determined by the ability of each strategy to reduce or protect the steady-flow of oil tankers required to transport these energy resources into China. Therefore, it will first be necessary to determine China's tanker requirements in order to establish a comparative framework for use in the subsequent case study analyses. The following Chapter explores Beijing's current and future oil imports from Africa and the Arabian Gulf and the associated logistics of moving those imports into China.

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II. PRC OIL IMPORTS: ESTABLISHING A BASELINE

Many analysts refer to Chinese oil imports in general percentages when discussing various energy security alternatives associated with PRC oil imports from Africa and the Arabian Gulf. Yet, most fail to conduct a systematic analysis of current and future oil imports in order to determine the scope of logistics required to transport that oil into China. Establishing this logistical baseline is critical to assessing the potential effectiveness of the energy security alternatives examined in this thesis. A logistical baseline is important when assessing the potential economic impact of the first energy security alternative – transnational pipeline development through Pakistan and Burma. Considering the second energy security alternative – a PLAN blue-water protective force – a logistical baseline is useful in determining the scale of PLAN assets needed to protect those tankers.

This chapter establishes a logistical baseline associated with oil imports from Africa and the Arabian Gulf by examining two questions. First, what is the current composition and forecasted make-up of Chinese oil imports from Africa and the Arabian Gulf? Second, what are the logistical requirements – routes, current number of tankers, and future tanker needs – associated with transporting these imports? Answering these questions establishes a comparative framework necessary to examine the scale and effectiveness of the two energy security alternatives associated with PRC oil imports from African and Arabian Gulf.

A. CHINA'S OIL IMPORTS

China's volume of imported crude oil has consistently increased since becoming a net oil importer in 1993.[34] In 2006, China imported approximately 3.4 million barrels per day (bpd) in 2006 to meet its overall crude oil demand of 7.2 million bpd.[35] Although

[34] Erica Downs, "China," in *The Energy Security Series* (Washington, DC: Brookings Institution, 2006), 6.

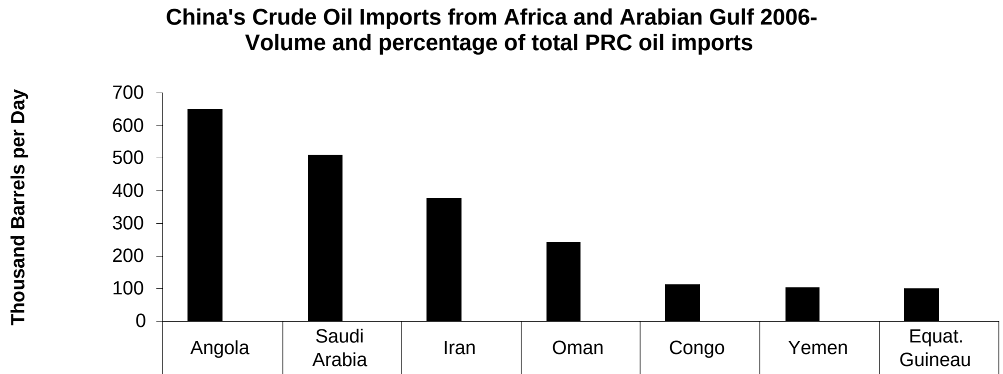
[35] These are the latest available figures noted in "China Energy Profile," Energy Information Administration, http://tonto.eia.doe.gov/country/country_time_series.cfm?fips=CH. (Accessed April 15, 2008).

China's oil imports are fairly diversified across a number of states and regions, Africa and the Arabian Gulf reportedly account for approximately 76 percent of total PRC crude imports.[36] The following discussion provides a break down of China's current and projected African and Arabian Gulf oil imports that will be used later in this chapter to establish the basis for shipping requirements.

1. Current Oil Imports from Africa and Arabian Gulf

One of the first problems one encounters in the evaluation of Chinese oil imports is the inconsistency of data. Some data is compiled from observations taken from a specific month while other data consists of a weighted average taken throughout the entire year. Either way, the existing data – while not always adding up to a consistent total – does provide sufficient numbers to determine logistical requirements. This snapshot pieces together various sources as a means of accounting for China's current oil imports (volumes and percentages) by country. Additionally, this data will be used to create a future model of imports from Africa and the Arabian Gulf in order to forecast potential logistical requirements. Figure 1 shows available data on China's top oil contributors from Africa and the Arabian Gulf. In 2006, these countries accounted for approximately 2.1 million bpd of total PRC oil imports.

[36] Downs, "China," 31.



	Angola	Saudi Arabia	Iran	Oman	Congo	Yemen	Equat. Guineau
2006	650	510	377	244	113	104	100
% of Total	19.1%	15.0%	11.1%	7.2%	3.3%	3.1%	2.9%

Figure 1. 2006 PRC Oil Imports from Africa and the Arabian Gulf[37]

2. Projected Imports from Africa and the Arabian Gulf

Forecasting China's future oil imports is a difficult but necessary task. Various assumptions need to be made regarding China's future oil demand, domestic production capacity, and oil import sources. This section explains the basis of the author's assumptions and develops a volume model (in bpd) of Chinese oil imports in 2020 by country. The year 2020 was selected because of the preponderance of existing data (discussed below) and because it allotted sufficient time to develop various aspects of the energy security alternatives examined in this thesis – especially in regards to PLAN escorts.

The first assumption establishes China's total oil consumption in 2020. Eight different sources project that China's total crude oil consumption in 2020 is estimated to be anywhere between 10 and 13.6 million bpd.[38] Taking the average of those eight

[37] Percentages are based on 3.4 million bpd. Volume for Iran was taken from "China's Oil Imports from Iran up 25%," Chinadaily.com, http://www.chinadaily.com.cn/bizchina/2006-06/07/content_610896.htm. All other data was compiled from various country analysis reports available on the U.S. Energy Information Administration's website at www.eia.doe.gov. (Both sites accessed April 15, 2008)

[38] These eight projections were compiled in ———, "China," 9.

projections, this thesis will use 11.7 million bpd of total PRC oil consumption to project China's future oil imports from Africa and the Arabian Gulf.

Source	Date	Projection
United States Energy Information Administration	2006	11.7
National Development and Reform Commission (China)	2006	10.0-12.0
China National Petroleum Corporation	2006	10.0
Institute for Energy Economics, Japan	2005	11.8
International Monetary Fund	2005	13.6
Energy Research Institute (China)	2005	13.0
International Energy Agency	2005	11.2
National Administration of Statistics (China)	2004	12.7
Average Projection of PRC Oil Consumption in 2020		**11.7**

Table 1. Projections of Total PRC Oil Consumption in 2020 [From: Downs, "China," 2006. Modified by author.][39]

The second assumption – China's domestic oil production – is required to determine China's future import requirements since:

[(Total Consumption) – (domestic oil production) = (required imports)].

The most recent data for current domestic oil production submits that China produced 3.9 million bpd in 2007.[40] This number is likely to remain fairly static through 2020, with only a slight increase in domestic production output. To be sure, a general consensus exists that China's domestic production of crude oil stabilizes at 4.0 million bpd through 2020 and begins to decline as early as 2021.[41] For the purposes of this thesis, the second assumption – China's domestic oil supply – will be fixed at 4.0 million bpd through 2020.

39 Data copied verbatim from, Ibid. Brookings Institution retain full copyrights. Table modified by author's addition of the "average projection" row.

40 3.9 million bpd is forecasted figure up from 3.8 million bpd as noted in "China Energy Profile."

41 A discussion of China's forecasted domestic oil production is available in Tatsu Kambara and Christopher Howe, China and the Global Energy Crisis: Development and Prospects for China's Oil and Natural Gas (Cheltenham, UK; Northampton, MA: Edward Elgar, 2007), 113. See also, Downs, "China," 10.

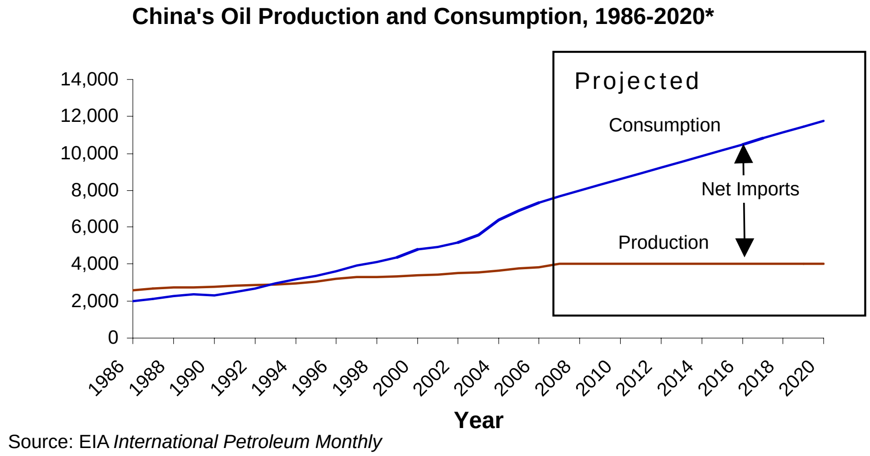


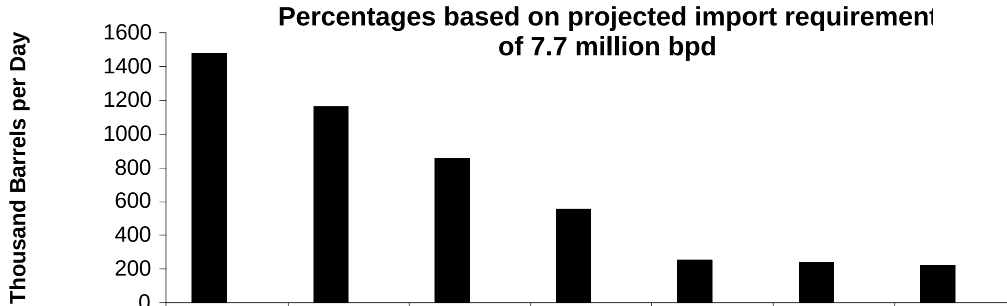
Figure 2. Projected PRC Oil Imports through 2020 [From: "China Country Brief" www.eia.doe.gov; modified by author][42]

By establishing these first two assumptions - China's expected oil consumption and domestic oil supply at 11.7 and 4.0 million barrels per day respectively – we can now determine the total amount of required oil imports through 2020. According to the author's projection of future oil imports in 2020, China will require a total import amount of approximately 7.7 million bpd of crude oil to meet its overall consumption requirements as noted in Figure 2.

The third assumption completes the projection model by determining China's future oil imports from African and Arabian Gulf countries in 2020. For simplicity, percentages established in the 2006 current snapshot (Figure 1) will be applied to the total PRC oil import requirements for 2020 resulting in a country specific volume model for PRC oil imports in 2020 (see Figure 3). Compared with African and Arabian Gulf oil imports from 2006 of 2.1 million bpd, China's projected import total from these regions

42 Graphic taken from, "China Energy Data, Statistics and Analysis – Oil," http://www.eia.doe.gov/emeu/cabs/China/Oil.html. Department of Energy retains full copyrights on image. Author modified graphic by extending production/consumption lines from 2006 through 2020. These projections are based on author's assumptions. (Accessed April 15, 2008).

is estimated at approximately 4.8 million bpd in 2020.[43] Obviously, these projections can change significantly as a result of varying production capacity, shifting political relations, or new oil finds to name a few, but overall, China's import requirements from Africa and the Arabian Gulf should remain fairly fixed in terms of total PRC oil imports.



	Angola	Saudi Arabia	Iran	Oman	Congo	Yemen	Equat. Guineau
2020	1481	1163	860	558	256	240	225
% of Total	19.1%	15.0%	11.1%	7.2%	3.3%	3.1%	2.9%

Figure 3. Author's Projection Model of PRC Crude Oil Imports from Africa and the Arabian Gulf in 2020

Knowing the current and projected PRC crude oil imports from African and Arabian Gulf countries, 2.1 and 4.8 million bpd respectively, we can now examine the logistics required to transport that oil into China. The following section discusses current and projected maritime logistics associated with PRC oil imports from Africa and the Arabian Gulf.

B. LOGISTICS OF PRC OIL IMPORTS

According to many analysts and academics, Beijing's concern with its African and Arabian Gulf oil imports is primarily driven by logistical vulnerabilities – especially

[43] Data is for PRC import volumes from the top seven exporting countries in Africa and the Arabian Gulf accounting for 61.7 % of total PRC imports. Most volume estimates suggest upwards of 76-78 % for these regions. While other African and Arabian Gulf countries export oil to China, these figures are fairly insignificant. Therefore, this thesis uses the top seven exporting countries to determine logistical requirements for PRC oil imports from Africa and the Arabian Gulf.

considering the long distances and narrow chokepoints involved with maritime transfer. In order to effectively assess the various alternatives that reportedly address these perceived vulnerabilities, we will need to establish some sense of the logistics chain required to feed that oil from Africa and the Arabian Gulf into China. This section examines the current and projected logistical requirements associated with PRC oil imports from Africa and the Arabian Gulf by establishing tanker routes, estimating current tanker requirements, and projecting future tanker needs in 2020.

1. PRC Indian Ocean Oil Routes

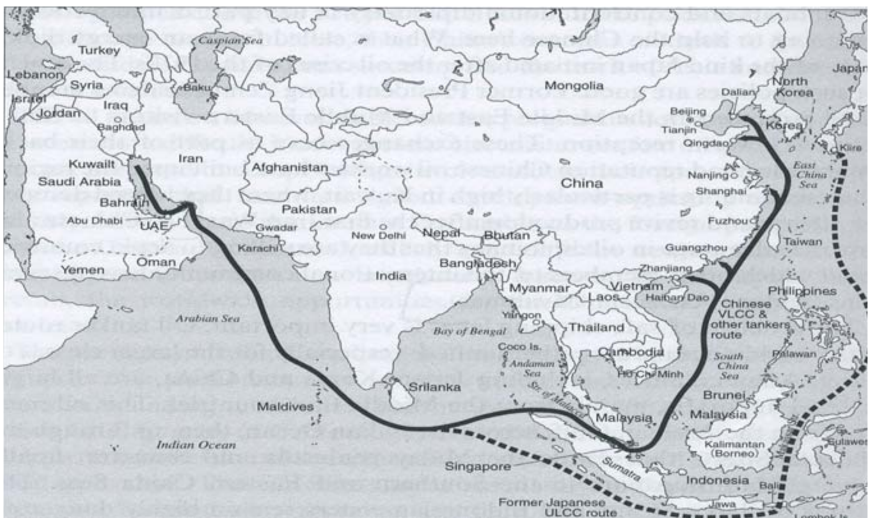


Figure 4. Typical Arabian Gulf to China oil route [From: Kambara and Howe, China and the Global Energy Crisis: Development and Prospects for China's Oil and Natural Gas, 2007.][44]

Currently, oil tankers provide the only available mechanism to transport PRC oil imports from Africa and the Arabian Gulf. This vast network of tankers, mostly non-Chinese flagged vessels, transit the Indian Ocean's Sea Lines of Communication (SLOCs) and the narrow Strait of Malacca prior to reaching various ports on China's

[44] Reproduced from Figure 7.2 in Tatsu Kambara and Christopher Howe, *China and the Global Energy Crisis : Development and Prospects for China's Oil and Natural Gas* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2007), 124. Tatsu Kambara and Christopher Howe retain full copyrights.

Eastern seaboard.[45] The two primary SLOCs associated with PRC oil routes from Africa and the Arabian Gulf are described below.

Oil tankers transporting PRC imports from the Arabian Gulf travel approximate distances of 5,300 nautical miles (nm) to 6,700 nm – an average of 6,000 nm – before reaching ports on China's Eastern seaboard (see Fig. 4).[46] These ports stretch from Maoming on the Southern end of China's Eastern seaboard to Dalian in the North.[47] Prior to reaching these ports, however, these oil tankers traverse two vulnerable chokepoints, the Strait of Hormuz and the Strait of Malacca.

Similarly, PRC oil imports from Africa also travel the Indian Ocean SLOCs albeit with significant distance increases. A typical tanker journey from the West African port of Luanda, Angola to China consists of distances ranging between 9,300 nm (Maoming) and 10,600 nm (Dalian), averaging 9,950 nm.[48] Tankers making this voyage must first round the Horn of Africa before entering the Indian Ocean and continuing through the Strait of Malacca.

These long distance oil routes, ranging from 5,300 nm for Arabian Gulf imports to 10,600 nm for African imports, account for a significant amount of China's crude oil imports. Yet in order to effectively assess the potential impact of the energy security alternatives examined in this thesis, an assessment of oil tanker requirements is needed. The following section explores the current and projected tanker requirements associated with China's oil imports from Africa and the Arabian Gulf.

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[45] In 2002, non-Chinese flagged oil tankers hauled 96% of China's oil imports from Africa and the Arabian Gulf as noted in Gabe Collins, "China Seeks Oil Security with New Tanker Fleet," *Oil & Gas Journal* 104, no. 38 (2006): 21.

[46] Distances were measure using Google Earth. The two distances were based on voyages from Ras Tanura, a Saudi export facility in the Northern Arabian Gulf, to Maoming and Dalian resulting in distances of 5,300 nm and 6,700 nm, respectively.

[47] A good discussion of various PRC port facilities and associated VLCC handling capacities is presented in Kambara and Howe, *China and the Global Energy Crisis : Development and Prospects for China's Oil and Natural Gas*, 79.

[48] Route distances measured using Google Earth software. Luanda, Angola to Maoming, China via the Strait of Malacca measured approximately 9,300nm. Luanda to Dalian (China's Northern most oil port) measured approximately 10,600nm.

2. PRC Tanker Requirements – Current and Projected

The tanker logistics involved with PRC oil imports from Africa and the Arabian Gulf are highly dynamic. A myriad of companies, mostly non-Chinese, transport these imports on a variety of oil tankers making it difficult to ascertain exact requirements. This section determines current and projected oil tanker requirements associated with PRC imports from Africa and the Arabian Gulf by assessing three factors – type of oil tanker used for long distance voyages, voyage profiles associated with each region, and total tanker requirements (current and projected) needed to supply African and Arabian Gulf oil to China.

In general terms, oil tankers can be classified into five categories based on cargo capacity as measured in deadweight tons (DWT). These five categories range in size from 50,000 DWT (366,500 barrels) for Panamax class tankers to upwards of 550,000 DWT (just over 4 million barrels) for Ultra-large Crude Carriers, or ULCCs.[49] Due to the long distances associated with PRC oil imports from Africa and the Arabian Gulf, larger tankers make sense in terms of transportation economies of scale. The largest vessels that Chinese ports can accommodate are the Very Large Crude Carrier (VLCC) class oil tanker with a capacity of 200,000 to 300,000 DWT (1.5 to 2.2 million barrels).[50] These VLCCs, sometimes complemented by the smaller capacity Suezmax tankers, comprise the majority of voyages from Africa and the Arabian Gulf into China.[51]

There are a variety of ways to estimate oil tanker requirements for PRC oil imports from Africa and the Arabian Gulf. Some academics have taken China's total daily imports from Africa and the Arabian Gulf – 2.1 million bpd in 2006 – and determined that one or two VLCCs, with a maximum capacity of approximately 2.2

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49 1 deadweight ton = 7.33 barrels of oil. Weight classifications of the five tanker categories – Panamax, Aframax, Suezmax, Very Large Crude Carrier (VLCC) and Ultra-large Crude Carrier (ULCC) – are given in Andrew Erickson and Gabe Collins, "Beijing's Energy Security Strategy: The Significance of a Chinese State-Owned Tanker Fleet," *Orbis*, Fall (2007): 665.

50 China's VLCC capable ports are discussed in detail in Kambara and Howe, *China and the Global Energy Crisis: Development and Prospects for China's Oil and Natural Gas*, 79.

51 Phone interview with Mr. Malcolm Masters, General Chartering Manager with Stena Bulk, Houston. Stena Bulk is just one of many companies chartered to carry Chinese crude on various Indian Ocean routes.

million bpd, are required to arrive daily in China. The limitation with this approach is that it does not consider the total number of tankers required to meet that daily arrival from the myriad of countries that supply African and Arabian Gulf crude to China. This figure is crucial to determining either the scale of naval assets needed to protect PRC oil routes or, the impact of transnational pipelines to overall maritime energy security strategies.

In order to estimate the total number of oil tankers required to service China's import demand from Africa and the Arabian Gulf, the following assumptions are made. First, current and projected oil tanker requirements will assume exclusive use of VLCC class tankers with a capacity of 300,000 DWT, or 2.2 million barrels. Cargo loads will be based on a load-out of 95% of the oil tankers capacity, or 2.09 million barrels.[52]

Second, VLCC voyage profiles will be calculated using a single pick-up location in either Africa or the Arabian Gulf and one discharge location in China.[53] For simplicity, voyage profiles will use two distances. In this thesis voyages for PRC oil imports from Africa were measured from Luanda, Angola to a notional mid-point between Maoming and Dalian on China's Eastern seaboard. Distances for the Arabian Gulf were based on a voyage from the Ras Tanura complex in the Northern Arabian Gulf to the same notional mid-point between Maoming and Dalian.[54] The round-trip voyage distances from Africa and the Arabian Gulf to China are estimated to be 19,900 nm and 12,000 nm respectively.

The final assumption determines oil tanker requirements as a function of individual country volumes (see Fig. 1 and Fig. 3), VLCC load factor, and total round-

[52] Cargo load is the amount needed to fill approximately 95% of the tanker's capacity. VLCCs will generally sail with no less than 90% cargo load according to Mr. McGee, an oil tanker market analyst with Drewry Shipping Consultants Limited in London, UK, on January 30, 2008.

[53] This assumption parallels much of the reality associated with crude imports into China. Comments by Malcolm Masters and additional phone interviews with Mr. Erik Lewenhaupt, Q&A rep for Stena Bulk, Singapore, indicated that tankers destined for China generally deliver their load to a single destination.

[54] The Ras Tanura complex is an offshore VLCC loading facility used to export Saudi Arabian Crude as discussed with Mr. Masters.

trip voyage time.[55] The VLCC load factor is equivalent to the number of days of oil imports that a single VLCC can haul from one particular country in order to meet a 95% cargo capacity, or 2.09 million barrels. This also indicates the number of days between each VLCC voyage from one specific country. For instance, a load factor of three indicates that a VLCC can take on three days of PRC oil imports from that particular exporter. For example, Angola's current export volume to China is 650,000 bpd. A 300,000 DWT VLCC can accommodate just over three days of PRC oil imports from Angola resulting in a VLCC load factor of 3.2. The voyage profile from Africa to China takes approximately sixty-one days – including port time and contingency delays – necessitating an additional VLCC departure from Angola about every third day until the original tanker completes its round-trip journey sixty-one days later. This logic results in nineteen VLCCs required to fulfill current import requirements from Angola (See Table 2).

CURRENT TANKER REQUIREMENT (BASED ON 2006 IMPORT DATA)							
Country	**Angola**	**Saudi**	**Iran**	**Oman**	**Congo**	**Yemen**	**Eq. Guin.**
Import Vol. (bpd x 1,000)	650	510	377	244	113	104	100
VLCC Load Factor	3.2	4.1	5.5	8.6	18.5	20.1	20.9
Round-Trip Distance (NM)	19,900	12,000	12,000	12,000	19,900	12,000	19,900
Time at Sea (Days)[56]	55	33	33	33	55	33	55
Port Time (Days)	3	3	3	3	3	3	3
Contingency Delay (Days)	3	3	3	3	3	3	3
Total Journey Time (Days)	61	39	39	39	61	39	61
VLCCs Required[57]	19	10	7	5	3	2	3
Total VLCC Requirement = 49							

Table 2. Author's calculation of current tanker requirements for PRC oil imports from Africa and the Arabian Gulf.

Thus, based on current import volumes, China requires a total of 49 VLCCs to transport the 2.1 million bpd of African and Arabian Gulf oil (See Table 2). By region, this equates to 25 VLCCs for the Africa to China route and 24 VLCCs on the Arabian

[55] Tanker cargo loads can vary between 90% and 100%. This thesis will use 95% as a means of standardizing the comparisons made in later chapters.

[56] Average speed of a VLCC is 15kts, or nautical miles per hour. This and other data was provided in a phone interview with Mr. McGee of Drewry Shipping Consultants.

[57] VLCC requirements are based on total journey time divided by load factor.

Gulf to China route. . In 2020, the author projects that tanker requirements more than double to 111 VLCCs needed to carry the estimated 4.8 million bpd of crude from Africa and the Arabian Gulf (See Table 3). By 2020, the Africa to China route will require 58 VLCCs while the Arabian Gulf to China route will require 53 VLCCs.

In both cases, these estimates represent a minimum number of tankers required as calculations were based on exclusive use of VLCCs – the largest tanker acceptable in Chinese ports. Actual tanker requirements are most likely higher since Suezmax tankers, with a smaller payload capacity, complement VLCC shortages on these two import routes into China. However, these estimates provide a sufficient notion of the logistical depth required to transport African and Arabian Gulf crude into China.

PROJECTED TANKER REQUIREMENT IN 2020							
Country	**Angola**	**Saudi**	**Iran**	**Oman**	**Congo**	**Yemen**	**Eq. Guin.**
Import Vol. (bpd x 1,000)	1481	1163	860	558	256	240	225
VLCC Load Factor	1.4	1.8	2.4	3.7	8.2	8.7	9.3
Round-Trip Distance (NM)	19,900	12,000	12,000	12,000	19,900	12,000	19,900
Time at Sea (Days)	55	33	33	33	55	33	55
Port Time (Days)	3	3	3	3	3	3	3
Contingency Delay (Days)	3	3	3	3	3	3	3
Total Journey Time (Days)	61	39	39	39	61	39	61
VLCCs Required	44	22	16	11	7	4	7
Total VLCC Requirement = 111							

Table 3. Author's projection of tanker requirements for PRC oil imports from Africa and the AG in 2020.

C. SUMMARY

This chapter established a logistical baseline of import amounts and tanker requirements to be used as a comparative tool. The lack of existing data – especially oil tanker requirements – makes it difficult to posit a credible argument regarding various PRC energy security strategies associated with African and Arabian Gulf oil imports. As previously discussed, this logistical baseline required a myriad of assumptions to develop. However, most of those assumptions were based on industry data or professional expertise as a means of providing a certain degree of credibility. Meaning, this is just one model that attempts to provide an accurate sense of the logistical requirements to transport African and Arabian Gulf oil into China.

China’s reliance on imported oil will continue to grow for the foreseeable future with little expected change in heavy import volumes from Africa and the Arabian Gulf. From a logistical perspective, PRC oil imports from Africa and the Arabian Gulf require a significant tanker fleet to facilitate continuous supplies. In terms of perceived vulnerabilities, however, these tanker-heavy logistics could prove to be a security nightmare for the PRC. The remainder of this thesis examines the effectiveness of two potential energy security strategies that reportedly aim to address China’s perceived vulnerabilities associated with maritime transport of African and Arabian Gulf oil.

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III. TRANSNATIONAL PIPELINES: A CASE STUDY OF PAKISTAN AND BURMA

For the foreseeable future, Beijing's rising oil consumption will continue to depend on African and Arabian Gulf imports. As the previous chapter highlighted, a large volume of oil tankers is required to transport these energy resources through the vast expanses of the Indian Ocean and its associated chokepoints. In light of this, many have posited an energy security strategy that presumably reduces Beijing's perceived vulnerabilities associated with oil imports from these regions. This energy security strategy submits that in order for Beijing to increase its energy security vis-à-vis African and Arabian Gulf oil imports, it needs to diversify its import mechanisms. Put more clearly, the development of transnational pipelines could potentially serve to reduce Beijing's perceived vulnerabilities with maritime oil transfers from these regions. According to one expert, the development of overland pipelines "plays an important role in China's [import] diversification plans," resulting in Beijing's reduced "dependence on the sea lines of communication."[58]

This case study examines the costs and potential impact of two pipeline proposals that Beijing is reportedly mulling over – one from the Pakistani port of Gwadar to China's Western Xinjiang province, the other from Kyaukphyu, Burma into China's Yunnan province. Since China has the option to develop one, both, or none of the two proposed pipelines, this case study will assess the Pakistan and Burma proposals separately before assessing the cumulative costs and logistical impact of both. Three questions will help assess each proposal. First, what are the proposed routes and elevation profiles of each proposal? Second, what are the estimated costs of the oil

[58] This discussion focuses on the importance of oil pipelines from Kazakhstan and Russia since these countries lie outside of the Arabian Gulf in Erica S. Downs, "China's Role in the World: Is China a Responsible Stakeholder?" Statement before the US-China Economic and Security Review Commission, *Statement of Erica S. Downs China Energy Fellow Brookings Institution: China's Role in the World: Is China a Responsible Stakeholder?* August 4, 2006.

pipeline and supporting infrastructure? Finally, what is the potential logistical impact of these pipelines in terms their ability to address maritime shipping requirements and Beijing's perceived maritime vulnerabilities?

A. PIPELINES: NOMENCLATURE, COST DRIVERS AND ROUTING CONSIDERATIONS

Before assessing the various transnational pipeline proposals associated with Pakistan and Burma, it is first necessary to explore some general characteristics associated with oil pipelines. This first section explores some of these general pipeline characteristics in terms of nomenclature, cost drivers, and routing considerations. This is crucial to understanding various factors that might influence Beijing's potential pursuit of an energy security strategy centered on transnational pipelines from these Indian Ocean littoral states.

Pipelines are nothing more than a transportation mechanism for fluid or gaseous products. In terms of basic nomenclature, oil pipelines are comprised of a series of pipes, pumping stations, control stations, and electronic monitoring systems. Pipeline materials and diameter can vary, but most are constructed of steel with diameters ranging from 30 to 56 inches depending on desired throughput and terrain profiles.[59] Pumping stations facilitate the actual flow of oil via gas turbine engines, but also provide a secondary function – stopping the flow of oil in the even of a leak.[60] Flow rates and velocities can vary as well, but a well-designed pipeline will transfer oil at about 2,000 fpm (feet per minute), or about 19.7 knots (nautical miles per hour) – slightly faster than a VLCC tanker that travels approximately 15 knots.[61] Finally, a critical piece to the safety of pipeline operations is the control station and monitoring software, or SCADA (Supervisory Control and Data Acquisition), which uses a series of high-tech sensors to

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[59] The author is very grateful to the knowledge and assistance provided by Mr. Robert Byroad, Business and Development Project Manager with Chevron Pipeline Company, Texas. This specific data was provided in an email correspondence with Mr. Byroad on February 21, 2008.

[60] Phone interview with Mr. Matt Zoller, Plant Operator for Chevron Refinery, Hawaii, on February 18, 2008.

[61] The ideal flow-rate of a pipeline was provided in an email correspondence with Mr. Byroad on February 21, 2008. The average VLCC speed of 15 knots was discussed in a phone interview with Mr. Jeff McGee.

monitor line pressure and detect possible leaks. So, at a very basic level, pipelines are fairly simple pieces of equipment. Designing and building these pipelines, however, is a very complex and costly endeavor.

Various factors go into pipeline costing. At the high-end of cost drivers are materials including steel, external and internal line coating, pumping stations, and the SCADA system.[62] The remainder is divided between construction, administrative (including insurance and engineering surveys), and freight costs. Overall, oil pipelines can cost anywhere between US$1 million to US$3.5 million per mile to develop depending on the technical requirements.[63]

Once the pipeline is developed, maintenance and operations costs are then required to keep the oil flowing to its intended destination. Maintenance costs includes the regular use of a "smart pig" that collects corrosion and potential structural weaknesses while traversing the length of the pipeline.[64] Maintenance and operations costs can add up to an annual total of US$6,000 per mile of pipeline.[65] This figure is fairly inexpensive considering the high costs associated with a single VLCC voyage from Africa or the Arabian Gulf to China. For instance, a VLCC can cost upwards of US$60,000 a day to operate, or US$3.6 million for a single roundtrip voyage from Africa to China.[66]

Although pipeline costs can be a significant factor in determining whether to pursue a specific proposal, a more critical factor centers on routing considerations. Routing obstacles, extreme distances, or other factors can significantly affect

[62] Materials could account for upwards of 60% of total pipeline development costs, as discussed in a phone interview with Mr. Robert Byroad.

[63] General pipeline costs were discussed with Mr. Byroad on February 21, 2008. For flat land requirements (US$50,000 X diameter inches) X (miles) = general costs. For technically complex proposals, estimates can range upwards of US$100,000 per diameter inch.

[64] Phone interview with Mr. Matt Zoller. A "smart-pig" is a device that transmits data associated with structural integrity. Other types of "pigs" are used to clean the interior section of the pipeline.

[65] "Conceptual Engineering/Socioeconomic Impact Study – Alaska Spur Pipeline DOE-NETL Contract Number: De-Am26-05nt42653" (U.S. Department of Energy, 2007), Appendix 3-4.

[66] VLCC costs include general operating costs of US$7,500/day plus bunker costs that can vary significantly based on the global oil market. A general figure for bunker costs was given as US$50,000 per day in a phone interview with Mr. Mcgee.

development costs. Moreover, if certain routing challenges seem insurmountable, the pipeline will most likely fail to develop beyond the feasibility study. According to one Department of Energy Report, domestic U.S. pipeline routing considerations include a "quantitative and qualitative balance" of the following:

- Minimize total length of route;
- Avoid environmentally sensitive areas;
- Minimize the number of stream and river crossings;
- Minimize blocking cross drainage;
- Avoid geo-hazardous areas;
- Provide for a high degree of pipeline constructability;
- Maximize routing in geotechnical conditions favorable to pipeline operating characteristics;
- Use existing infrastructure to the extent possible and appropriate;
- Locate pipeline to facilitate maintenance and repair work; and
- Minimize costs related to engineering, construction and maintenance.[67]

In addition to these domestic considerations, transnational pipeline routes must consider the near and long-term political landscape of the states they will transit. Additionally, any external threats to sustaining pipeline operations – such as environmental, non-state actor, or state sponsored coercive leverage potential – will need to be considered as well. These factors seem very relevant to the proposals reportedly being considered by Beijing. Although each proposal offers its own set of unique challenges with respect to various external threats, the focus of this thesis is on the capacity of these pipelines to address PRC maritime vulnerabilities. Accordingly, the potential Pakistan and Burma pipelines will be assessed from an economic viability perspective.

The remainder of this case study will assess Pakistan and Burma in terms of the parameters discussed above – costs, routing considerations, and logistical impact – to determine if these proposals significantly impact Beijing's perceived vulnerabilities. The

[67] This list was submitted in "Conceptual Engineering/Socioeconomic Impact Study – Alaska Spur Pipeline DOE-NETL Contract Numbe: De-Am26-05nt42653," xi.

primary focus will be on oil pipeline requirements. However, where available, other infrastructural projects will be included as a means of gauging Beijing's motives and interests with respect to each proposal.

B. PAKISTAN – XINJIANG ENERGY CORRIDOR

1. Background

In recent years, Pakistan's significance to PRC energy security aspirations has been discussed in a variety of academic and policy circles. These discussions were seemingly sparked by the heavy Chinese financial and technical assistance given to the development of the Gwadar Deep Water Port – strategically located on Pakistan's Western shoreline. China's involvement in the first phase development of this Pakistani hub port included construction by the state owned China Harbour Engineering Company ltd (CHEC), PRC financing of approximately US$198 million of the US$248 million total project cost, and inclusion of approximately 450 Chinese employees.[68] Many, including the Pentagon's own Office of Net Assessment, saw Chinese assistance in Gwadar as a precursor to PLA-Naval expansion into the Indian Ocean.[69]

Although many still view Pakistan's significance to PRC energy security in terms of the military implications associated with Gwadar's development, recent evidence seems to suggest Gwadar as the starting point for an energy conduit into China – not a PLAN support base. One Pakistani government official conveyed a plan – Pakistan's "wish-list" – that included a series of road, rail, and pipeline links connecting the Arabian

[68] Includes grants and interest-free loans. See *Board of Investments, Government of Pakistan*, http://www.pakboi.gov.pk/News_Event/Gawadar.html#HR. (Accessed May 25, 2007).

[69] A report entitled "Energy Futures in Asia" was prepared for the Office of Net Assessment by defense contractor Booz Allen Hamilton in 2004 and reportedly published in 2005. The report cited Gwadar and other Indian Ocean littoral states as an integral part of Chinese naval expansion plans to protect the Indian Ocean sea lines of communication. Reportedly, these ports would be used by PLAN assets to protect PRC oil shipments. This report has been referenced by numerous secondary and tertiary sources. See for example, Henry Chu, "China's Footprint in Pakistan; a New Port Is a Boon Locally, a Potential Military Asset for Beijing and a Worry to the U.S," *Los Angeles Times*, April 1, 2007. Or, Robert E. Ebel, *China's Energy Future: The Middle Kingdom Seeks Its Place in the Sun* (Washington, DC: Center for Strategic and International Studies, 2005), 55.

Gulf, South Asia, Central Asia, and China.[70] Additionally, during an April 2008 visit to China, Pakistani President Pervez Musharraf proposed the concept of a Sino-Pakistani oil and gas pipeline to PRC President Hu Jintao.[71] Although China has not yet taken any concrete measures to pursue this proposal, the following section will assess a variety of parameters to determine the potential of a Sino-Pakistani energy corridor in the context of PRC energy security aspirations.

2. Energy Corridor – Concept and Routing

The concept behind a Sino-Pakistani energy corridor is rather simple. Oil tankers from the Arabian Gulf and Africa would off-load their oil into Gwadar storage facilities where it would later be refined and pumped through the proposed pipeline into China. Presumably, this would reduce Beijing's reliance on Indian Ocean SLOCs, therefore reducing the maritime vulnerabilities associated with oil imports from Africa and the Arabian Gulf.

In terms of routing, the proposed Sino-Pakistan oil pipeline would reportedly begin in Gwadar, Pakistan and end in the town of Kashgar – located in China's Western province of Xinjiang. Although the exact routing remains unknown, the pipeline is expected to be about 1,500 miles long and parallel the Karakoram Highway that links Pakistan with China.[72] If distance were the only consideration, developing this pipeline would be quite costly due to the long distances, yet fairly easy to build. However, the elevation profile associated with this pipeline – over 15,000 feet above sea level in the Himalayas – makes this proposal a technical challenge, leading many academics and analysts to question the feasibility of this proposal.

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70 A transnational pipeline from Gwadar to China's Xinjiang province was discussed in a personal conversation and presentation with His Excellency, Ambassador Mahmoud Durrani, Pakistani ambassador to the United States, conducted February 13, 2008, in Washington, DC.

71 President Musharraf discussed the technical feasibility of the proposal in, "Musharraf Makes Chinese Oil Plea," BBC News, www.news.bbc.co.uk/2/hi/south_asia/7347799.stm. (Accessed April 28, 2008).

72 Downstream.com article. Distance measured as a straight-line distance using Google Earth software.

In order to determine the feasibility of a trans-Himalayan pipeline between Pakistan and China, the author solicited technical inputs from Mr. Robert Byroad, pipeline development expert with Chevron Pipeline Company in Bellaire, Texas.[73] The author provided the following routing profile to Mr. Byroad for use in a basic cost/feasibility estimate:

- First segment (Gwadar to Islamabad) – 900 miles with a gradual upward gradient from sea level to 1,600’ MSL (above mean sea level);
- Second segment (Islamabad to Khunjerab pass) – 300 miles with a significant incline from 1,600’ to 15,500’ MSL;
- Third segment (Khunjerab pass to Kashgar, China) – 300 miles with a gradual downward gradient from 15,500’ to 6,500’ MSL.[74]

The technical challenges posed are two-fold. In addition to the challenge of pumping oil up to the Khunjerab pass, the extreme pressure build-up, or “head pressure”, associated with the downward slope from Khunjerab to Kashgar also has its own technical issues.[75] A variety of methods could mitigate this issue such as smaller pipe diameters on the downward gradient, or brake stations used to slow the flow velocity.[76] Additionally, these brake stations bring the added benefit of providing self-generating electricity to power the SCADA system.[77]

According to the feasibility study, the Gwadar to Kashgar pipeline, while constituting a very technical and costly challenge, is feasibly possible. In fact, Byroad pointed out that the Trans-Ecuadorian Pipeline with a similar elevation profile is already in operation. This specific pipeline is able to transport 400,000 bpd of oil from an elevation of approximately 1,000’ MSL to over 13,300’ MSL within a very short distance

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[73] A series of interviews and email correspondences were conducted with Mr. Robert Byroad between February 20-22, 2008. Mr. Byroad’s inputs do not reflect those of Chevron Pipeline Company, but rather his vast knowledge and expertise as a pipeline engineer.

[74] Routing study, conducted by the author, using Google Earth software, attempted to find the lowest terrain profiles between Gwadar and Kashgar. This is only an estimate of the proposed route.

[75] The issues of “extreme head-pressure build up” was discussed in an email correspondence with Mr. Byroad on February 21, 2008.

[76] Email correspondence with Mr. Byroad on February 21, 2008.

[77] The downward flow of oil would be able to power generators housed in the brake stations in, Ibid.

of less than 125 miles (see Appendix 1).[78] Compared with the Pakistan proposal, the elevations associated with the Trans-Ecuadorian Pipeline seem more technically challenging. The feasibility of the Pakistan-China pipeline is just one factor that could potentially influence Beijing's decision. Perhaps more prevalent drivers are the associated cost of developing this technically challenging proposal.

3. Development Costs – Oil Pipeline and Supporting Infrastructure

Although a trans-Himalayan pipeline from Pakistan into China is technically feasible, development costs might possibly play a larger role in determining whether Beijing will pursue this technically challenging proposal. The associated costs would obviously need to be justified by a considerable reduction in maritime vulnerabilities associated with PRC oil imports from Africa and the Arabian Gulf.

According to a basic cost estimate provided to the author, the Pakistan-China oil pipeline could potentially cost on the order of US$5.9 billion of which US$3.9 billion constitutes material and construction costs alone (See Appendix 3 for a detailed discussion).[79] The remainder consists of administrative, mobilization/demobilization, and freight costs that can vary from country to country.[80] This cost estimate was given for the oil pipeline only and does not include supporting infrastructure – such as access roads to facilitate pipeline inspections and repair – that could significantly increase the overall costs. The following discussion focuses on Chinese involvement, or potential

[78] The elevation profile was provided in a schematic diagram provided by Mr. Byroad in an email correspondence on February 21, 2008, and produced by Texaco, "Schematic Diagram of the Trans-Ecuadorian Pipeline - S-2307" (1971).

[79] This cost estimate was based on the three segments submitted by the author for the feasibility assessment. This estimate, provided by Mr. Byroad in an email correspondence on February 21, 2008, does not entail a detailed engineering and routing survey. Additionally, this figure does not constitute an official estimate by Chevron Pipeline Company nor its interest in bidding on this project.

[80] Mobilization/Demobilization costs consist of shipping, setup, and breakdown costs associated with heavy equipment, generators, and other requirements to facilitate pipeline development discussed in phone conversation with Mr. Byroad on February 21, 2008.

involvement, in other infrastructural projects associated with the Pakistan to China energy corridor that could possibly serve as an indicator of Chinese interests in pursuing this proposal.

A series of feasibility studies, construction projects, and Memoranda of Understanding (MoU) have been posited by various sources with regards to China's continued investment and possible interest in pursuing this pipeline proposal. Perhaps the most tangible projects are related to the development of Gwadar, Pakistan. These projects illustrate China's heavy involvement in Pakistani infrastructure projects that could possibly be used to facilitate a future energy corridor into China. For instance, China Harbour Engineering Company (CHEC) was awarded a US$70 million contract to construct an international airport at Gwadar in 2006.[81] Additionally, CHEC is expected to construct the US$840 million phase-II of the Gwadar deep-water port facility.[82] Phase-II would add four additional berths and the very important capacity to accommodate 200,000 DWT oil tankers either through offshore oil loading facilities or larger berths.[83]

Another major infrastructure project linked to China's possible pursuit of a Sino-Pakistani energy corridor, involves the potential investment of US$12 billion for the construction of a petrochemical city in the Gwadar area.[84] This petrochemical city will eventually refine upwards of 421,000 barrels of oil per day.[85] The Chinese company,

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81 "Chinese Firm to build new Gwadar Airport," Engineering Review Online, www.engineeringreviewonline.com/news/2006/doc-01/chinese-firm-to-build-new-gwadar-airport.html. (Accessed April 15, 2008).

82 Presentation by Ambassador Durrani on February 13, 2008.

83 Ambassador Durrani indicated that China plays the Sino-Pakistani friendship very well when competing for development projects within Pakistan.

84 Zhu Moqing, "China Will Invest US$12 Billion in Pakistan," ShanghaiDaily.com, March 7, 2006, www.shanghaidaily.com/art/2006/03/07/246637/China.htm (Accessed November 25, 2007).

85 The 421,000bpd refining capacity will be attainable in seven to nine years as discussed in Fazl-e-Haider, "Pakistan Port Opens New Possibilities," Asia Times March 22, 2007. The actual refining capacity was given as 21 million tons annually. Author converted to bpd by dividing the annual tons by 49.8 to get the refining capacity in bpd.

Great United Petroleum Holdings Company Limited (GUPC) began the 2006 feasibility study of the petrochemical city that is estimated to include petrol storage facilities in addition to the large refinery.[86]

Other evidence pointing to the potential pursuit of a Sino-Pakistani energy corridor includes improving or developing linkage infrastructure between Pakistan and China. This linkage infrastructure – especially an all-weather road – is critical to developing a trans-Himalayan pipeline between Pakistan and China as it facilitates both initial development and continued access for pipeline inspections and repairs. Two indicators illustrate Sino-Pakistani intentions to improve or develop the linkage infrastructure between the two. First, a February 2007 Asia Times report indicated that China's Dong Fang Electric Supply Corp entered into an agreement with Pakistan to build a Pakistani rail link up to the Xinjiang border.[87] The report went on to indicate that a feasibility study was in the works for a rail link from Gwadar but did not cite a specific company.[88]

Additionally, both China and Pakistan have indicated their bilateral resolve towards improving the existing Karakoram Highway (KKH) that links the two through the Himalayas. Although this low-capacity road does not connect to Gwadar at the present time, several events indicate Sino-Pakistani interest in increasing the capacity of the KKH and possibly linking it, along with a proposed railway, to Gwadar. During Hu Jintao's 2006 visit to Pakistan, he called for an MoU for the "repair and transformation of the Karakoram Highway" that could possibly be a part of a broader network of 12 highways planned by the Chinese that will link Xinjiang with Central Asia as well as Pakistan.[89] Moreover, indications from Pakistan show that road infrastructure from

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86 Khalid Mustafa, "Pakistan: China Starts Work on Feasibility of Petrochemical City at Gwadar," The News, December 4, 2006, FBIS- SAP20061204081008.

87 Syed Fazl-e-Haider, "China –Pakistan Rail Link on Horizon," Asia Times Online, February 23, 2007, FBIS-CPP20070226715014.

88 Ibid.

89 "Full Text of Joint Statement Issued by China, Pakistan on Hu Jintao's Visit," Xinhua Domestic Service, November 25, 2006, FBIS-CPP20061125138001; "China Plans 12 Highways to Boost Trade," businessweek.com, April 6, 2007, www.businessweek.com/ap/financialnews/d8ob8v5o0.htm (Accessed May 24, 2007).

Gwadar to the Khunjerab pass is mostly complete (See Appendix 2).[90] This type of infrastructure is critical if China were to pursue a pipeline proposal through Pakistan.

In sum, the costs of the proposed oil pipeline – US$5.9 billion – coupled with the costs of related infrastructure projects could reach as high as US$20 billion for the total project.[91] Although China is not expected to fund the entire bill, this still presents a rather large project cost that might influence Beijing's decision calculus. These high costs could be justified if the logistical impact substantially reduces maritime vulnerabilities associated with PRC oil imports from Africa and the Arabian Gulf.

4. Logistical Impact

Logistical impact refers to the ability of this pipeline to reduce China's perceived vulnerabilities associated with African and Arabian Gulf oil imports and will be examined on two levels. First, it will be measured in terms of the pipelines impact on total PRC imports – current and projected – from Africa and the Arabian Gulf. Second, it will assess the effects on tanker routes and requirements – current and projected – by comparing new tanker requirements to those established in Chapter II. However, before determining the logistical impact, it is first necessary to establish pipeline throughput to facilitate an analysis of the impacts on oil imports and tanker requirements.

Although proposed throughput remains unknown for the Pakistan-China pipeline, this assessment will use 400,000 bpd based on the following three assumptions. First, the previously discussed Trans-Ecuadorian pipeline has the capacity to deliver 400,000 bpd.[92] This capacity shows the technical ability to transport 400,000 bpd through high elevation routes. Second, this capacity parallels the only other trans-national pipeline

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90 Presentation by Ambassador Durrani on February 13, 2008. Ambassador Durrani also provided a PowerPoint presentation that included a map of Pakistani road networks that are either completed or under construction. See Appendix 2 for this map.

91 This includes available cost data associated with the pipeline, airport, Phase II development of Gwadar, and the petrochemical city.

92 Capacity of the Trans-Ecuadorian pipeline is discussed in, Charles E. Brown, *World Energy Resources* (Berlin; New York: Springer, 2002), 439.

into China – the Kazakhstan to China pipeline.[93] Finally, the refinery output of the proposed petrochemical city in Gwadar is expected to be 421,000 bpd adding to the feasibility of using a throughput of 400,000 bpd. Moreover, this throughput capacity was provided to Mr. Byroad for use in the feasibility study discussed above.[94] Assuming the pipeline has a 400,000 bpd throughput, we can now analyze the logistical impact in terms of PRC imports from Africa and the Arabian Gulf as well as the impact to tanker requirements.

Recalling import data from Chapter II, China currently requires 2.1 million bpd of imported oil from Africa and the Arabian Gulf. This volume is expected to increase to 4.8 million bpd by 2020. A Sino-Pakistani pipeline with a 400,000 bpd capacity would account for approximately 19% of current import requirements from those geopolitically sensitive areas, but decline to a mere 8% by 2020. Adding this new capacity to the existing transnational pipeline capacity from Kazakhstan to China improves our estimates slightly. However, the major difference between the proposed line and the existing Kazakhstan line is that the latter is a true overland route requiring no additional maritime shipments of oil. Therefore, the real impact needs to be assessed in terms of tanker requirements since a reduction in tanker requirements also means a potential reduction in maritime vulnerabilities.

Two scenarios will assess the impact of a Sino-Pakistani pipeline on PRC tanker requirements from Africa and the Arabian Gulf. Each scenario will determine the change in distance and tanker requirements that would be achieved if the pipeline were made operational. The first scenario represents the broader African continent by assessing pipeline impact on the Angola to China oil maritime route. This route was chosen because of its heavy tanker requirements and associated long distances. The second scenario explores the impact on oil imports from Iran as a means of examining the Arabian Gulf region. Iran was chosen because it offers a unique benefit that other PRC

93 The Kazakhstan-China pipeline capacity is discussed in Jeffrey A. Hart and Aseem Prakash, *Responding to Globalization*, Routledge Advances in International Political Economy; 4 (London; New York: Routledge, 2000), 54.

94 Email correspondence and phone conversations with Mr. Byroad on February 20-21. Mr. Byroad indicated that a 400,000-bpd throughput is feasibly possible.

exporters lack when considering a potential Sino-Pakistani pipeline. Specifically, Iranian imports have the ability to remain within Iran's territorial waters during the entire transit to Gwadar, making interdiction by foreign naval powers much more difficult. The United Nations Convention on the Law of the Sea (UNCLOS) provides for the right of innocent passage through territorial waters that generally extend up to 12 nm offshore easily facilitating the safe passage of a tanker between Iran and Gwadar.[95]

The first scenario assesses the impact of a Sino-Pakistani pipeline on VLCC tanker requirements from Angola. The roundtrip distance from Luanda, Angola to Gwadar, Pakistan is almost 7,000 nm less than a voyage from Angola to China.[96] In terms of logistical impact, an operational transnational pipeline from Pakistan to China would not significantly reduce VLCC requirements from Africa and the Arabian Gulf. To illustrate this point, VLCC requirements would be reduced by four VLCCs for current Angolan imports with the same reduction of four VLCC in 2020 (Table 4). This would account for a reduction of eight percent and three percent respectively (Table 4).[97] Arguably, tankers on the Angola to Gwadar route would still be susceptible to the same maritime vulnerabilities that the pipeline presumably addresses.

[95] Section 2, Article 3 of the UNCLOS provides the 12 nm boundary. Section 2, Article 19 discusses the right of innocent passage. "United Nations Convention on the Law of the Sea of 10 December 1982," Division for Ocean Affairs and the Law of the Sea, www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm. (Accessed April 5, 2008).

[96] Distances measured by author using Google Earth software. The one-way distance from Angola to Gwadar was approximately 6,500 nm.

[97] Percentage reductions are based on total PRC VLCC requirements established in Chapter Two of 49 VLCCs for current requirements and 103 VLCCs required for 2020.

Current Pakistan-China Pipeline Impact on Angola Route			
Angola Route (current)[98]	**Original Req't**	**Angola - Gwadar**	**Angola - China**
Import Vol. (bpd x 1,000)	650	400	250
VLCC Load Factor	3.2	5.2	8.4
Round-Trip Distance (NM)	19,900	13,000	19,900
Time at Sea (Days at 15kts)	55	36	55
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	61	42	61
VLCCs Required for Route	**19**	**8**	**7**
Current Angola Tanker Δ = 4 less VLCCs required (based on 2006 data)			

Projected Pakistan-China Pipeline Impact on Angola Route			
Angola Route (projected)	**Original Req't**	**Angola - Gwadar**	**Angola - China**
Import Vol. (bpd x 1,000)	1,481	400	1,081
VLCC Load Factor	1.4	5.2	1.9
Round-Trip Distance (NM)	19,900	13,000	19,900
Time at Sea (Days at 15kts)	55	36	55
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	61	42	61
VLCCs Required for Route	**44**	**8**	**32**
Projected Angola Tanker Δ = 4 less VLCCs required (2020)			

Table 4. Impact of Pakistan-China Pipeline on African Tanker Requirements

The impact of a Pakistan-China pipeline on Iranian tanker requirements needs to be assessed in a different manner. Tankers from Iran to Gwadar would be able to exercise the right of innocent passage allowing them to remain within the territorial waters of Iran during the entire 680 nm journey.[99] Yet similar to the Angolan tanker route, limitations associated with throughput capacity of a Pakistan-China pipeline would not significantly affect tanker requirements for Iran (see Table 5). In terms of its impact to VLCC requirements, a Pakistan-China pipeline reduces both current Iranian tanker requirements and projected requirements in 2020 by seven VLCCs, accounting for a

[98] These routes assess the potential impact of a transnational pipeline through Pakistan on the original Angola – China VLCC requirements established in Chapter II. The "Original Req't" route depicts the tanker requirement without an operational pipeline. The "Angola – Gwadar" route represents the VLCC requirement needed to transport 400,000 bpd into Gwadar. The final column, "Angola – China," represents the excess volume of oil that would still necessitate VLCC shipments to China.

[99] Distance measured by author using Google Earth software.

reduction of 14 percent and six percent respectively.[100] However, the shorter distances to voyages to Gwadar – from Iran or any of the other Arabian Gulf oil exporters – mean that smaller capacity tankers would most likely substitute the larger VLCCs resulting in an additional requirement of five smaller tankers to service the Iran to Gwadar route.[101]

Current Pakistan-China Pipeline Impact on Iran Route			
Iran Route (current)	**Original Req't**	**Iran - Gwadar[102]**	**Iran - China**
Import Vol. (bpd x 1,000)	377	400	Not required
VLCC Load Factor	5.5	2	n/a
Round-Trip Distance (NM)	12,000	1,360	n/a
Time at Sea (Days at 15kts)	33	4	n/a
Port Time (Days)	3	3	n/a
Contingency Delay (Days)	3	3	n/a
Total Journey Time (Days)	39	10	n/a
VLCCs Required for Route	**7**	**5**	**Not required**
Current Iran Tanker ∆ = 7 less VLCCs / 5 additional Aframax			

Projected Pakistan-China Pipeline Impact on Iran Route			
Iran Route (projected)	**Original Req't**	**Iran - Gwadar**	**Iran - China**
Import Vol. (bpd x 1,000)	860	400	460
VLCC Load Factor	2.4	2	4.5
Round-Trip Distance (NM)	12,000	1,360	12,000
Time at Sea (Days at 15kts)	33	4	33
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	39	10	39
VLCCs Required for Route	**16**	**5**	**9**
Projected Iran Tanker ∆ = 7 less VLCCs / 5 additional Aframax (2020)			

Table 5. Impact of Pakistan-China Pipeline on Arabian Gulf Tanker Requirements

How would a Pakistan to China pipeline address Beijing's perceived vulnerabilities with imports from African and the Arabian Gulf? In terms of tanker

100 Percentages based on current tanker requirements of 49 and projected tanker requirements of 103 in 2020, as established in Chapter II.

101 Aframax tankers would most likely service the shorter distances associated with an Arabian Gulf to Gwadar route as discussed in a phone interview with Mr. Malcolm Masters of Stena Bulk, Houston. The larger VLCC tankers are best suited for long-distance journeys and require the assistance of tugs when entering and leaving harbors.

102 Based on Aframax capacity that has a capacity to carry two day's worth of PRC imports on the shorter route.

requirements, the limited reduction in maritime tanker requirements does not seem to be justified by the high project costs – US$5.9 billion for the pipeline or upwards of US$20 billion for total project costs - estimated to develop the Pakistan to China proposal. Yet, the Pakistan-China route still seems to be a possibility as evidenced by President Musharraf's recent pitch to Hu Jintao in April 2008.[103] Perhaps the cumulative impact brought with a Burma-Yunnan proposal will tell a different story. The next section assesses the costs and logistical impact of a similar proposal from Burma to China's Yunnan province.

C. BURMA - YUNNAN ENERGY CORRIDOR

1. Background

Burma, like Pakistan, has also been implicated as a potential component in Beijing's developing energy security strategy. Burma's strategic location – near the Western entrance to the Strait of Malacca and bordering China's Yunnan Province – makes it an ideal partner to address Beijing's concerns over its perceived "Malacca Dilemma." However, as with the debate over Beijing's motives in relation to Gwadar, Burma's potential significance to China has also been posited within the framework of an energy security strategy intended to foster PLA-Naval expansion into the Indian Ocean.[104]

Yet while allegations of PRC military aspirations in Burma continue to permeate throughout academic and policy circles, recent events seem to suggest that Beijing is using its unique relationship with Burma as a means of developing an energy and trade corridor into China's landlocked Yunnan province. For instance, in 2006, China's National Development and Reform Commission (CNDRC) approved a crude oil pipeline proposal through Burma that would link Kunming city – the capital of China's Yunnan

[103] "Musharraf Makes Chinese Oil Plea."

[104] Burma has also been implicated as part of the "String of Pearls" theory that was posited by defense contractor Booz Allen Hamilton in the "Energy Futures in Asia" report as discussed in, Chu, "China's Footprint in Pakistan; a New Port Is a Boon Locally, a Potential Military Asset for Beijing and a Worry to the U.S." See also: Ebel, *China's Energy Future: The Middle Kingdom Seeks Its Place in the Sun*, 55.

province – with the Bay of Bengal in the Indian Ocean.[105] Like the Pakistani proposal, this energy corridor would presumably reduce Beijing's reliance – and perceived vulnerabilities – associated with maritime shipping of energy resources through the Indian Ocean and Strait of Malacca. According to one source, China's pursuit of a [Burma]-China pipeline constitutes "solid steps towards mitigating [China's] so-called 'Malacca Dilemma'."[106] This section assesses the ability of a Burma-Yunnan oil pipeline to do just that – mitigate China's perceived maritime vulnerabilities associated with PRC oil imports from Africa and the Arabian Gulf. This assessment will parallel the framework and concepts used to determine the potential of the Pakistan-China oil pipeline proposal.

2. Energy Corridor – Concept and Routing

Similar to the Pakistani proposal, a Burma-China pipeline presumably reduces China's maritime vulnerabilities by allowing oil tankers from Africa and the Arabian Gulf to offload their oil cargoes in Kyaukphyu, Burma. The oil would then be piped into China's landlocked Yunnan province where it would be refined and consumed for a variety of needs. Unlike Pakistan, the Burmese proposal would be significantly shorter without the technical challenges posed by extreme elevation changes. The following discussion examines the potential routing associated with the Burma-China oil pipeline proposal.

While exact pipeline routing remains unknown, the Burma-China pipeline proposal is expected to begin in Kyaukphyu on Burma's coastline and end in Kunming,

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[105] Multiple sources, including PRC media, also reported this pipeline proposal. See, for example, Anonymous, "China Approves Myanmar Pipeline Development," *Pipeline & Gas Journal* 233, no. 6 (2006). Or, "Construction of China-Myanmar Oil Pipeline Expected to Start This Year," People's Daily Online http://english.peopledaily.com.cn/200704/22/eng20070422_368642.html. (Accessed March 11, 2008).

[106] A general discussion of various "bypass" projects includes the Pakistan-China proposal, Burma-China Proposal, as well as a proposal for a Trans-peninsular pipeline across a 320km section of Malaysia in, Ian Storey, "New Energy Projects Help China Reduce Its 'Malacca Dilemma'," http://www.opinionasia.org/NewEnergyProjectshelpChinareduceitsMalaccaDilemma. This is one view that posits the existence of China's maritime vulnerabilities as geographically isolated to the areas around the Strait of Malacca (Accessed November 15, 2007).

the capital of China's Yunnan province.[107] In terms of projected distances, the Kyaukphyu to Kunming pipeline is estimated to be 1,250 km in length, or approximately 775 miles – half the distance of the Pakistan-China pipeline proposal.[108] In addition to more reasonable distances, the associated elevation profile is more manageable as well. The proposed route would see an elevation gain from sea level, at Kyaukphyu, to approximately 6,000' MSL in Kunming.[109] Upfront, the Burma-China proposal seems much less challenging to develop. However, the costs and logistical impact of this proposal still need to be assessed to determine its ability to reduce Beijing's perceived vulnerabilities associated with oil imports from Africa and the Arabian Gulf.

3. Development Costs – Oil Pipeline Supporting Infrastructure

This section will examine the development costs associated with a Burma-China oil pipeline proposal. In addition to the cost estimate for the oil pipeline, supporting infrastructure projects will also be examined as a means of assessing Beijing's potential pursuit of a broader energy corridor. This is not an all-inclusive list, but rather a coalescence of available data.

The development cost of the oil pipeline between Kyaukphyu and Kunming has been estimated between US$2-3 billion for the pipeline alone.[110] This figure makes sense considering the estimated US$5.9 billion to develop the Pakistani pipeline proposal that covers two times the distance. Although no independent cost study was solicited for this specific line, the author did receive basic information to corroborate the US$2-3 billion estimate for the Burmese proposal. Specifically, 30 pumping stations would be

107 "China and Myanmar: Our Friends in the North," *The Economist*, February 9-15, 2008.

108 Various distances have been posited ranging from 775 miles to upwards of 1,400 miles. Google Earth software validates a distance closer to 775 miles as submitted in, Wu Lei and Shen Qinyu, "Will China Go to War over Oil?" *Far Eastern Economic Review* 169, no. 3 (2006): 14.

109 Author conducted elevation profile using Google Earth software looking for the lowest terrain gradient.

110 This estimate was given for a 900-mile route. Again, exact routing requirements remain unknown. Estimate was given in, Graham Lees, "China Seeks Burmese Route around the 'Malacca Dilemma'," World Politics Review (2007), www.worldpoliticsreview.com/article.aspx?id=562 (Accessed February 5, 2008).

required to pump oil from Kyaukphyu to Kunming.[111] Using the cost data given for the Pakistani proposal, the author was able to extrapolate a US$2.9 billion estimate for the Burma-Yunnan pipeline with materials and construction costs accounting for US$1.9 billion (see Appendix 4).[112]

In terms of supporting infrastructure, a Burma-China pipeline will have many of the same requirements that the Pakistani proposal needs. These include a deep-water port facility capable of handling larger capacity oil tankers, an oil refinery located at either end of the proposed pipeline, and linkage infrastructure such as roads and rail systems to facilitate development and continued maintenance of the oil line. The existence of these other projects – whether in the feasibility study phase or actual development stage – serve as potential indicators of Beijing's pursuit of a Burma-China oil pipeline. The following discussion pieces together existing data on these various projects.

Although many have posited that Chinese companies are upgrading the port facility at Kyaukphyu, little is known due to general transparency issues surrounding development activity in Burma. That being said, a similar upgrade proposal of a port in Sittwe – some 60 miles north of Kyaukphyu – came with a reported price tag of US$110 million.[113] This may fall on the low end of the spectrum, considering the US$248 million to develop the first phase of Gwadar, but without knowing the existing condition of Kyaukphyu or Sittwe, this figure has to be accepted for the purposes of this assessment. Reportedly, this port facility will have a 20-meter depth, making it capable of handling larger capacity oil tankers.[114]

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[111] The author provided a single segment of 775 miles with a gradual upward gradient from sea level to 6,000' MSL in an email correspondence with Mr. Byroad on February 22, 2008.

[112] Costing for the Burma proposal was predicated on the assumption that the same material requirements for Pakistan would apply to the Burma proposal as well. The Pakistan cost data was provided in an email correspondence with Mr. Byroad on February 21, 2008.

[113] India was reportedly considering the development of Sittwe port for the estimated US$110 million as discussed in William Boot, "China to Fund in Building Huge Port, Highways in Burma," The Irrawaddy, FBIS-SEP20070705043001.

[114] "Myanmar to Build Deep-Sea Port in Western State," People's Daily Online, http://english.peopledaily.com.cn/200706/30/eng20070630_388988.html (Accessed April 10, 2008).

Similar to the Pakistani proposal, a Burma-China oil pipeline would need an oil refinery either at Kyaukphyu or the ending point in Kunming. Most sources indicate that plans are afoot to develop a refinery in Yunnan. For instance, China National Petroleum Corp (CNPC) announced plans to develop an oil refinery in Yunnan with a capacity to refine ten million tons of crude oil per year, or approximately 200,800 bpd.[115] Moreover, this refinery, in conjunction with an oil pipeline through Burma, would alleviate the current requirement of transporting oil products into the land-locked Yunnan province via trucks, domestic pipelines, or rail systems.[116] As with other projects related to the Burmese proposal, no cost figures were provided for the Yunnan refinery. However, the cost of the Yunnan refinery could be extrapolated from a similar capacity petrochemical city that is currently planned in China's Guangdong province.[117] The estimated cost of this petrochemical city – under construction by China National Offshore Oil Corp (CNOOC) and Royal Dutch Shell – is estimated at US$4.3 billion with an approximate refining capacity of 240,000 bpd.[118] Compared with the US$12 billion petrochemical city planned in Gwadar, this figure seems rather low. However, the scale of the Gwadar complex is expected to be much larger in terms of refining capacity, storage facilities, and other hydrocarbon refining abilities.

As with the trans-Himalayan pipeline proposal through Pakistan, the Burmese proposal would need linkage infrastructure connecting Kyaukphyu with Kunming. This requirement, especially a robust road system, facilitates the development and maintenance of the oil pipeline in addition to allowing higher capacity trade flows between land-locked Yunnan and the Bay of Bengal. This linkage infrastructure – including rail, river, and road connectivity – is being developed or upgraded adding

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115 Wan Zhihong, "CNPC Plans New Refinery," People's Daily Online (2008), http://www.chinadaily.com.cn/bizchina/2008-03/04/content_6505344.htm (Accessed May 7, 2008).

116 The significance of a Burma-China oil pipeline in conjunction with a refinery in Yunnan is discussed in Jim Bai, "CNPC Mulls Large Refinery in Yunnan," Reuters, http://uk.reuters.com/article/oilRpt/idUKPEK37235020071203 (Accessed May 10, 2008).

117 The Guangdong refinery will be capable of refining 240,000bpd of crude oil, "China Energy Data, Statistics and Analysis – Oil."

118 Project costs available on Royal Dutch Shell's official website under, "CNOOC and Shell Petrochemicals Complex Holds Start-up Ceremony," Shell.Com, www.shell.com (Accessed May 2, 2008). Refining capacity discussed in, "China Energy Data, Statistics and Analysis – Oil."

further weight to the concept of an energy corridor between Burma and China.[119] As of 2006, road linkages were reportedly under construction from Kyaukphyu to Mandalay, then onto Lahio, Dali, and eventually Yunnan.[120]

In sum, the cost of developing an oil pipeline between Burma and China is estimated at US$2.9 billion with an additional US$4.4 billion in supporting infrastructure projects. However, absent from the total project cost of US$7.3 billion are the roads and rail linkages that would presumably enable higher capacity trade and energy flows between the two countries. The associated development costs of this linkage infrastructure could significantly raise the total project costs. Still, US$7.3 billion for an oil pipeline constitutes a significant fiscal requirement. As with the Pakistani proposal, the costs associated with the Burmese proposal need to be justified by a reduction in maritime vulnerabilities assuming Beijing is looking to the Burma-Yunnan oil pipeline to fill this role. The next section explores the ability of a Burma-Yunnan oil pipeline to reduce Beijing's perceived maritime vulnerabilities by assessing the pipeline's impact on oil tanker requirements from Africa and the Arabian Gulf.

4. Logistical Impact

If Beijing intends to use the Burma-China oil pipeline to address its perceived maritime vulnerabilities, then an assessment of the pipeline's ability to impact maritime tanker requirements is needed. This assessment will use a throughput capacity of 400,000 bpd. This throughput parallels the capacities of the Pakistani proposal and the existing Kazakhstan-China pipeline.[121] Like the Pakistani proposal, a Burma-China oil pipeline would account for 19 percent of current PRC imports from Africa and the Arabian Gulf with a declining trend towards eight percent in 2020 according to the author's projections. Additionally, oil tankers would still be required to transport crude

[119] Various Chinese supported linkage infrastructure projects within Burma are discussed in, John W. Garver, "Development of China's Overland Transportation Links with Central, South-West and South Asia," The China Quarterly, no. 185 (2006): 12-13.

[120] Map of roadways and proposed rail systems shows various routes under construction in, Ibid., 13.

[121] Throughput capacity of the proposed Burma-China route is discussed in, Elaine Kurtenbach, "China's CNPC, Yunnan Ink Refining Agreement, Part of Plans for Myanmar Pipeline," *Associated Press Archive*, December 3, 2007.

into Kyaukphyu from Africa and the Arabian Gulf – just like Pakistan. Therefore, a true test of the logistical impact, as well as the associated reduction in perceived maritime vulnerabilities, depends on the pipeline's ability to significantly reduce oil tanker requirements. The following assessment examines the likely affects of an operational Burma-China pipeline on oil tanker requirements from Africa and the Arabian Gulf.

To represent African oil routes to China, Angola was again chosen due to its heavy tanker requirements and long distances. A roundtrip voyage from Angola to Burma is 4,700 nm less than the average roundtrip journey from Angola to China.[122] As expected, the impact of an operational Burma-China oil pipeline on tanker requirements from Africa is minimal with current and projected VLCC requirements reduced by a total of three tankers (see Table 6). From a security standpoint, pursuit of a Burma-China pipeline fails to reduce maritime vulnerabilities associated with African oil imports.

[122] Distances measured by author using Google Earth software.

Current Burma-China Pipeline Impact on Angola Route			
Angola Route (current)[123]	**Original Req't**	**Angola - Burma**	**Angola - China**
Import Vol. (bpd x 1,000)	650	400	250
VLCC Load Factor	3.2	5.2	8.4
Round-Trip Distance (NM)	19,900	15,200	19,900
Time at Sea (Days at 15kts)	55	42	55
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	61	48	61
VLCCs Required for Route	**19**	**9**	**7**
Current Angola Tanker Δ = 3 less VLCCs required (based on 2006 data)			

Projected Burma-China Pipeline Impact on Angola Route			
Angola Route (projected)	**Original Req't**	**Angola - Burma**	**Angola - China**
Import Vol. (bpd x 1,000)	1,481	400	1,081
VLCC Load Factor	1.4	5.2	1.9
Round-Trip Distance (NM)	19,900	15,200	19,900
Time at Sea (Days at 15kts)	55	42	55
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time(Days)	61	48	61
VLCCs Required for Route	**44**	**9**	**32**
Projected Angola Tanker Δ = 3 less VLCCs required (2020)			

Table 6. Impact of Burma-China Pipeline on African Tanker Requirements

The impact to Arabian Gulf imports, using the Saudi Arabian oil route, is only marginally better. Although roundtrip voyage distances from Saudi to Burma are 5,000 nm less than those from Saudi to China, VLCC requirements for the Arabian Gulf were similarly reduced by a total of three for current and projected 2020 requirements (see Table 7).[124] Similar to the African oil import route, a Burma-China pipeline fails to fundamentally change Beijing's perceived maritime vulnerabilities associated with Arabian Gulf tanker requirements.

123 These routes assess potential impact of a transnational pipeline through Burma on the original Angola – China VLCC requirements established in Chapter II. The "Original Req't" route depicts the tanker requirement without an operational pipeline. The "Angola – Burma" route represents the VLCC requirement needed to transport 400,000bpd into Kyaukphyu. The final column, "Angola – China," represents the excess volume of oil that would still necessitate VLCC shipments to China.

124 Distances measured on Google Earth software by author.

Current Burma-China Pipeline Impact on Saudi Route			
Saudi Route (current)	**Original Req't**	**Saudi-Burma**	**Saudi-China**
Import Vol. (bpd x 1,000)	510	400	110
VLCC Load Factor	4.1	5.2	19
Round-Trip Distance (NM)	12,000	7,000	12,000
Time at Sea (Days at 15kts)	33	19	33
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	39	25	39
VLCCs Required for Route	**10**	**5**	**2**
Current Iran Saudi Δ = 3 less VLCCs (based on 2006 data)			

Projected Burma-China Pipeline Impact on Saudi Route			
Saudi Route (projected)	**Original Req't**	**Saudi-Burma**	**Saudi-China**
Import Vol. (bpd x 1,000)	1163	400	763
VLCC Load Factor	1.8	5.2	2.7
Round-Trip Distance (NM)	12,000	7,000	12,000
Time at Sea (Days at 15kts)	33	19	33
Port Time (Days)	3	3	3
Contingency Delay (Days)	3	3	3
Total Journey Time (Days)	39	25	39
VLCCs Required for Route	**22**	**5**	**14**
Projected Saudi Tanker Δ = 3 less VLCCs (2020)			

Table 7. Impact of Burma-China Pipeline on Arabian Gulf Tanker Requirements

Like the Pakistan-China oil pipeline proposal, the Burma-China line fails to significantly reduce oil tanker requirements from Africa and the Arabian Gulf. In both cases, oil tankers that are destined for Kyaukphyu are still exposed to foreign naval interdiction on the high seas. Although the cost of this pipeline is significantly less expensive than the Pakistani proposal, the reduction of only two VLCCs for African imports or three for Arabian Gulf imports, does not seem to justify the US$2.9 billion estimated to develop the oil pipeline nor the US$7.3 billion for the pipeline and supporting infrastructure. Of course this is all predicated on the assumption that this pipeline proposal is meant to address Beijing's perceived maritime vulnerabilities associated with the "Malacca Dilemma."

D. COMBINED ASSESSMENT AND SUMMARY

Assessing the individual pipeline proposals through Pakistan and Burma resulted in a very limited reduction of tanker requirements considering the high project costs associated with each proposal. The simultaneous pursuit of these two proposals would indicate that Beijing is choreographing some sort of "grand strategy" with respect to energy security alternatives in the Indian Ocean. While this remains highly debatable, the cumulative effects of these two pipelines must be assessed in terms of their combined ability to reduce maritime tanker requirements and the perceived vulnerabilities associated with tanker shipments through the Indian Ocean.There are a myriad of ways to assess the combined effect of the Pakistani and Burmese pipeline proposals into China. For simplicity, the combined effect will be measured using the same methodology that was used in the individual assessments. The combined effect will use the "best-case" scenarios from each proposal to determine the highest possible tanker reduction. **For current oil imports from Africa and the Arabian Gulf, VLCC requirements could be reduced from 49 total VLCCs to 39 VLCCs.**[125] As discussed, only the Iran tanker traffic would presumably avoid the risk of foreign naval interdiction leaving 42 VLCCs – roughly 85 percent – still exposed to the perceived vulnerabilities that these pipelines supposedly address. The impact to projected VLCC requirements in 2020 is even more dismal. If both pipeline proposals were made operational, **VLCC requirements in 2020 would see a total VLCC reduction from 111 to 101**, leaving 91 percent of oil tanker from Africa and the Arabian Gulf still at risk according to the posited vulnerabilities associated with maritime transfer.

The combined costs of these proposals – US$8.8 billion for the two oil pipelines, or upwards of US$27.3 billion for total combined project costs – compared against the minimal reduction in maritime tanker requirements does not seem to indicate a viable energy security alternative to address Beijing's perceived maritime vulnerabilities. This chapter examined the ability of the Pakistani and Burmese proposals to reduce China's

[125] Total tanker reduction is based on seven less VLCCs on the Iran to Gwadar route and three less VLCCs on the Angola to Kyaukphyu route as depicted in Table 5 and Table 6.

perceived vulnerabilities from possible foreign naval interdiction. It did not, however, discuss some of the other vulnerabilities unique to each proposal. These include the potential for domestic terrorist action against the pipeline infrastructure, or the ability of the transit state to siphon-off oil flows to gain coercive leverage against China. These factors would obviously influence Beijing's decision on whether to pursue various proposals, only worsening the concern from a security perspective.

IV. EXTENDED SLOC PROTECTION AND THE PLA NAVY

In terms of energy security strategies, the development of transnational pipelines would still require a large amount of oil tankers to transport PRC imports from Africa and the Arabian Gulf. Yet Chinese naval forces are currently incapable of protecting these vital oil routes and, as a result, China-bound oil tankers must rely on the United States Navy for freedom of navigation through the high seas and safe passage into China. However, many analysts and academics submit that the same U.S. Navy that provides this service gratis also has the ability to impede China-bound oil supplies in the event of a Sino-U.S. crisis. In light of this dilemma, many scholars believe China is pursuing an energy security strategy based on blue-water naval expansion. In theory, this blue-water force would protect China's vital oil routes thereby limiting the possibility of interdiction by foreign naval forces.

This chapter assesses Beijing's ability to field an effective blue-water naval force capable of protecting China's oil SLOCs West of the Strait of Malacca. It does this by examining three questions. First, considering the scale of China's tanker requirements needed to transport African and Arabian Gulf oil imports, what would be the most suitable PLAN force configuration to conduct extended SLOC protection missions? Second, how effective would this force configuration be in terms of its ability to protect China's oil routes against probable opposition force capabilities? Finally, knowing the size requirements and estimated effectiveness of this blue-water force configuration, what is the likelihood that Beijing will pursue this hard-power energy security strategy? These questions are critical to gauging Beijing's interest in developing a blue-water naval force as a mechanism to reduce perceived vulnerabilities associated with PRC oil imports from Africa and the Arabian Gulf.

A. THE PLA NAVY

This section briefly explores current PLAN force structure limitations and posits certain assumptions necessary to model a notional blue-water force configuration designed for extended SLOC protection. It will first discuss PLAN limitations that

Beijing would need to address if were to pursue its blue-water naval aspirations. It then advances a series of assumptions as a means setting the justification for PLAN SLOC defense as well as testing the ability of this notional force to operate in true blue-water conditions.

1. PLAN Limitations

In recent years, the PLAN has embarked on a robust modernization program that has qualitatively and quantitatively improved its anti-air warfare capabilities, nuclear and diesel submarine operations, and anti-ship weapons technology.[126] However, despite a total complement of 74 surface combatants and 57 attack submarines, the PLAN currently lacks the ability to project a credible protective force over its extended oil routes from Africa and the Arabian Gulf.[127] Aside from the impressive sea-going voyages of Zh*eng He* in the early fifteenth century, China's demonstrated history of blue-water naval operations has been limited to "flag-waving" port visits by very limited fleet assets.[128] For instance, in 2006, a Chinese fleet comprised of the guided-missile destroyer, *Qingdao*, and the replenishment vessel, *Hongzehu*, made port calls in the United States, Canada, and the Philippines.[129]

The PLAN's inability to conduct credible blue-water operations in defense of China's long-distance oil routes is limited by three interrelated factors to include doctrinal focus, operational experience, and fleet force-structure. First, the PLAN's main doctrinal focus is aimed at developing a naval force that can "succeed in a short-duration conflict with Taiwan and… deter U.S. intervention or delay the arrival of U.S. forces…

[126] For a complete list of recent PLA-Naval modernizations, see "Annual Report to Congress, Military Power of the People's Republic of China 2008" (Washington, D.C.: Office of the Secretary of Defense, 2008), 4-5.

[127] For a more detailed complement of PLAN assets see, Ibid., 4.

[128] Zheng He's voyages demonstrated the Ming Dynasty's mastery of sea-faring technology as discussed in, Cole, The Great Wall at Sea: China's Navy Enters the Twenty-First Century, 3.

[129] This two-ship fleet is representative of other "blue-water" voyages of the PLAN as discussed in, "Chinese Navy Fleet Returns Home after Visiting U.S.A., Canada, Philippines," www.chinamil.com.cn, http://english.pladaily.com.cn/site2/special-reports/2006-11/20/content_651699.htm (Accessed April 14, 2008).

in such a conflict."[130] This strategy is evidenced by the PLAN's development and acquisition of various weapons platforms like the Russian developed *Sovremenny* destroyers with their lethal SS-N-22 anti-ship cruise missile (ASCM) as well as a robust diesel attack submarine fleet including the Type-039 *Song* class diesel submarine capable of carrying the YJ-82 ASCM.[131] Not to say that these platforms are exclusively suited towards anti-access missions in the event of a cross-strait showdown. Rather, the limited manner in which these and other naval assets are employed underscores the PLANs strategic focus on the Taiwan contingent. How does this doctrinal focus lead to other limiting factors of China's blue water aspirations?

In terms of operational experience, a short duration conflict over Taiwanese reunification does not require the extended sea-deployments or the logistical support capabilities required with distant blue-water operations. The same holds true for PLAN fleet force structure limitations with respect to a would-be blue water force. The pursuit of PLAN weapons platforms required to effectively project and sustain naval power at vast distances from the Chinese homeland is limited by the doctrinal focus associated with a Taiwanese conflict. Additionally, the PLAN currently lacks a logistical support fleet, such as sufficient numbers of replenishment ships paramount to sustaining blue-water mission sets.[132]

Barring a resolution – peaceful or otherwise – to Beijing's cross-strait stalemate, the PLAN would have to modify more than just its doctrinal focus if it were to pursue a blue-water mission capacity. It would also have to modify its geopolitical strategy, procurement focus, and defense expenditure priorities. Additionally, if Taiwan remains the strategic priority, the PLAN would need to develop and build an additional force

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130 Ronald O'Rourke, "CRS Report Rl33153 – China Naval Modernization: Implications for U.S. Navy Capabilities – Background and Issues for Congress" (Congressional Research Service, 2008), Summary.

131 China's acquisition of the Sovremenny II and capabilities of the Song class submarine are discussed in "Annual Report to Congress, Military Power of the People's Republic of China 2006," (Washington, DC: Office of the Secretary of Defense, 2006), 4-5.

132 A discussion of China's limited number of naval replenishment ships is submitted in Bernard D. Cole and National Defense University. Institute for National Strategic Studies, "Oil for the Lamps of China": Beijing's 21st-Century Search for Energy (Washington, DC: Institute for National Strategic Studies, National Defense University, 2003), 57-68.

configuration in order to engage in long distance SLOC protection while maintaining a credible naval deterrence force for Taiwan related contingencies.

2. Assumptions

If China were to modify its doctrine to include blue-water protection of its Indian Ocean oil routes, certain assumptions would be necessary in order to determine the most suitable force configuration for the PLAN to employ. This section, therefore, posits three assumptions as a means of setting the stage for modeling a PLAN notional blue-water force tasked with extended SLOC protection of China's vital oil routes. These assumptions will attempt to illustrate one potential example of China's "worst-case" scenario with respect to perceived oil supply vulnerabilities in the Indian Ocean.

The first assumption is that in the event of a Sino-U.S. conflagration over Taiwanese reunification, China's oil imports would be at risk of interdiction by U.S. and Indian Navies operating in the Indian Ocean. Though interdicting China's oil shipments may not necessarily play into current U.S. and Indian Naval strategies, the goal of this assumption is to mirror the perceived vulnerabilities that reportedly drive China's blue-water aspirations. In short, this assumption sets the conditions for a blue-water naval showdown in the context of China's perceived vulnerabilities.

The second assumption creates a justification that would enable PLAN protection of China-bound oil tankers. More specifically, it assumes that China will have developed a nationalized oil tanker fleet capable of handling oil imports from Africa and the Arabian Gulf.[133] According to one source, a PRC nationalized oil tanker fleet "helps set a legal basis for militarily protecting these vessels" similar to U.S. Naval protection of oil tankers during the 1987 Iran-Iraq "tanker wars." [134] Arguably, without the assumption of a nationalized oil tanker fleet – meaning the majority of China's oil would still be

[133] The idea of a PRC nationalized tanker fleet has a fair degree of credibility as discussed in a phone interview with Mr. Malcom Masters of Stena Bulk. Mr. Masters indicated that much of the shipping industry believes that China is pursuing this route.

[134] The aspect of legality is discussed in Erickson and Collins, "Beijing's Energy Security Strategy: The Significance of a Chinese State-Owned Tanker Fleet," 665. The parallel to U.S. naval escort missions in 1987 can be found in Collins, "China Seeks Oil Security with New Tanker Fleet," 24.

transported by foreign-flagged vessels – it would be extremely difficult for interdicting forces to identify which tankers were destined for China let alone board and confiscate those tankers.[135]

The final assumption asserts that a notional PLAN blue-water force would have to rely exclusively on its own replenishment ships thereby forcing it to operate under true blue-water conditions. What does this mean? In short, this means exclusion of potential PLAN support bases in the Indian Ocean littoral. Although much has been written on China's pursuit of a "String of Pearls" strategy, including Pakistan and Burma to name a few, this section will assume that PLAN combatants lack the benefit of logistical or maintenance facilities outside of China.[136]

This discussion attempted to highlight the PLAN's doctrinally driven limitations with respect to blue-water capabilities. More importantly, it illustrated China's "worst-case" energy security threat scenario as a means of creating the basis for developing a blue-water naval force capable of protecting Indian Ocean oil routes into China. In sum, this scenario asserts that PRC-flagged oil tankers would be vulnerable to U.S. and Indian naval interdiction as a result of a U.S.-Sino conflagration over Taiwan. Moreover, this scenario excludes the PLAN's use of reported Indian Ocean littoral support bases thereby requiring the PLAN to operate its forces at their full blue-water potential. Considering this scenario, what is the most suitable PLAN blue-water force configuration for use in extended SLOC protection West of Malacca?

B. BLUE WATER FORCE MODEL – CONCEPT AND EMPLOYMENT

In 1998, China purchased the ex-*Varyag*, a Russian *Kuznetsov* class aircraft carrier that has since been transported to Dalian, repainted in PLAN colors, and

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[135] For a more detailed discussion of the difficulties with interdicting China-bound oil tankers see, Gabriel B. Collins and William S. Murray, "No Oil for the Lamps of China?" *Naval War College Review* 61, no. 2 (2008).

[136] China's "String of Pearls" refers to a series of dual-use bases in the Indian Ocean littoral that would presumably be used to support PLAN surface combatants or submarines. See, for instance, Henry Chu, "China's Footprint in Pakistan; a New Port Is a Boon Locally, a Potential Military Asset for Beijing and a Worry to the U.S," Los Angeles Times, April 1, 2007. See also, Ebel, China's Energy Future: The Middle Kingdom Seeks Its Place in the Sun, 55.

reportedly re-named the *Shi Lang*.[137] Many believe this indicates China's pursuit of a blue-water force based on an aircraft carrier strike group (CSG) concept. Further speculation has been caused by Beijing's supposed interest in purchasing 48-50 SU-33 carrier-based fighters from Russia for an estimated US$2.5 billion.[138] Could this be the beginning of a doctrinal shift by the PLAN towards blue-water operations? If so, would PLAN CSGs be employed to protect China's vital oil routes in the Indian Ocean thereby reducing Beijing's perceived vulnerabilities? This section argues that a CSG concept would be the most suitable force configuration for the PLAN to pursue in terms of extended SLOC protection of China's Indian Ocean oil routes. It does this by examining the CSG concept in relation to SLOC defensive missions as well as potential employment models for the PLAN considering the scale of oil tankers requiring protection from perceived foreign naval threats. This employment model will be used to estimate its effectiveness against probable opposition force capabilities, as discussed later in this chapter.

1. Concept of a PLAN Carrier Strike Group

According to one PLAN expert, a would-be blue-water force "require[s] task groups of missile-firing, power projection capable ships supported by nuclear-powered submarines and maritime air power."[139] The PLAN already possesses, or is developing, the "missile-firing" ships and nuclear powered submarines needed in this type of task group. This capacity includes a robust fleet of surface combatants and growing complement of Type-093 *Shang* class nuclear-powered attack submarines.[140] However, if this notional task group were to be somewhat effective at distant blue-water operations, it would need the added capability of maritime air power. The only weapons system

[137] The ex-*Varyag* was sold as an incomplete platform, even lacking propulsion systems. For a comprehensive history of China's carrier ambitions see, "Annual Report to Congress, Military Power of the People's Republic of China 2006," (Washington, DC: Office of the Secretary of Defense, 2006), 32.

[138] An October 2006 Russian press report is cited in, "Annual Report to Congress, Military Power of the People's Republic of China 2008," (Washington, DC: Office of the Secretary of Defense, 2008), 38.

[139] China's blue-water aspirations are discussed in Cole, The Great Wall at Sea: China's Navy Enters the Twenty-First Century, 172.

[140] The PLAN's force composition and recent platform additions are detailed in, "Annual Report to Congress, Military Power of the People's Republic of China 2008," 4 and 54.

capable of providing blue-water maritime air power – and thus completing this notional force's potential lethality – is the aircraft carrier.

With the PLAN's current focus on asymmetrical tactics and strategies, a Chinese CSG would be a departure from PLAN doctrine leading many to question the suitability of this endeavor. However, the added component of maritime air power provides the following critical benefits needed in a blue-water force tasked with extended SLOC protection of China's vital oil routes. These include increased capacity in air defense, surveillance, and maritime interdiction operations as posited in the following discussion.

First, maritime air power would give a notional PLAN force the ability to interdict enemy air threats at greater distances from the task group. Based on the performance of an SU-33 Flanker – reportedly being considered for carrier use by Beijing – the protective "bubble" around a PLAN CSG could extend upwards of 800 nm.[141] This range vastly expands the defensive reach of the CSG compared with the PLAN's most effective shipboard anti-air system, the SA-N-20 surface-to-air missile that has a reported range of 81 nm.[142] Carrier based aircraft, therefore, would limit the ability of enemy air assets to close within air-to-sea weapons delivery ranges of the notional PLAN force or the oil tankers that this force would be tasked to protect.

In order to support maritime-surveillance/interdiction operations, carrier based aircraft could provide early-warning detection of surface assets that were attempting to interdict Chinese-flagged oil tankers. Accordingly, air assets would be able to provide command and control functionality as well, by directing friendly surface combatants towards enemy forces that are attempting to interdict Chinese oil imports. In addition to providing targeting data to friendly surface combatants, Chinese carrier-based aircraft would also be able to conduct air-to-sea attacks against enemy surface combatants.

[141] The 800nm figure is half of the stated max-range at altitude, not combat-radius. This distance can vary significantly depending on the intercept profile, speed, altitude, use of afterburner, etc. Ranges and other data for the SU-33 are given in "Sukhoi Su-33 (Su-27k)," in www.Janes.com. (Accessed April 30, 2008).

[142] The SA-N-20 is reportedly fitted only to the newest PLAN fighting ship, the Luzhou (Type-051c). This is the most advanced anti-air maritime asset that the PLAN possesses, as discussed in "Annual Report to Congress, Military Power of the People's Republic of China 2007," 3. Technical data for the Luzhou and SA-N-20 is available at "Luzhou Class (Type 051c) (DDGHM)," in www.Janes.com (Accessed May 3, 2008).

Similar to extended air-defense ranges associated with the SU-33, the 800 nm figure would also apply to surveillance/interdiction patrols in support of extended SLOC defense operations.[143] This capability would qualitatively improve the ability of PLAN forces to detect, deter, and defeat would-be oil interdictors at greater ranges than with surface combatants and submarines alone. That said, the SU-33 is more than capable of prosecuting maritime strike operations but is not well suited to conduct surveillance or early warning missions. Ideally, the Chinese would want to invest in some type of airborne early warning platform similar to the U.S. Navy's E-2C Hawkeye if were to pursue an effective carrier strike group concept.[144]

The ability to employ maritime air power is perhaps the single most critical aspect of an effective blue-water naval force. Some may argue that this is a U.S.-centric concept that could be overcome by PLAN asymmetric strategies. However, without maritime air power a PLAN task group would be limited in the protective coverage it could provide to Chinese-flagged oil tankers. Moreover, the lack of air cover would leave the task group vulnerable to detection by maritime patrol aircraft and subsequent interdiction by tactical aircraft employing stand off ASCMs. Establishing that maritime air power is an integral necessity of a blue-water naval force, how would China potentially employ these task groups for use in a hard power energy security strategy?

2. Employment of a PLAN Carrier Strike Group

Due to the lack of transparency surrounding China's naval modernizations, it is difficult to determine the nature and aspirations of the PLAN's aircraft carrier development program. Some sources, however, indicate that the ex-*Varyag* could be operational by the end of this decade as a possible training platform, with an indigenously

[143] The 800nm figure is half of the stated max-range at altitude, not combat-radius. This distance can vary significantly depending on the intercept profile, speed, altitude, use of afterburner, etc. Ranges and other data for the SU-33 are given in, "Sukhoi Su-33 (Su-27k)," in www.Janes.com (Accessed April 30, 2008).

[144] Currently, the ex-*Varyag* is designed for SU-25 and SU-33 aircraft. This severely restricts the lethality of this aircraft carrier compared with U.S. capabilities that employ a variety of carrier-based aircraft including the E-2c. The E-2c – operating from the decks of U.S. aircraft carriers – forms the command and control backbone for carrier based strike aircraft like the F/A-18 Hornet. Lacking a similar platform, Chinese carrier-based aircraft would be "easy pickings" for a U.S. carrier air wing.

produced carrier, or two, available between 2015 and 2020.[145] Another source posits that Beijing desires a "3-carrier force requirement, which may or may not include the ex-*Varyag.*"[146]

This section explores Beijing's employment options of PLAN CSGs in support of extended SLOC protection missions. It will first examine two different employment models available for China to follow. Next, it establishes a notional force model based on China's extended Indian Ocean oil SLOCs and the high volume of tankers required to transport those imports into China. This will be conducted using two interpretations of China's reported "3-carrier force requirement."

Numerous carrier employment models are available for China to emulate. Yet two of these seem to have more relevance to the PLAN's potential carrier aspirations. These two models – the U.S. model and the French model – represent the extremes of present day blue-water aircraft carrier employment capabilities. The U.S. Navy currently has 11 aircraft carriers, allowing it to keep two to three Carrier Strike Groups (CSGs) deployed at any one time in addition to one CSG forward deployed in Japan.[147] Additionally, the U.S. Navy has demonstrated its ability to "surge" six of its 11 carrier strike groups in a crisis response situation.[148] The French Navy, on the other hand, has a single aircraft carrier that generally deploys once a year for approximately four months.[149] In terms of a constant deployed carrier presence, the U.S. model of two to three carriers deployed at any one time can be thought of as a 2.5 carrier presence

[145] For a compilation of various sources regarding China's aircraft carrier aspirations, see Ronald O'Rourke, "CRS Report Rl33153 – China Naval Modernization: Implications for U.S. Navy Capabilities – Background and Issues for Congress" (Congressional Research Service, 2008), 15-17.

[146] Keith Jacobs, "PLA-Navy Update: People's Liberation Army – Navy Military-Technical Developments," *Naval Forces* 28, no. 1 (2007): 24.

[147] "Aircraft Carriers - CV, CVN," Navy.Mil, http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=200&ct=4. (Accessed May 5, 2008).

[148] The U.S. Navy has the capacity to "surge" six carrier strike groups (CSGs) within 30 days with a seventh CSG available at 30 days, as discussed in "Seven Carrier Strike Groups Underway for Exercise 'Summer Pulse 04'," Navy.mil, http://www.news.navy.mil/search/display.asp?story_id=13621. (Accessed May 5, 2008).

[149] Phone interview with Mr. Louis "Sweet Lou" Ryan, former U.S. Naval Flight Officer assigned to the French Aircraft Carrier, *Charles De Gaulle*, as an exchange officer with Air Squadron 4F from 2003 – 2007. Mr. Ryan indicated that the French Carrier generally deploys in Spring for NATO support operations. Interview conducted on May 9, 2008.

representing approximately 22% of the U.S. Navy's total carrier force.[150] The lone French carrier, on the other hand, is capable of providing a presence of 0.25.

Why discuss these two models in relation to China's carrier aspirations? China will need to determine whether it wants to pursue multiple carriers to support a constant deployed carrier presence, like the United States, or a single carrier capable of limited deployments in support of national objectives, similar to the French model. What model China chooses to follow is inevitably tied to how these carriers fit into the overall grand naval strategy of the PLAN. If China's intends to use the CSG concept as part and parcel of an Indian Ocean energy security strategy, what type of presence would be required to establish a bare-minimum protective force in the context of China's "worst-case" scenario established earlier in this chapter?

Considering the three-carrier force requirement discussed at the beginning of this section, two possibilities exist for protecting the vast expanses of China's Indian Ocean oil SLOCs. The first possibility is that China aspires to have a total of three aircraft carriers, enabling a 0.75 constant deployed carrier presence.[151] This presence would be woefully inadequate to protect Chinese-flagged oil tankers transporting African and Arabian Gulf imports into China due to the long distances and potential opposition force capabilities that would presumably be brought to bear on PLAN assets and Chinese-flagged oil tankers. Therefore, a second interpretation of China's reported three-carrier force requirement needs to be assessed in terms of its ability to defend China's Indian Ocean oil routes.

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150 Carrier presence index (CPI) is based on constant carrier presence throughout the year. For example, one aircraft carrier deployed year-round would equal a CPI of 1.0.

151 The 0.75 carrier presence is based a combination of the French and U.S. models.

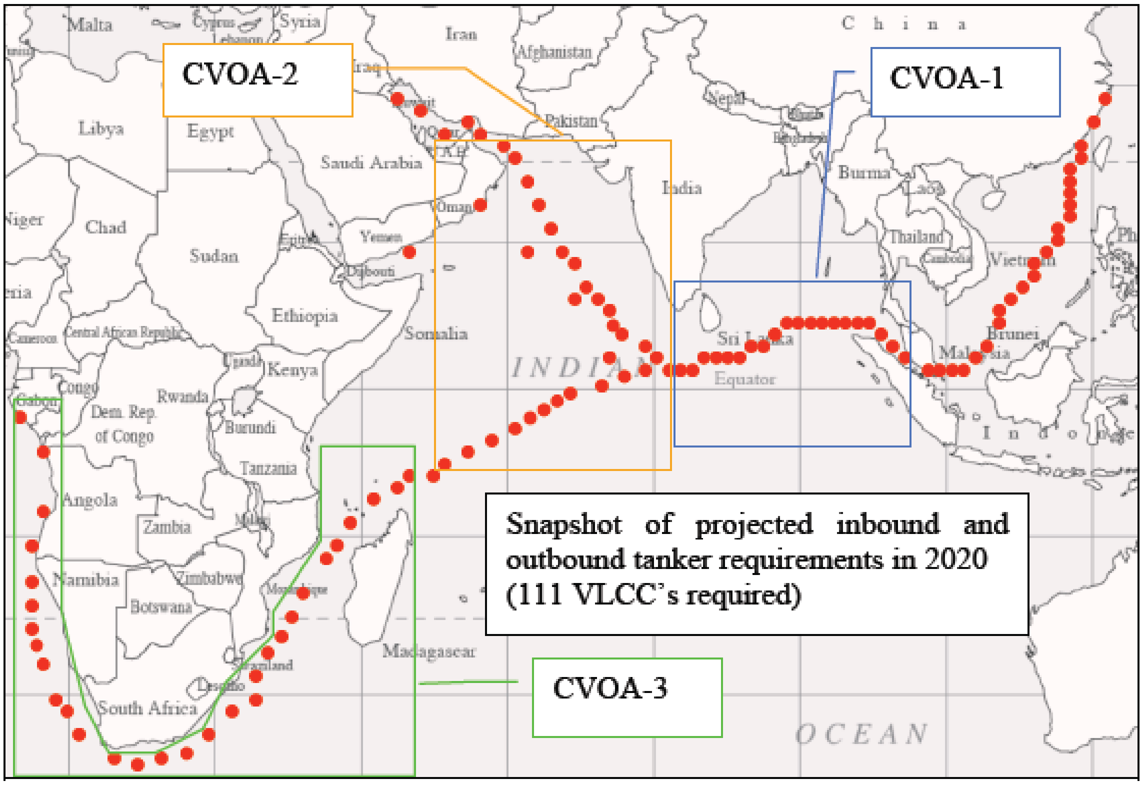

Figure 5. Notional Carrier Group Operating Area (CVOA) for Three PLAN Strike Groups. [Map from ©Map Resources modified by author][152]

The second possibility considers a deployable three-carrier force requirement. As depicted in Figure 5, a 3.0 carrier presence would provide bare-minimum protection to Chinese-flagged oil tankers in the Indian Ocean. This does not necessarily mean that China would need 11 aircraft carriers to support this 3.0 presence, similar to the U.S. model. Rather, this carrier presence would represent China's crisis response capabilities, or "surge" capacity, resulting from a U.S.-Sino conflict over Taiwanese reunification. If using the U.S. "surge" model – 11 carriers required to "surge" six CSGs – then China would most likely need a total of six aircraft carriers in order to "surge" three CSGs in support of extended SLOC defensive missions in the Indian Ocean. This, of course, would represent a crisis response option rather than a normal mode of CSG operations.

152 Red dots indicate outbound and inbound tanker traffic required for PRC oil imports from Africa and the Arabian Gulf. Colored boxes indicate notional operating areas for PLAN protective force strength. Map was ordered from © Map Resources, who retains full copyrights of map image.

China's pursuit of six CSGs by 2020 seems highly unlikely, especially considering the additional assets needed to configure these CSGs. For comparison sake, a typical U.S. CSG is generally comprised of the following:

- 1 Fixed-wing aircraft carrier (Nimitz, Enterprise, or Kitty Hawk Class), carrying 75+ Fixed wing aircraft (F/A-18s, E-2Cs, EA-6Bs, C-2As)
- 2 Air-defense destroyers
- 1 Multi-mission guided-missile cruiser
- 1 Nuclear powered attack submarine
- 1 Multi-role replenishment/oil supply vessel[153]

Using this U.S. configuration to model a PLAN notional force requires some degree of subjectivity. However, based on the PLAN's recent naval modernizations and submarine-heavy orientation, one possible model of a PLAN CSG could resemble the following:

- 1 Fixed-wing aircraft carrier (*Kuznetsov* Class or indigenous design) carrying 22 Fixed-wing aircraft (18 SU-33 Flankers, 4 SU-25 Frogfoots)[154]
- 2 *Luzhou* (Type-051C) air-defense DDGs (SA-N-20 fitted)
- 1 *Sovremenny* II DDG multi-role (SS-N-22 fitted)[155]
- 2 *Shang* SSNs (Type-093)
- 1 Multi-role replenishment/oil supply vessel

From a conceptual perspective, the U.S. CSG and the notional PLAN CSG look quite similar. However, a deeper examination reveals many differences – positive and negative – in surface, submarine, and air capabilities. Three of these differences will be discussed in this section. First, the PLAN CSG has a limited number and variety of fixed-wing aircraft. As discussed earlier, this would severely limit the lethality and effectiveness of the PLAN

[153] This battle group configuration will generally be modified according to the mission or expected threat environment. A more detailed description is available through the official navy.mil website at "The Carrier Strike Group," Chinfo.navy.mil, http://www.chinfo.navy.mil/navpalib/ships/carriers/powerhouse/cvbg.html. (Accessed May 4, 2008).

[154] "Kuznetsov (Orel) Class (Project 1143.5/6) (CVGM)," Jane's, file:///Users/coreyjohnston/Desktop/Thesis%20Master/China%20Mil/Into%20Chapter/russian%20a:c%20carrier%20group.webarchive. (Accessed May 6, 2008).

[155] The SS-N-22 *Sunburn* ASCM (3M80E Moskit) is considered a highly lethal weapon capable of Mach 2.1 and advanced terminal phase maneuvering at an altitude as low as seven meters. Although reported ranges vary, the original model has a 120 km range as reported in "Fu Feng-1/JL-9(SS-N-22 Sunburn" in www.Janes.com. (Accessed May 19, 2008).

CSG against a U.S. CSG.[156] Secondly, the ex-*Varyag* uses a "ski-jump" assisted take-off instead of a catapult launching system used to launch U.S. carrier aircraft. This further limits the lethality of would-be PLAN carrier aircraft as their fuel-load and weapons complement would be restricted by take-off weight limitations.[157] Finally, the PLAN notional force has an additional submarine paralleling the PLAN's current emphasis on this type of weapons system.

If China desires to develop a blue-water force based on six CSGs this would entail developing, or acquiring, a total of 29 additional ships and 12 additional submarines, not to mention the 108 SU-33s required of the carrier air wing.[158] In terms of surface combatants alone, this represents a 40% increase to the PLAN's current complement of 74 ships that would be required to field a force capable of providing very limited protection over China's Indian Ocean oil routes. If China does pursue this massive force increase, how effective could it be considering the probable opposition force capabilities reportedly driving Beijing's blue-water aspirations?

C. ESTIMATED EFFECTIVENESS AGAINST PERCEIVED THREATS

The question of how effective the employment of notional PLAN CSGs might be at protecting Chinese-Flagged oil tankers in the Indian Ocean is a difficult one to address. At a fundamental level, a Sino-U.S. naval showdown in the Indian Ocean would test the operational capacity of both navies. Moreover, this type of carrier vs. carrier battle has not been demonstrated since World War II. Yet, some measure of effectiveness could be gained by comparing the capabilities of U.S. and Indian naval forces against the limitations of potential PLAN forces. The capabilities that favor U.S. and Indian threat

[156] The U.S. CSG aircraft serve a variety of roles including airborne early warning, electronic warfare (jamming), airborne refueling, maritime precision strike, and logistical support.

[157] U.S. carrier-based aircraft have a demonstrated ability to take off with an impressive fuel and weapons load-out. Heavier aircraft loads are facilitated by stronger catapult shots as experienced by the author on numerous carrier take-offs with generally the same amount of carrier landings.

[158] This considers five additional aircraft carriers, twelve additional Luzhou DDGs, six additional Sovremenny II DDGs, six additional replenishment vessels, and twelve additional Shang SSNs.

operations include their ability to detect and target PLAN forces in the early stages of crisis response and their capacity to employ and sustain a qualitative and quantitative force ratio against PLAN CSGs.

Early detection and targeting of PLAN CSG could be conducted in two ways. First, PLAN CSGs could be detected upon leaving the safety of Chinese ports, thus allowing U.S. and Indian forces the advantage of waiting to target these vessels immediately after they enter the Indian Ocean through the Strait of Malacca. According to one analyst, PLAN assets would be "vulnerable to subsea, surface, and aerial threats at the location's of the [opposing] forces choosing."[159] A second means of detecting PLAN surface forces is by land-based maritime patrol aircraft like the U.S. P-3C Orion or the Indian TU-142 Bear. These aircraft could cover large areas of the Indian Ocean by operating from Diego Garcia, the Indian sub-continent, or the Indian Air Force base on the island of Car Nicobar in the Bay of Bengal. The ability of these aircraft to detect enemy surface combatants, or exploit weak coverage areas of Chinese-flagged oil vessels, would give the U.S. and Indian forces the flexibility to take one of two courses of action. The U.S. and Indian forces could either attack PLAN surface assets or avoid them altogether, instead interdicting Chinese-flagged vessels that lack PLAN protective cover.

A second advantage of U.S. and Indian forces in countering three PLAN CSGs, is their ability to employ and sustain a quantitative and qualitative force against Chinese surface and air assets. To underscore this concept, this argument will revisit the "surge" capacity of the U.S. Navy, the U.S. and PLAN CSG disparities, and the proven capability of U.S. and Indian naval interoperability. As the following discussion asserts, these three factors severely limit the effectiveness of potential PLAN CSGs to protect Chinese-flagged oil tankers.

As previously discussed, the U.S. Navy has the ability to "surge" six of its eleven carrier strike groups within thirty days. Knowing that two to three U.S. carriers would potentially be required for combat operations in support of Taiwanese forces, the additional three to four carriers could be deployed to the Indian Ocean for maritime

159 Collins and Murray, "No Oil for the Lamps of China?" 82.

interdiction operations against PLAN surface assets and Chinese-flagged oil tankers. This means that one U.S. carrier could operate off the Southern-tip of the African continent, a second in the Gulf of Oman, and a third could operate with the Indian aircraft carrier, INS *Viraat*, in the Bay of Bengal as demonstrated by Operation Malabar in 2007.[160] Although the CSG ratio in the Indian Ocean operating area is only 4:3 in favor of the U.S. and Indian Navies, the ability to sortie air assets at a more than a 3:1 ratio underscores the lethal disparity that would face PLAN CSGs. Moreover, the U.S. CSGs enjoy the full range of air capabilities needed to conduct a multitude of operations like airborne command and control, electronic warfare, and aerial refueling to name a few. This aspect alone gives an incredible advantage to U.S. and Indian forces. How likely is China to pursue this hard power energy security strategy?

D. SUMMARY

In sum, a 3.0 PLAN CSG force requirement – itself an almost inconceivable increase in Chinese forces within a ten-year period – would be inadequate to protect Chinese-flagged oil tankers against Beijing's perceived source of threat – the U.S. and Indian Navies. How could Beijing overcome some of these disparities in order to provide a more protective blue-water naval force? One way is to build towards qualitative and quantitative force parity with the U.S. Navy. In other words, China would have to develop a force as large and as capable as the U.S. Navy if it were to pursue a blue-water naval force capable of protecting its vital oil routes through the Indian Ocean. Among other issues, this force would have to overcome the 3:1 air advantage currently held by the United States as discussed earlier. For China, this would mean creating an indigenous super-carrier fleet – eleven to be exact – with a wide-range of aircraft types and catapult launching systems similar to U.S. carrier force capabilities.[161] This would also likely

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160 The U.S. and Indian navies collectively operated three carrier battle groups in the Bay of Bengal, as discussed in U.S. 7th Fleet Public Affairs, "Exercise Malabar 07-2 Kicks Off," Navy.mil, http://www.navy.mil/search/display.asp?story_id=31691. (Accessed April 10, 2008).

161 If relying on the design of the ex-*Varyag*, China would need 33 carriers of this type to overcome the 3:1 force ratio. This in itself would be an unfathomable and costly endeavor.

require the pursuit of the "String of Pearls" strategy that calls for PLAN support bases in the Indian Ocean littoral as a means of shoring up the PLAN's logistical weaknesses with long distance operations. If China were to pursue this type of impressive naval build-up, the political consequence would be undeniably destabilizing, both regionally and globally. At a very basic level, a PLAN build-up of this scale would certainly spark a series of regional and global security dilemmas. The U.S., Indian, and Japanese forces would surely respond in kind, embarking on naval force strength increases of their own as a means of balancing against China's potential naval rise. From an economic perspective, a naval build-up of this scale would certainly be a drain on China's fiscal resources thereby making this endeavor even more unlikely.

V. CONCLUSION

What is China's most suitable energy security alternative to address its perceived vulnerabilities associated with African and the Arabian Gulf oil imports? This thesis assessed two possible energy security strategies reportedly intended to reduce these vulnerabilities. The first strategy examined would presumably reduce the maritime threat to Chinese-flagged oil tankers by developing transnational oil pipelines through Pakistan and Burma. These pipelines would arguably reduce China's maritime vulnerabilities by reducing the amount of oil tankers required to transport these energy resources into China. The second strategy explored the possibility of reducing Beijing's perceived vulnerabilities by using blue-water capable PLAN aircraft carriers to conduct extended SLOC protection missions of Chinese-flagged oil tankers. These two strategies were assessed as a means of gauging Beijing's interest in pursuing either one as a mechanism to improve China's energy transportation security through the Indian Ocean.

This final chapter conducts a summary and assessment of the case study findings by examining three questions. First, what does this assessment reveal about possible Chinese courses of action with respect to energy security alternatives in the Indian Ocean? Second, at what point could these courses of action pose a possible threat to regional or global security thereby challenging U.S. forces? Finally, how can Washington and Beijing work together to address mutual energy security concerns? These questions intend to serve two purposes. Primarily, these questions intend to posit the findings and author's estimates commensurate with the assessment of China's two energy security strategies examined in this thesis. Equally important, however, they serve to identify areas of further study that could illuminate other facets of Beijing's energy security aspirations as well as possible drivers to Beijing's available courses of action.

A. FINDINGS

China's rising oil consumption will require a continued reliance on oil imports from West Africa and the Arabian Gulf accounting for upwards of 4.8 million barrels per day (BPD) in 2020. Accordingly, these heavy import volumes require a corresponding increase of oil tankers to transport African and Arabian Gulf imports into China. The author estimates that China's oil tanker requirements will increase from the current requirement of 49 Very Large Crude Carriers (VLCCs) to 111 VLCCs in 2020. This data, or logistical baseline, formed the comparative framework to assess the effectiveness of each energy security alternative.

An assessment of both energy security alternatives revealed the inability of either strategy to significantly reduce Beijing's perceived vulnerabilities associated with African and Arabian Gulf oil imports. The first case study examined the potential ability of Pakistani and Burmese transnational pipelines to ameliorate Beijing's perceived energy security vulnerabilities associated with energy resources from these regions. The development of these oil pipelines would be extremely costly with estimates reaching US$8.8 billion for the pipelines alone. Worse yet, as Chapter III showed, these two pipeline proposals failed to significantly reduce China's oil tanker requirements thereby also failing to reduce Beijing's perceived maritime vulnerabilities. There were two reasons for this failure. First, the limited throughput capacity of each pipeline, compared with the total volume of Chinese oil imports from these regions, would not be enough to significantly reduce maritime tanker requirements. Second, the fact that these pipelines would not be true "overland" routes means that oil tankers would still be required to transport PRC imports for some segments of the route, leaving them vulnerable to foreign naval interdiction. If both pipelines were made operational, China would still require 101 VLCCs to transport African and Arabian Gulf imports in 2020 compared with the original figure of 111 VLCCs required without either pipeline being operational. This accounts for only a nine percent reduction in Beijing's perceived vulnerabilities. Conceivably, the remaining 101 VLCCs would still be vulnerable to foreign naval interdiction leading to the conclusion that developing these pipelines fails to address Beijing's perceived vulnerabilities.

The second case study examined the ability of a notional PLAN blue-water force to protect Chinese-flagged oil tankers in the Indian Ocean. This notional force was based on an aircraft carrier strike group (CSG) concept corresponding to China's reported three-carrier force requirement. As established in Chapter IV, a notional force of three PLAN CSGs – deployed in support of extended SLOC defense missions in the Indian Ocean – would be incapable of protecting Chinese-flagged oil tankers against the superior capabilities of the United States and Indian navies. It is these navies that presumably drive China's fears associated with African and Arabian Gulf oil imports. In order to provide even a modicum of defensive capability on station in these faraway regions, the PLAN would have to develop something along the lines of a dozen CSGs. (To face down a concerted U.S. effort, a much larger force would be required.) The large force requirement associated with this aspiration would be a significant drain on China's fiscal resources.[162] Moreover, this endeavor would be regionally and globally destabilizing, a point to which I return later.

The fact that neither of these strategies significantly reduces Beijing's energy insecurities in the Indian Ocean raises a very fundamental question. Will China pursue either strategy knowing the inability of each to address its perceived vulnerabilities associated with African and Arabian Gulf oil imports? In an effort to address this question, the next section will survey possible courses of action available to Beijing as well as resulting implications for Washington.

B. ALTERNATIVE DRIVERS FOR BEIJING

This thesis revealed that developing transnational pipelines or pursuing a blue-water capable PLAN would not significantly reduce Beijing's perceived worry over its vital oil routes in the Indian Ocean. Considering this, it is still possible that Beijing might pursue these strategies to some degree in a different context. The following discussion, therefore, explores alternative drivers for Beijing's possible pursuit of these two mechanisms. In other words, why else would Beijing want to pursue transnational pipelines through Pakistan and Burma or a blue-water capable PLAN based upon a fixed-wing aircraft carrier? Each strategy will be examined in turn.

[162] China's need to shift its national budgeting priorities to support PLAN SLOC defense is discussed in, Bernard D. Cole, "Chinese Naval Modernization and Energy Security," in 2006 Pacific Symposium (Washington, DC: National Defense University, 2006), 7.

1. Transnational Pipelines

Knowing that Pakistani and Burmese transnational pipelines fail to address Beijing's oil insecurities, will China still choose to pursue their development and if so, why? The author argues that China will most likely pursue the development of both pipelines for many reasons – two of which will be discussed here. Specifically, China's pursuit of transnational pipelines through Pakistan and Burma will reduce transaction costs associated with current oil import transportation as well as facilitate Beijing's Western development strategy. These alternative drivers will be briefly detailed in the following discussion.

First, China's pursuit of Pakistani and Burmese transnational pipelines could reduce transaction costs associated with African and Arabian Gulf oil transports. The Angola to Burma route will be used to briefly illustrate this point. The current route to transport Angolan oil into Kunming requires a roundtrip tanker voyage of 18,600 nm between Luanda and Maoming. Once the tanker arrived in Maoming, the oil would then be placed on ground transport, rail, or pipeline for the remaining journey into Kunming refineries. If a Burma-China pipeline were made operational the roundtrip sea distance would be reduced by 3,400 nm to approximately 15,200 nm.[163] In terms of tanker operating transaction costs, this would equate to a savings reduction of just over US$566,000 per journey, or US$39 million per year.[164] If similar economic benefits of a transnational pipeline through Pakistan were considered, then economic drivers may be more important to China than the ephemeral security enhancements.

A second possible driver to Beijing's pursuit of transnational pipelines could be framed in the context of China's Western development strategy. This strategy, launched by Jiang Zemin in 1999, intends to "integrate the western region of China into the

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163 This is based on a roundtrip voyage between Luanda, Angola, and Kyaukphyu, Burma – the reported start of the Burma-China pipeline.

164 This rudimentary calculation is based on data covered in Chapter III. A VLCC averages US$60,000 to operate daily. The cost savings is based on a 15 knot VLCC speed of advance using the following calculation: 3400nm ÷ 15 knots = 226 hours, or 9.4 days. 9.4 days X 60,000 dollars = $566,666. The yearly cost savings was calculated using the load factor established in Chapter III of 5.2, meaning 70 voyages between Angola and Kyaukphyu.

booming Chinese economy" as a means of fostering political stability and regional development.[165] Transnational pipelines into Xinjiang and Yunnan could potentially facilitate this strategy in two ways. First, the development projects associated with these pipelines – roads, refineries, rail systems to name a few – could inject a significant amount of fiscal resources and jobs into these disparaged areas. Additionally, the completed pipelines would provide a direct source of energy resources crucial to transportation and industrial capacity – two enablers to further development.

2. PLAN Aircraft Carrier Strike Group

In terms of a blue-water capable PLAN, the limited two-ship fleet comprised of a single surface combatant and one replenishment ship that Beijing sends on "flag-waving" missions hardly constitutes a blue-water capacity.[166] What about the pursuit of an aircraft carrier? Many in academia and policy circles have suggested China's active interest, even pursuit, of at least one aircraft carrier. Whether that carrier is the ex-*Varyag* or some other indigenously produced ship-type remains to be seen. Yet enough credible evidence exists that seems to support the plausibility of China possessing at least one operational fixed-wing aircraft carrier by 2015. How would China potentially employ this carrier?

As a weapons platform, an aircraft carrier definitely indicates blue-water intent, and arguably a blue-water capability. The author submits that China will pursue an aircraft carrier, or multiple aircraft carries, to serve two purposes – national prestige as well as for expeditionary and humanitarian capacity. First and foremost, China's possession of an operational aircraft carrier would coincide nicely with the national prestige aspirations of Beijing. According to one analyst, in addition to an aircraft carrier's sheer impressiveness, "possession of such vessels also highlights the technological capability of a nation, and the nation's ability to undertake grand

165 This "Develop the West" strategy includes Xinjiang and Yunnan as discussed in, Niklas Swanström, Niklas Norling, and Li Zhang, "China," in *The New Sild Roads: Transport and Trade in Greater Central Asia*, ed. S. Frederick Starr (Washington, DC: Johns Hopkins University-SAIS, 2007).

166 This two-ship fleet was discussed in Chapter III from "Chinese Navy Fleet Returns Home after Visiting U.S.A., Canada, Philippines," www.chinamil.com.cn, http://english.pladaily.com.cn/site2/special-reports/2006-11/20/content_651699.htm. (Accessed April 10, 2008).

projects."[167] Moreover, China is the only permanent member of the United Nation's Security Council that does not possess an operational aircraft carrier. If China were to employ an aircraft carrier, this would showcase to the world the pinnacle of the PLAN's naval modernization efforts.

A second means of potential Chinese employment of an aircraft carrier would be in support of expeditionary and humanitarian operations. More and more, China's citizens and state-owned-enterprises are seeking overseas opportunities in less than stable countries – like Sudan and Ethiopia to name a few. An aircraft carrier could provide China the flexibility to conduct its own non-combatant evacuation and repatriation operations, or NEO for short. This capability would be similar to U.S. Expeditionary Strike Groups (ESG) providing the means and security to extract U.S. citizens from imminent crises. Additionally, China could employ its aircraft carrier capabilities in response to disaster relief similar to the repeated employments of U.S. CSGs and ESGs to humanitarian relief efforts worldwide.

This section briefly discussed alternative drivers to explain why Beijing might choose to pursue these mechanisms to some degree. The inability of transnational pipelines and aircraft carrier strike groups to address Beijing's perceived energy security vulnerabilities does not mean that China will abandon these endeavors. This is especially true considering the alternative drivers discussed in this section. If Beijing does choose to pursue either strategy, what concerns would be posed to Washington?

C. IMPLICATIONS AND POLICY OPTIONS FOR WASHINGTON

When could China's energy security pursuits – whether to address perceived vulnerabilities or fulfill some of the alternative drivers discussed in the previous section – begin to concern Washington? This section briefly explores both strategies in terms of their implications for Washington. Further, it will recommend policy options that address the more prevalent implications.

[167] Scott Cooper, "China's Aircraft Carrier Ambition," Sinodefence.com, http://www.sinodefence.com/research/aircraft-carrier/China_Aircraft_Carrier_Ambition.pdf. (Accessed March 23, 2008).

Transnational pipelines through Pakistan and Burma would pose little, if any, threat to regional or global stability. Considering the political and domestic landscapes of Burma and Pakistan, these pipelines could foster the same benefits associated with China's western development strategy discussed in the previous section. Further, China's pursuit of either pipeline proposal would not pose any real concerns for Washington.

How would China's pursuit of an operational aircraft carrier pose a concern to the United States? To reiterate, China's active aircraft carrier research program will most likely produce an operational carrier by 2015 with a second carrier shortly thereafter – possibly by 2020. What does this mean for the United States? If these aircraft carriers are employed in the manner discussed in the previous section, it will mean very little. The author submits that even with four operational aircraft carriers – meaning the ability to field a 1.0 carrier presence – the United States would have little to worry about as long as it maintained its current force posture. However, if China develops the ability to surpass this 1.0 carrier presence, Washington would need to think critically about how to address a potentially growing threat posed by an increasing PLAN force strength. Why choose a 1.0 carrier presence as a maximum acceptable force posture for the PLAN when the United States would still hold a force ratio advantage? A 1.0 carrier presence provides Washington with some lead-time to respond to a Chinese naval build-up. This means that if Washington waits until China achieves a 2.0 carrier presence capability, then the strategic advantage – currently held by the United States – could be reduced in Beijing's favor.

In terms of policy options, Washington's most prevalent concern should be focused on China's naval modernization efforts, especially considering Beijing's lack of transparency in terms of weapons system procurement, defense expenditures, and force strength goals. Washington needs to continue to encourage increased transparency in Beijing's naval modernization programs, yet establish indicators, such as the carrier presence benchmark of 1.0, to allow sufficient response time to develop or enhance forces as a means of maintaining a strategic advantage. This not only applies to China's aircraft carrier aspirations, but to other PLA modernization programs as well.

As for China's perceived vulnerabilities with its African and Arabian Gulf oil imports, Washington and Beijing need to work together to identify common areas of energy security concerns as well as ways to discuss various misperceptions. For instance, piracy and non-state actor threats against Chinese-flagged oil vessels could be one area of potential cooperation between China and the United States. Issues such as these need to be identified and discussed – either in official dialogue or in academic and policy circles – as a means of reducing misperception in order to progress towards common interests such as maintaining energy resources for all.

D. SUMMARY

This thesis revealed the inability of two energy security strategies – one based on transnational pipelines, the other on PLAN blue-water capabilities – to significantly reduce Beijing's perceived vulnerabilities associated with African and Arabian Gulf oil imports. What does this tell us about Beijing's interest in pursuing these projects? It could mean that security interests are not as much of a driver as conventional wisdom suggests. If it were, Beijing would take more concrete steps towards addressing its so-called "Malacca Dilemma" in as short a time frame as possible.

The time that would be required to develop a capable blue-water naval force or enough transnational pipelines to significantly reduce Beijing's Indian Ocean oil tanker requirements implies one of two conditions. Either Beijing is biding its time until it can effectively protect its vital Indian Ocean oil routes – an inconceivable endeavor by 2020, let alone 2030. Or, more likely, Beijing is not as concerned with the risk of foreign naval interdiction as many have argued. The argument can be made, therefore, that China does not have a "Malacca Dilemma" in the context of foreign naval threats. Rather, China's "Malacca Dilemma" is no different from that of other nations who rely on the Indian Ocean and the same narrow Strait of Malacca for many of the same resources as China does. If China is not as concerned with its African and Arabian Gulf imports, as many have argued, will it still pursue some variant of the energy security strategies examined in this thesis?

By 2020, China will have most likely pursued the development of transnational pipelines through Pakistan and Burma. Moreover, the PLAN will probably have at least one operational aircraft carrier that may even make an occasional deployment to the Indian Ocean alongside the *Qingdao* and *Hongzehu*. As argued in this thesis, however, the drivers for these pursuits are not based upon security concerns. More likely, these endeavors will be pursued for reasons of economic benefit, political stability, regional development, and national pride. Realizing this, Washington will need to carefully navigate its relations with Beijing to encourage military transparency, identify and reduce misperceptions, and increase cooperation in areas of common energy security interests. In the end, Beijing's energy security does not result from transnational pipelines or strong naval capabilities, but rather, the ability to act as a responsible player on the global stage.

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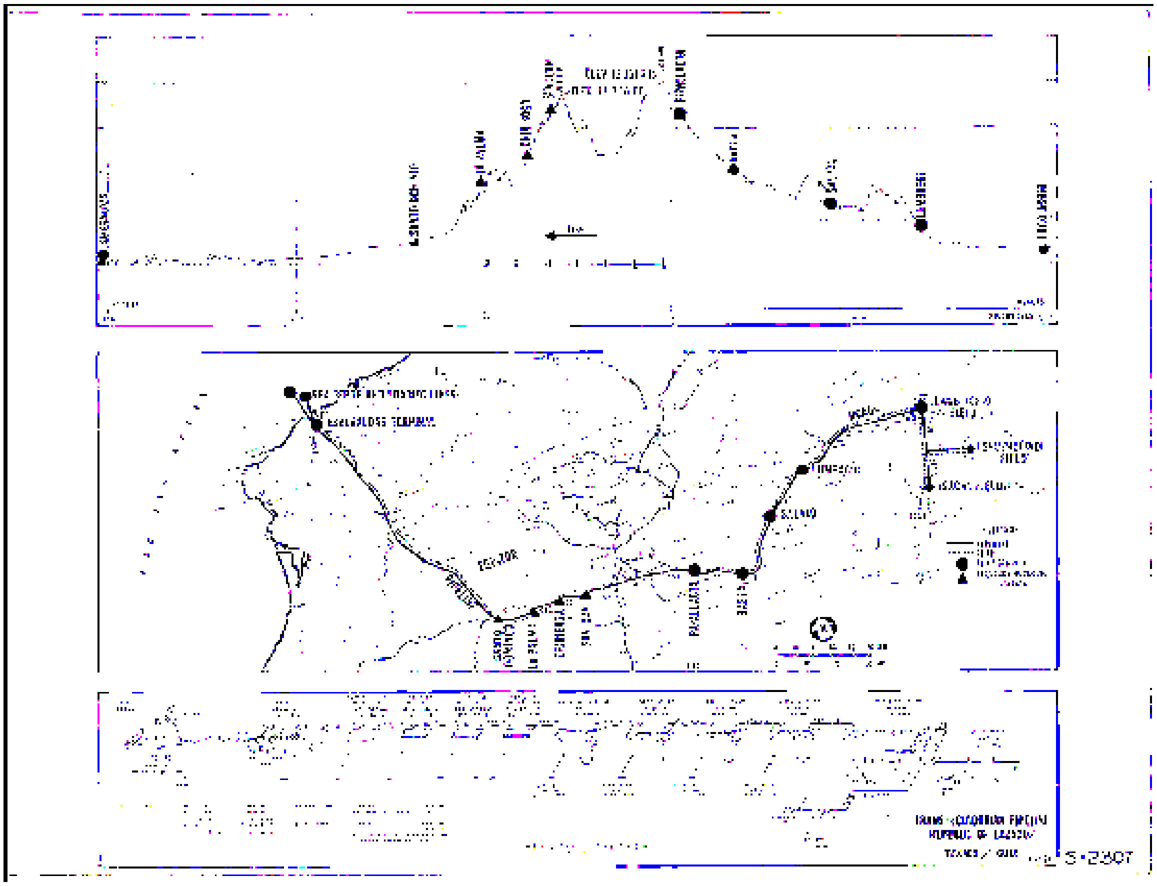
APPENDIX 1 – TRANS ECUADORIAN PIPELINE ROUTE



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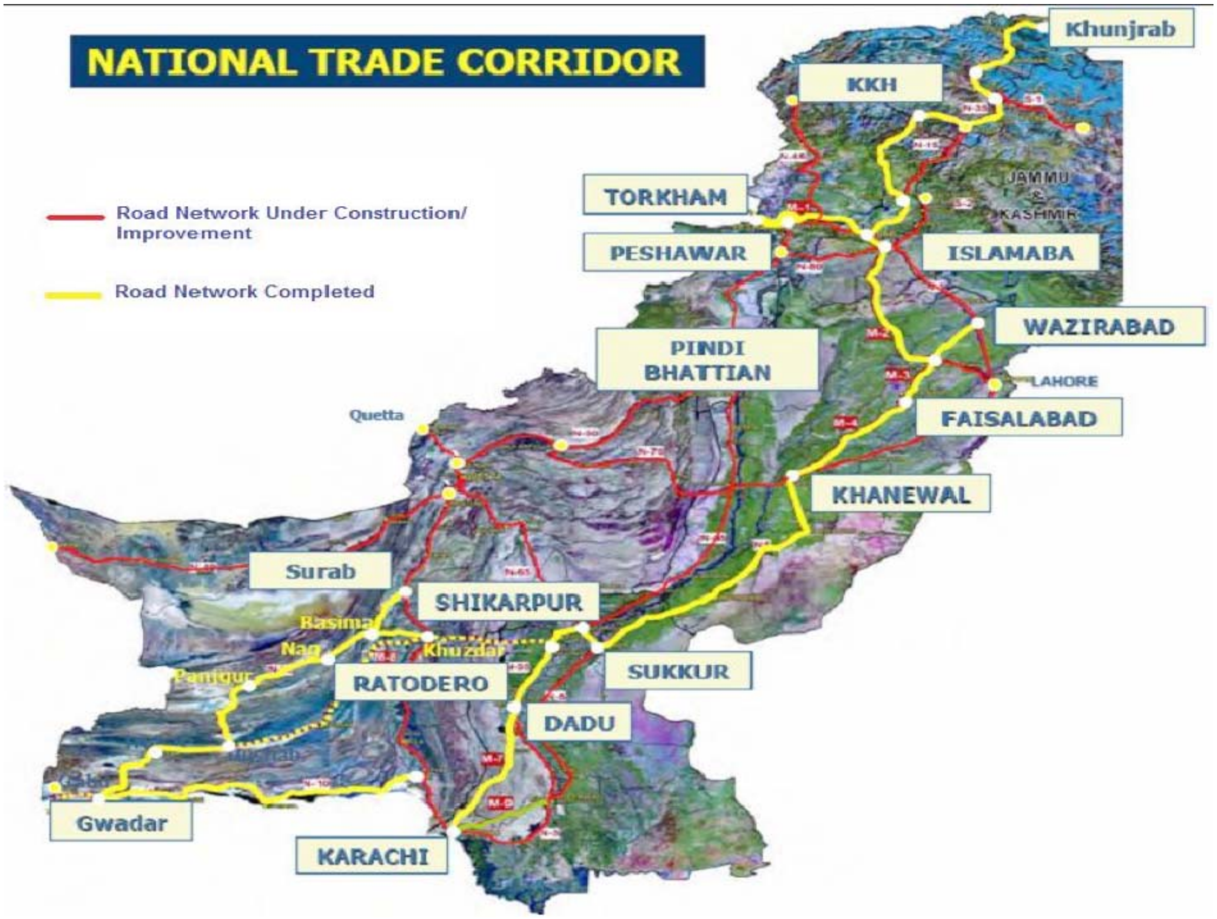
APPENDIX 2 – PAKISTANI TRADE CORRIDOR



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APPENDIX 3 – PAKISTAN PIPELINE COST DATA

Run date:02/21/2008 07:08 AM — 02/21/2008 07:10 AM Printed

Summary Cost Report — 1

Description	Units	Unit cost	Quantity	Cost	Remarks
Line pipe (steel)	ton	1,050.00	2,186,425	2,295,746,000	* ERW
Coating, Internal	sq.ft.	1.50	116,113,500	174,170,300	*
Coating, External	sq.ft.	7.50	116,113,500	870,851,500	*
Valve Stations	each	148,281.30	75	11,121,100	*
Scada	mile	16,000.00	1,500	24,000,000	*
					Material cost=3,375,889,000
Pipeline	mile	359,851.10	1,500	539,776,600	*
Valve Stations	each	45,660.28	75	3,424,521	*
ROW Restoration / Environmental	acre	421.74	14,545	6,134,195	*
					Construction cost=549,335,400
Material Cost =3,375,889,000: Construction Cost =549,335,400: (Material + Construction) Cost =3,925,224,768					
ROW cost	ft	4.60	7,920,000	36,431,999	
Insurance	%	3,925,224,768	1.5	58,878,372	
Taxes / VAT	%	549,335,360	5	27,466,768	
Custom Duty	%	3,375,889,408	16	540,142,305	20 % on 80 % of MC
Regulatory / Legal	%	3,925,224,768	1	39,252,248	
Engineering / Survey	%	3,925,224,768	6	235,513,486	
					subtotal=937,685,100
Risks	%	3,925,224,768	0		
Contingency	%	3,925,224,768	20	785,044,954	
					subtotal=785,044,900
Mob / Demob					
Contractor Country	ton-mile	.11	2,800,000	308,000	800 mile, 3500 ton, 1 spread
Ocean Freight	ton-mile	.18	3,500,000	630,000	1000 mile, 3500 ton, 1 spread
In-Country Transportation	ton-mile	.75	3,500,000	2,625,000	1000 mile, 3500 ton, 1 spread
					Mob / Demob=3,563,000.
Material Freight					
Ocean Freight	ton-mile	.06	1,093,212,000	65,592,736	500 mile 2186425 ton **
In-Country Transportation	ton-mile	.15	1,311,855,000	196,778,216	600 mile 2186425 ton **
					Material Freight=262,370,900.
Total pipeline cost = $5,913,888,851					

*=avg unit cost, **=Material Weight (steel=2186425, Pump=0)
Database: C:\LandPipe\LandPipe.mdb
Input: C:\LandPipe\China.lpc

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APPENDIX 4 – BURMA PIPELINE COST DATA

Burma - Summary Cost Report					
Description	**Units**	**Unit Cost**	**Quantity**	**Cost**	**Remarks**
Line pipe(steel)	ton	$1,050	1,093,212	$1,147,872,600	
Coating, internal	sq. ft.	$1.50	58,056,750	$87,085,125	
Coating, External	sq. ft.	$7.50	58,056,750	$435,425,625	
Valve Stations	each	$148,281	30	$4,448,439	
Scada	mile	$16,000	775	$12,400,000	
Material Cost= $1,687,231,789					
Pipeline	mile	$359,851	775	$278,884,603	
Valve Stations	each	$45,660	35	$1,598,110	
ROW Restoration/Environ	acre	$422	7,272	$3,066,893	
Construction Cost= $283,549,605					
Material + Construction Cost = $1,970,781,394.58					
ROW Cost	ft	5	3,960,000	$18,216,000	
Insurance	%	1,970,781,395	1.5	$29,561,721	
Taxes / VAT	%	283,549,606	5	$14,177,480	
Custom Duty	%	1,687,231,789	16	$269,957,086	
Regulatory / Legal	%	1,970,781,395	1	$19,707,814	
Engineering / Survey	%	1,970,781,395	6	$118,246,884	
Subtotal = $469,866,985					
Risks	%	$1,970,781,395	0		
Contingency	%	$1,970,781,395	20	$394,156,279	
Subtotal = $394,156,278					
Material Freight	%	$1,858,165,315	7	$130,071,572.04	
Material Freight= $130,071,572					
TOTAL PIPELINE COST = $2,964,876,230					

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