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ENERGY SECURITY

Impacts of Lifting Alaskan North Slope Oil Exports Ban

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Resources, Community, and
Economic Development Division

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November 8, 1990

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy and Power
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

Your letter of February 9, 1989, asked us to assess the impacts of removing export restrictions on Alaskan North Slope (ANS) crude oil. In April of this year, while our study was ongoing, we testified with your concurrence on this subject before the Subcommittee on International Economic Policy and Trade, House Committee on Foreign Affairs. Although our analysis was completed prior to the August 1990 Iraqi invasion of Kuwait, we have recognized the potential impact of the invasion in this report. As agreed with your office, our review focused on likely changes in the Alaskan oil trade between now and 1995, both with and without the ban, and how these changes will affect the nation's economy and energy security.

Results in Brief

If the ban on exporting ANS crude oil remains in place, ANS production will, of course, continue to go to U.S. ports. However, because of declining ANS production, shipments to eastern U.S. ports, i.e., those on the East Coast, the Caribbean, and the Gulf of Mexico, will probably cease at some time in the next several years. Producers of ANS crude prefer to sell their crude to West Coast refiners, given the cost of transporting it to East Coast refiners.

If the ban on exporting ANS crude oil is removed, some of it is likely to be exported to Pacific Rim countries. Since transportation costs to Pacific Rim ports are much less than those to eastern U.S. ports, oil that is currently transported to the eastern United States is likely to be exported. In addition, some ANS crude that would have gone to the U.S. West Coast may also be exported, since the cost of transporting oil to some Pacific Rim destinations is comparable to, if not lower than, the cost to U.S. West Coast ports. In this regard, the heavier weight of ANS crude is more likely to be attractive to refiners in Pacific Rim countries than it is to U.S. West Coast refiners, who refine more of their oil into light products, such as gasoline.

The probable economic effects of lifting the ban on ANS crude (as compared with leaving it in place) will be to

- increase the price of ANS crude at the wellhead—because of the reduction in transportation costs and the attractiveness of ANS crude to Pacific Rim refiners—and, consequently, the price that West Coast refiners pay for crude oil;
- promote economic efficiency by reducing transportation costs in the ANS crude oil trade, increasing domestic oil production, allowing better use of refinery processing resources, and ensuring that ANS oil is allocated to its highest valued uses; and
- accelerate the decline in tanker demand and hurt the U.S. maritime industry because ANS exports are likely to be transported on foreign-flag rather than U.S.-flag tankers.

The energy supply disruption resulting from Iraq's invasion of Kuwait has focused attention on U.S. energy security and, in particular, our reliance on imported oil. From an energy security standpoint, the effect of lifting the ANS export ban would probably be to increase total U.S. oil imports but possibly decrease net imports (total imports minus exports) to the extent that refinery efficiency is improved and ANS oil production increases in response to higher prices. Finally, lifting the ban could also contribute to the integrated world market's smooth and efficient functioning.

Background

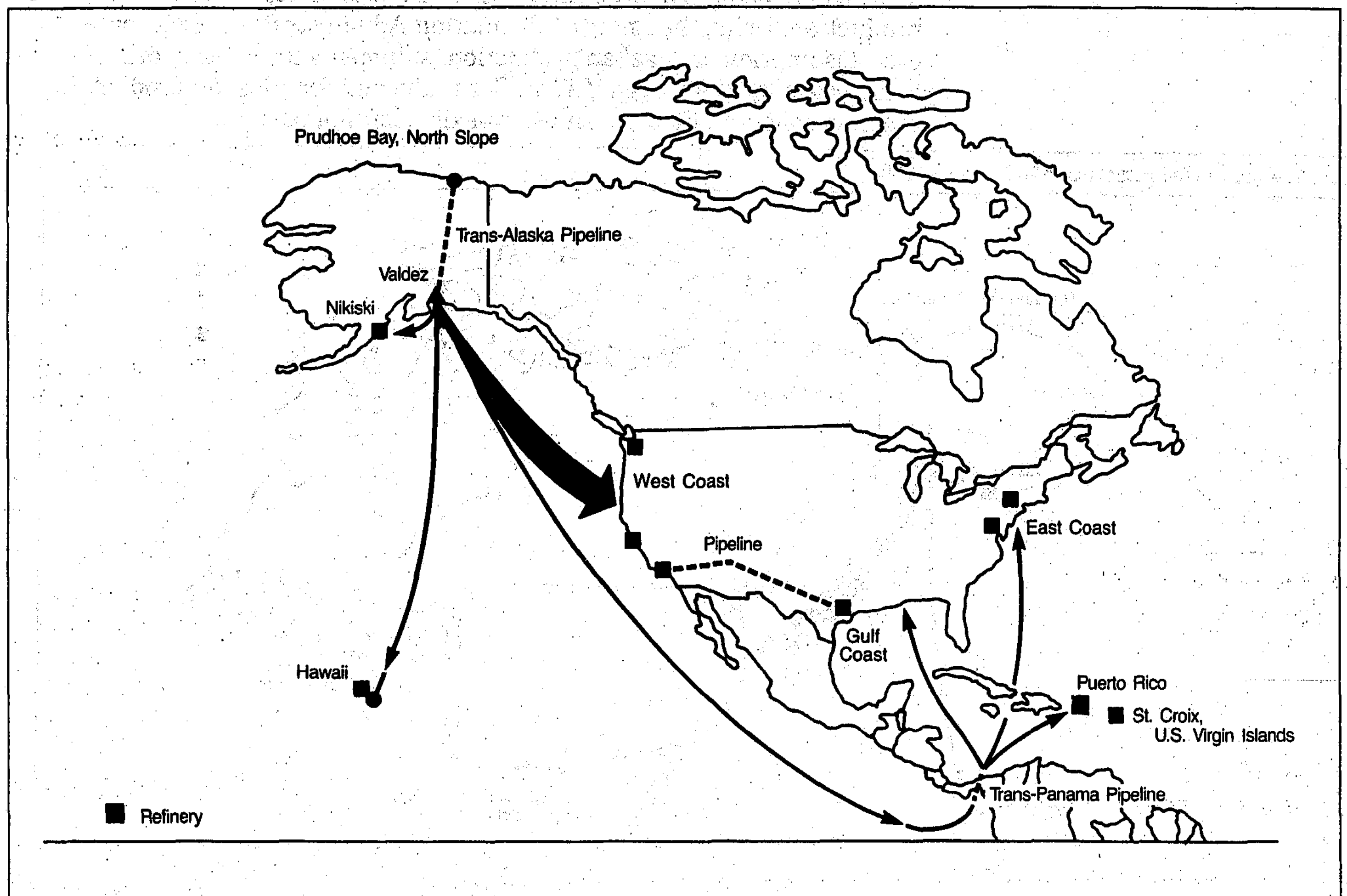
The Export Administration Act of 1979 places restrictions on the export of ANS crude that effectively ban its export.[1] The act states that "no domestically produced crude oil transported through the Alaskan pipeline may be exported from the United States." The purpose of this ban was to restrict "the export of goods where necessary to protect the domestic economy from excessive drain of scarce materials and to reduce the serious inflationary impact of foreign demand." This provision of the law was part of the compromise that permitted the construction of the Trans-Alaska Pipeline. The act allows the ban to be lifted only upon the President's certification that the export of Alaskan oil is in the national interest and meets several other specified conditions.

[1]The export of U.S. domestically produced crude oil is generally prohibited, including domestic crude transported by pipeline over certain rights-of-way, petroleum produced from the Naval Petroleum Reserve, and oil produced from the outer continental shelf.

Alaskan Crude Oil Distribution

Figure 1 illustrates the current pattern of ANS crude oil shipments on U.S. tankers with the ban in place.[2] In 1989, these shipments totaled about 1,700 thousand barrels per day (MBD). About 1,300 MBD went to the West Coast; about 300 MBD to eastern U.S. ports via the Trans-Panama Pipeline—the U.S. Gulf Coast, East Coast, and Caribbean; and the remainder to ports in Alaska and Hawaii.

Figure 1: Alaskan Oil Export Ban in Place—1990

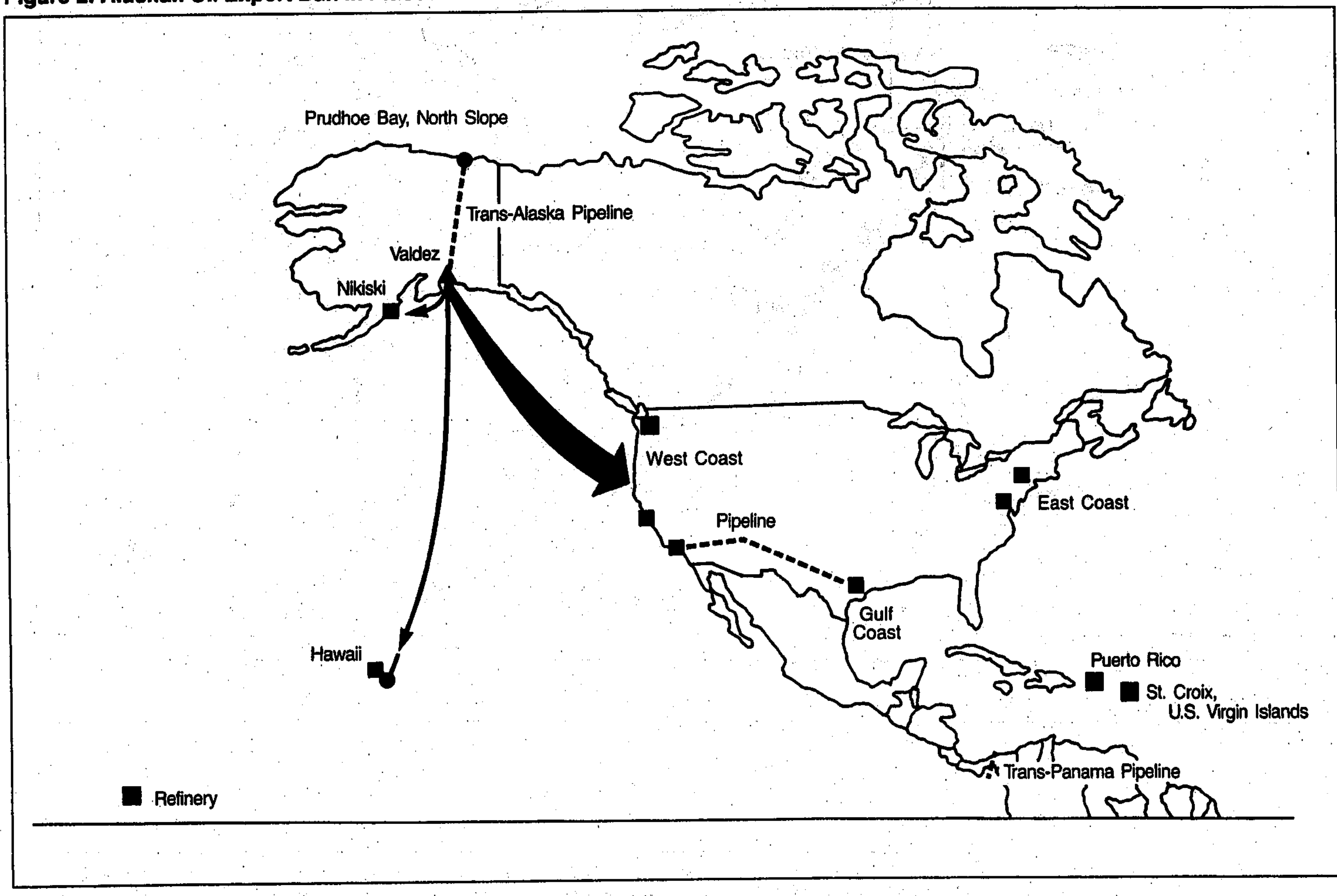


[2]Our analysis focused on ANS crude shipped on U.S.-flag tankers only. Some ANS oil, however, is shipped to the U.S. Virgin Islands on foreign-flag tankers and is an exception to the Merchant Marine Act of 1920 (the Jones Act). In 1989, 122 MBD, or about 6.6 percent of total ANS oil shipments, went to the U.S. Virgin Islands on foreign-flag tankers.

Since 1987, the amount of ANS oil shipped to eastern ports has declined as a result of decreasing ANS production and increasing West Coast consumption. Because transportation costs to eastern ports are considerably higher than those to the West Coast, Alaskan producers sell most of their oil to West Coast refiners.

This trend is expected to continue, so that in the near future ANS crude shipments to eastern ports will cease. The exact timing of this development will depend to a large extent upon the rate of decline of Alaskan production. Using the Energy Information Administration's (EIA) base case assumption of Alaskan production, shipments to eastern ports could cease by 1992, even if West Coast demand for Alaskan production remains constant. Figure 2 shows this distribution pattern.

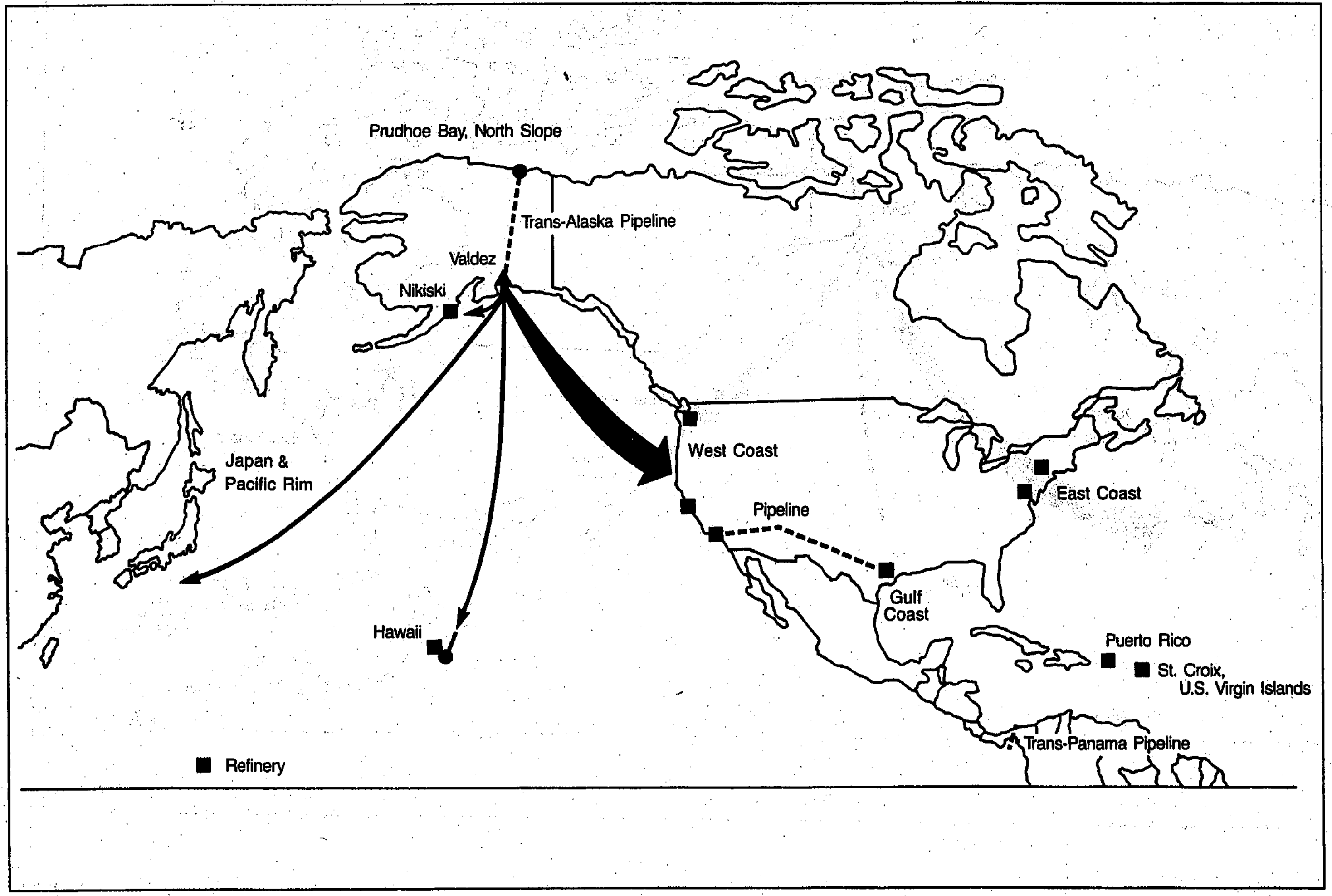
Figure 2: Alaskan Oil Export Ban in Place—1995



Impact of Lifting the Ban on Alaskan Oil Distribution

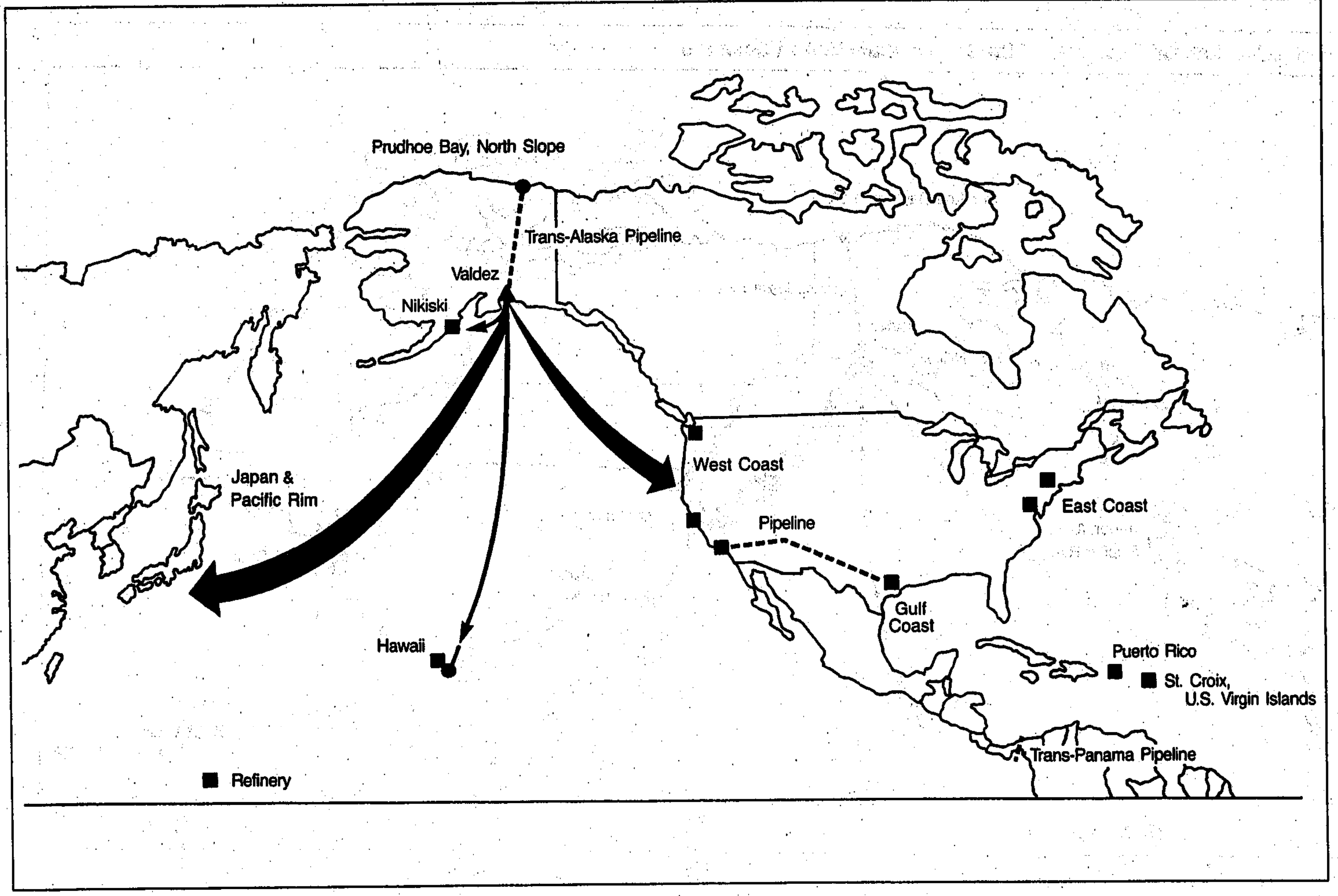
If the ban on exports of ANS crude is lifted, industry and public authorities generally agree that the oil now shipped to eastern U.S. ports—about 300 MBD—will be exported to Pacific Rim countries. This will occur, to a large extent, because such action would reduce transportation costs by a considerable amount. This reduction in transportation costs would increase the amount ANS producers receive for the oil. Figure 3 illustrates the resultant pattern of oil distribution. Conceptually this figure illustrates the minimum impact of lifting the ban.

Figure 3: Alaskan Oil Export Ban Lifted—Minimum Export Scenario



In addition, some of the oil that is now shipped to the West Coast may also be exported, but opinions vary on how much. A possible maximum impact of lifting the ban might be one in which the only ANS oil that would continue to be shipped to the West Coast would be oil used by integrated oil companies, that is, those that produce oil in Alaska and transport it to their own refineries on the West Coast. In 1989, these companies used around 570 MBD of ANS crude. Figure 4 illustrates a pattern of trade based upon this assumption of exporting about 1,000 MBD to Pacific Rim countries.

Figure 4: Alaskan Oil Export Ban Lifted—Maximum Export Scenario



Results of EIA Computer Modeling of Lifting the Alaskan Oil Export Ban

To better understand the effect of lifting the Alaskan oil export ban, we requested that EIA carry out an analysis using its Transportation and Refining of International Petroleum (TRIP) computer model. This model simulates world petroleum activities, including crude oil production and transportation, refinery operations, and petroleum products distribution. Model results indicate that if the ban had been lifted in 1988, up to 1,500 MBD, or three-fourths, of Alaska's crude oil production could have been exported that year and its price (refinery acquisition cost) on the West Coast could have increased by over $2.00 per barrel.[3] One reason why this might have occurred is that Pacific Rim refiners may be willing to pay more for Alaskan oil than West Coast refiners because it better suits their product demand and refinery configurations.

If, however, the ban were lifted in 1995, the model estimates that only 400 MBD, out of an ANS production level of 1,300 MBD, would likely be exported in that year and the price would increase over the no-exports case by only about $0.20 per barrel. According to EIA, ANS crude exports would be considerably smaller in 1995 than in 1988 for two main reasons. First, ANS production will have fallen from about 2,000 MBD to 1,300 MBD. Second, production of other crudes that are potential substitutes for ANS on the West Coast is also expected to decline by 1995. The decline of production in relatively nearby countries and the relatively high transportation costs from the Middle East to the West Coast will make ANS crude more attractive to West Coast refiners in 1995 than in 1988. There will not, however, be such a substantial increase in the price of ANS crude from lifting the ban as there would have been in the 1988 case. Lower ANS production levels would have already brought the ANS price closer to the upper bound of the world price even with the ban in place.

While these model results are useful in analyzing the potential impact of lifting the ban, they are only a guide for estimating actual changes in trade patterns that may take place. Appendix II contains a more detailed discussion of the computer models we used and the limitations of the TRIP model. Appendix III contains tabulated results from the TRIP computer runs.

[3] All dollar figures are in constant 1988 dollars.

Economic Impacts of Lifting the Alaskan Oil Export Ban

Basically, lifting the ban would have two general kinds of economic effects. First, there will be economic efficiency effects. In a well functioning oil market, economic efficiency means producing oil so long as incremental benefits exceed incremental costs of production and allocating oil to its highest valued uses, in both national and international contexts. Second, parties that are involved in Alaskan oil trade will be affected, creating both "winners" and "losers."

Efficiency Increases

Lifting the ban may lead to potential economic efficiencies. Currently, a declining, but significant, amount of Alaskan oil is making its way to eastern U.S. ports. Lifting the ban would accelerate the disappearance of this trade because transportation costs would decrease significantly if the oil were exported. Consequently, Alaskan producers would receive higher wellhead prices by selling their oil to Pacific Rim countries. Tanker rates to Japan from Alaska in 1988, for example, were about $2.50 per barrel cheaper than to Houston. Avoiding the higher tanker rates would produce an economic efficiency gain.

Another potential gain in economic efficiency could arise in the refining sector. Light crudes are more suited for the "light" petroleum products, such as gasoline and diesel fuel, which are preferred on the West Coast. Evidence suggests that U.S. West Coast refiners invested in additional "downstream"[4] refining capacity to process medium-gravity Alaskan oil than that needed to process lighter crudes. This occurred because West Coast refiners were able to purchase Alaskan oil at a lower price than could refiners on the Gulf Coast.

If the ban is lifted and ANS crude is sold on the world market, U.S. refineries are likely to pay more for crude oil and might purchase lighter crudes instead of ANS crude. EIA's analysis suggests that this might allow refiners to free up downstream processing capacity. If this occurs, refiners may be able to increase the volume of lighter petroleum products they produce. This could produce a gain in economic efficiency by reducing refining costs.

Lifting the ban could also promote economic efficiency by reducing the amount of heavy petroleum products, such as residual oil, produced by West Coast refiners. Residual oil can be used, among other things, to power ships and generate electricity. Because Alaskan oil is relatively

[4]"Downstream" refining processes are those that occur after initial distillation in order to produce light products, such as gasoline, from heavy crude oil.

heavy, refiners currently produce more residual oil than the U.S. West Coast requires. This supply of residual oil depresses its price and leads to more of its consumption than might otherwise occur. EIA's analysis says that lifting the ban could reduce production of residual oil if refiners purchase lighter crudes that yield a smaller volume of residual fuel.

Finally, a key aspect of economic efficiency deals with ensuring that products are allocated to their highest valued uses. In this regard, both the United States and its trading partners might be made better off by lifting the ban. Pacific Rim nations would have access to Alaskan oil that has the potential of better fitting their industrial needs, and the West Coast would import more light crudes, which better fit its needs for light end products.

Potential Winners and Losers

Lifting the ban could have important distributional effects—that is, it would produce winners and losers. Some oil producers in Alaska and California would particularly benefit if the ban is lifted. On the other hand, lifting the ban is likely to hurt both independent oil refiners on the West Coast and the maritime industry. Effects on consumers are unclear.

Impact on Producers

A lifting of the ban may benefit some oil producers since the ban has also affected wellhead prices for Alaskan and Californian oil and, as a result, Alaskan and Californian crude production. EIA modeling results suggest that lifting the ban might increase wellhead prices for Alaskan oil by as much as $2.16 per barrel, depending on the amount exported.[5] This may lead to some increases in production of both Alaskan and Californian oil, although the size of any increase is uncertain.

Impact on Refiners

Independent California refiners are likely to be hurt if the export ban is lifted because they will have to pay higher prices for Alaskan and Californian crudes. Unlike integrated producer-refiners, against whom they compete, the independent refiners will not benefit from increases in wellhead prices. EIA's model analysis suggests that refineries can be expected to mitigate this loss by purchasing lighter crudes, which are more ideally suited for producing gasoline. Lower costs of processing

[5]EIA ran the model several times, constraining it to allow only certain levels of exports. This generated different prices for different export levels. The maximum price increase of $2.16 occurred when exports were unconstrained. See apps. II and III.

these lighter crudes may, to some extent, help offset increases in the refiners' crude oil acquisition costs.

Impact on U.S. Shipping

The U.S. maritime industry also stands to lose from lifting the ban on ANS crude exports. As a result of the Jones Act (the Merchant Marine Act of 1920), U.S.-flag tankers transport virtually all ANS crude.[6] If the ban is lifted and some of this oil is exported, foreign-flag tankers, because their costs are lower, are likely to transport that oil. This will accelerate the loss of U.S. ships, which will be laid up, scrapped, or sold anyway as ANS production decreases.

Between 1989 and 1995, the Maritime Administration (MARAD) estimates that 32 ships will be lost because of declining ANS production, even if the ban stays in place. However, if the ban is lifted and exports begin in 1991, the same losses occur as in the minimum exports case, but earlier. An additional seven ships are lost if there are maximum exports.

The loss of these ships would also affect the national defense through reduced availability of U.S.-flag, "militarily useful" tankers; the federal budget through possible guaranteed loan defaults; and national unemployment by threatening seafarers' jobs. Appendix IV contains more details of our analysis of possible impacts on the U.S. maritime industry.

Impact on Consumers

It is unclear to what extent the refiners will be able to pass along increased crude oil costs to their customers in the form of increased product prices. While EIA's modeling suggests a possible substantial increase in the price of Alaskan crude, it shows little change in consumer prices for gasoline on the West Coast. We have identified at least two explanations. First, a switch by U.S. refineries to lighter crudes could mean more gasoline produced than under the ban. Second, the availability of imported gasoline may limit price increases for gasoline.

Energy Security

The energy supply disruption resulting from Iraq's August 2, 1990, invasion of Kuwait has focused attention on U.S. energy security. The effects of this disruption show the potential economic implications of relying on crude oil supplies from the Persian Gulf. For example, between August 1 and August 10, 1990, average gasoline prices rose almost 18 cents per gallon, resulting in consumers' paying about $63 million more per day for gasoline on August 10 than on July 31.

[6] In 1989, U.S.-flag tankers transported 93.4 percent of all ANS crude oil loaded at Valdez, Alaska.

Lifting the ban on Alaskan crude exports would affect U.S. energy security in three ways. First, it would increase total, or gross, U.S. imports. Second, it would possibly lead to a decrease in net imports. Finally, in an integrated world oil market, U.S. energy security depends in large part on this market's smooth and efficient functioning. Lifting the ban could contribute to this end.

Gross U.S. imports will increase because exports from Alaska will be replaced on the world market. It is difficult to tell with certainty where these imports will come from. However, on the basis of analysis provided by EIA's model, if the ban had been lifted in 1988, most of the increase would likely have originated from Latin America (particularly Mexico and Ecuador), the Middle East (especially the United Arab Emirates and Qatar), and Malaysia. If the ban were eliminated in 1995, nearly all of the increase would likely come from the United Arab Emirates and Qatar. The shift in sources occurs because Middle East crudes can more readily accommodate the 1995 increase in U.S. import demand because of declining production at alternate sources.

U.S. net crude imports, that is, total imports less exports, will remain unchanged according to EIA model results. Net imports may decline, however, if exports are not replaced on a barrel-for-barrel basis. Imported crude might lead to improved refinery efficiency with the result that refiners, particularly on the West Coast, may be able to meet the demand for light products with less crude. Furthermore, increased U.S. crude production, arising from higher prices in Alaska and California, might reduce the need for imports.

Worldwide oil market efficiency also could improve to some extent if the ban is lifted. This development could contribute to U.S. energy security in two ways. First, increased U.S. production would help diminish, to at least a small extent, world dependence on insecure oil supplies. Second, greater security and diversification of supply would reduce the likelihood that U.S. trading partners in the Pacific would bid up world oil prices as sharply as they might otherwise in a disruption.

Observations

Lifting the ban on ANS oil exports could result in a substantial amount of Alaskan oil being transported to Pacific Rim countries. Such action would probably end Alaskan oil shipments to the eastern United States. However, these shipments will cease anyway over the next few years as Alaskan production declines. Exports could also include oil that now goes to the West Coast.

Lifting the ban would probably lead to gains in economic efficiency and would benefit crude oil producers in Alaska and California. However, it would also probably have negative effects on independent refiners on the West Coast and the U.S. maritime industry, although much of the effect on the maritime industry will occur even if the ban remains in place because of declining Alaskan production.

From an energy security perspective, lifting the ban would increase total U.S. oil imports but, possibly, decrease net imports as a result of increased oil production and improvements in refinery efficiency. Finally, lifting the ban could also contribute to the integrated world market's smooth and efficient functioning.

As specified in your request, we focused our analysis on the energy and economic impacts of lifting the ban on Alaskan crude oil exports. We restricted our review to the period ending in 1995.

We interviewed government officials at the federal and state levels, as well as public, private, and academic authorities. Both the Department of Energy (DOE) and MARAD assisted in our data analysis. DOE utilized its TRIP computer model to develop possible changes in oil distribution patterns and their consequences. Model runs were made before the current Middle East crisis. MARAD assisted in analyzing maritime impacts. See appendix I for further details on our methodology.

We conducted our review in accordance with generally accepted government auditing standards. We discussed contents of this report with DOE and MARAD staff, who generally agreed with the facts as presented; but as requested, we did not seek official agency comments.

Our review took place between May 1989 and June 1990. Unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days after the date of this letter. At that time we will send copies to the Secretaries of Commerce, Energy, Transportation, and

Defense; the Director, Office of Management and Budget; and other interested parties. If you have any questions or concerns, please contact me at (202) 275-1441. Major contributors to this report are listed in appendix V.

Sincerely yours,

Victor S. Rezendes
Director, Energy Issues

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Abbreviations

ANS	Alaskan North Slope
DOE	Department of Energy
EIA	Energy Information Administration
GAO	General Accounting Office
MARAD	Maritime Administration
MBD	thousand barrels per day
OTM	Oil Trade Model
TRIP	Transportation and Refining of International Petroleum computer model

Scope and Methodology

We interviewed officials at the federal and state levels, as well as public, private, and academic authorities. These included officials at the Departments of Commerce, Defense, and Energy and the Maritime Administration (MARAD); state officials in Alaska and California; representatives of oil producing, trading, and refining companies; maritime and shipping interests; economists; and other academic authorities. We also convened a panel of federal and state officials and academics in January 1990 to discuss issues relating to ANS crude oil exports.

We examined numerous reports, studies, and other documents, including the June 1986 Report to Congress on Alaskan Oil by a Department of Commerce-chaired interagency task force and a previous GAO report, Pros and Cons of Exporting Alaskan North Slope Oil (GAO/NSIAD-83-69, Sept. 26, 1983).

We requested that DOE's Energy Information Administration (EIA) use its TRIP model to analyze how lifting the ban on ANS crude exports would affect oil trade. TRIP simulates world trade in crude oil and petroleum products and the refining of crude. EIA analysts used TRIP to produce a service report on the potential impacts of lifting the ban on petroleum refining and trade using actual data from 1988 and projections for 1995. We hired a consultant, Dr. Hank Jenkins-Smith, with experience in using computer models to analyze the oil export ban and also used the latest version of DOE's Oil Trade Model (OTM) to check EIA's work. OTM is a more aggregated and simplified version of TRIP, designed for use on a personal computer. Appendix II contains additional details describing the capabilities and functions of these DOE models. Appendix III contains tabulated results from EIA TRIP computer runs.

We do not view this modeling effort as a means of obtaining exact predictions of ANS trade flows and prices. Subject to the inherent model limitations, this modeling suggests the direction and, to a lesser extent, gross magnitudes of change.

MARAD estimated future U.S.-flag tanker requirements, on the basis of scenarios that we provided. With input from oil industry experts, maritime industry representatives, and government officials, we postulated four scenarios for future ANS oil distribution. All of the scenarios assume that, as future Alaskan production levels decrease to levels forecast by EIA, total shipments of ANS oil decrease proportionately. We also assumed that ANS oil shipments to the farthest, most expensive destinations would be the first to decline. Shipment to the East Coast, Gulf Coast, and U.S. Caribbean ports, in that order, is more expensive than to

West Coast ports. The least costly destinations would continue to receive ANS oil at historical levels as long as there is a sufficient supply. Two of the scenarios that we developed assume that the ban on ANS crude exports remains in place. One uses EIA base case estimates for Alaskan oil production, and one uses EIA high case estimates. The other two scenarios assume that the Alaskan oil export ban is lifted and use EIA base case estimates for Alaskan oil production. In one of these, we assumed that the oil that would have gone to distant U.S. ports is the only oil that is exported. In the other, we assumed that these exports, plus all the oil previously destined for West Coast ports and not controlled by integrated oil companies, are sent to foreign ports. On the basis of the experts we consulted, we assumed that 570 MBD would continue to flow to West Coast ports in this last case.

We requested that MARAD determine the effects that each of these scenarios would have on future U.S.-flag tanker employment. MARAD provided estimates of tanker requirements needed to transport oil from Alaska to U.S. destinations and of probable vessel displacement. In developing projected vessel displacements, MARAD considered the age of the vessel, carrying capacity relative to the requirements of the scenario, ownership (either by an oil company or a tanker company), charter status (long- or short-term), and employment history.

MARAD also developed estimates of operating costs of U.S.-flag tankers and foreign-flag tankers on two international routes. We requested this in order to assess the capability of U.S.-flag tankers to operate in the world oil trade in competition with foreign-flag tankers. Appendix IV provides further analysis of the possible effects of lifting the ANS crude oil export ban on the U.S. maritime industry as well as additional details on national security and federal budgetary implications and possible effects on seafarer employment.

Economic Modeling of Lifting the ANS Oil Export Ban

EIA utilized a large-scale linear programming model, the Transportation and Refining of International Petroleum (TRIP) model, to simulate the impacts of lifting the ANS oil export ban. To help guide EIA's modeling effort and increase the level of confidence in its results, we also performed our own simulations using another, smaller trade and refining model, the Oil Trade Model (OTM) housed at DOE's Office of Policy, Planning, and Analysis. We took into account inherent model limitations when using TRIP results in our analysis.

Overview of the Computer Models

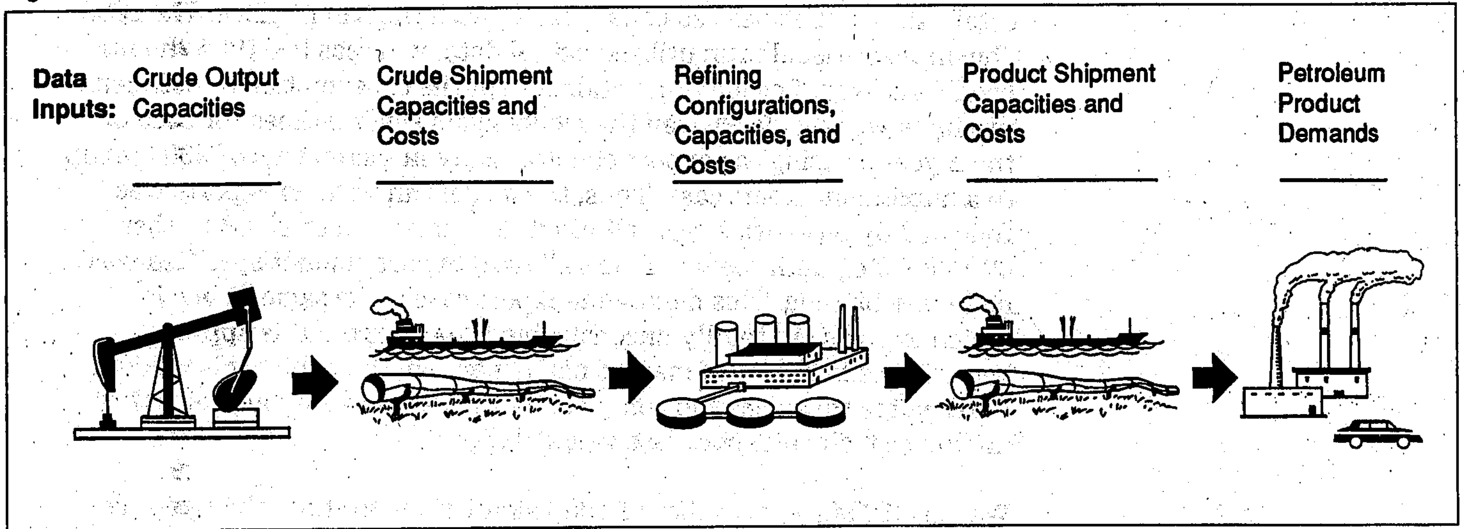
TRIP models world trade in crude oil, crude oil refining, and refined products for a single period, usually a year. It divides the world into 33 geographical regions.[1] Demand quantities for refined petroleum products are treated as given data inputs, as are upper limits for the production of all crude streams except Saudi Arabian Light. Saudi Arabia is considered the swing producer that can vary production at will to balance supply and demand. Ten refined petroleum products and 49 crude oil streams are represented. Crude suppliers are linked to refiners by tanker routes or pipelines with fixed capacities and transportation rates. Crude-refining activities are performed in submodels, representing aggregated refinery configurations and capacities in TRIP's 33 geographic regions. Refined petroleum products are then allocated to meet demands in the regions.

The objective of the model is to minimize the global cost of meeting demands for petroleum products worldwide. The cost components include the cost of purchasing crudes and other materials[2] and transportation and refining costs, which derive from fixed parameters supplied as data inputs. As shown in figure II.1, TRIP consists of three main sectors: crude production, or output; refining of crude into petroleum products; and the allocation of petroleum products for consumption. Marine and pipeline transportation links connect these three sectors.

[1]Centrally planned economies are depicted in the model with predetermined production and trade patterns.

[2]Only Saudi Arabian Light is explicitly priced in the data input. All other crudes are priced in relation to Saudi Light and reflect quality or location differences.

Figure II.1: TRIP Model Structure



TRIP assumes that, over a 1-year period, consumers will not change their "planned" consumption and crude production capacities are not likely to drastically change. On the basis of these assumptions, TRIP can determine the most economical pattern of allocating crude supplies to refineries and allocating refined products to consumers for the year for which the data have been provided.

OTM and its data base are essentially highly aggregated versions of their TRIP counterparts, which makes the model small enough to run on a personal computer.[3]

EIA Modeling Procedure

We limited the number of TRIP runs because of time and cost constraints. We chose 1988 because it was the last year for which complete data were available. We chose 1995 because this is the last year within the scope of this study and also because decreases in ANS crude oil production between 1988 and 1995 are expected to lead to changes in shipping patterns.[4]

[3]One difference between OTM and TRIP, however, is that the former features nonlinear demand curves for petroleum products, while TRIP demand quantities for petroleum products are predetermined data inputs.

[4]ANS crude production is forecast to be about 1,300 MBD in 1995, down from about 2,000 MBD in 1988.

In both the 1988 and the 1995 simulations, EIA first ran the model to establish the "business-as-usual" cases, with the ban in place. The 1988 "business-as-usual" run utilized actual data, whereas the 1995 run utilized forecasts of crude production and of the consumption of petroleum products worldwide. EIA ran the model again several times for each of the 2 years, easing the export ban gradually in increments of 200 MBD up to a maximum-export case. Thus, the model run with no exports was followed by one with exports limited to a maximum of 200 MBD, then 400 MBD, etc., until the maximum allowed export amount specified was no longer binding. This maximum-export case is the same as one in which exports are totally unconstrained. EIA adopted this approach because the behavior of market participants in the industry is unlikely to resemble the quick and complete adjustment to new conditions that an unconstrained export case would suggest.

We used OTM for a number of 1988 simulations to study the hypothetical effects of lifting the ban that year. Generally speaking, we found OTM results to be directionally consistent with those obtained from TRIP[5] and both generally consistent with the existing economic studies and the observations of experts we consulted.

Limitations of TRIP Modeling Effort

The TRIP model has various limitations, which stem from its inability to model changing, dynamic relationships; its high level of aggregation; and its potential for exaggerating the degree and speed of market adjustments.

TRIP Is Limited in Its Ability to Analyze Impacts Over Several Years

TRIP is limited in its ability to analyze impacts over a period spanning several years because it is a static, single-period model. In modeling an exhaustible resource, such as crude oil, changes occurring between time periods may be very important. Production in any one period depends not only on price but also on the remaining stock of the resource. In our

[5]TRIP and OTM results for 1988 indicated that lifting the ban would result in the disappearance of ANS crude oil shipments to the U.S. Gulf Coast and other distant U.S. locations. TRIP, however, allocated about 1,500 MBD of ANS crude exports to Japan and "Other Asia," while OTM allocated about 960 MBD to Japan only. In both TRIP and OTM, unconstrained ANS exports resulted in a rise of U.S. West Coast crude acquisition costs of about $2.00 per barrel. The direction of change in the price of key petroleum products was generally the same, but the magnitude was greater in OTM. OTM results, with respect to crude imports to replace ANS shipments to U.S. markets, did not seem as plausible as TRIP results. In particular, OTM seemed to underplay the role of Middle East producers as a source of replacement crudes, contrary to the expectations of observers we consulted. The differences between the two sets of results are probably due to the greater degree of detail in TRIP.

modeling the ANS crude trade, however, production in any one year was assumed independent of production in previous years.

In modeling the ANS crude trade, EIA assumed that production in future years will be at the same levels, with or without the export ban, although it was recognized that a likely rise in wellhead prices due to exports might raise the level of production over the next few years. If ANS crude production is indeed sensitive to price changes in the range of $1 to $2, 1995 production may be higher than assumed in EIA's modeling effort.

Similarly, the demands for petroleum products in TRIP are predetermined as data inputs for each product by region, and they do not adjust at all to changed market conditions.[6] Crude supply quantities are also somewhat rigidly specified in the model.

The model assumes that refinery capacities and configurations are static over the period 1988 to 1995 along with factors affecting transportation rates between 1988 and 1995, except for the cost component attributed to bunker fuel. The cost of bunker fuel in the model is linked to the price of a standard or "marker" crude, which is a data input.

TRIP Is Limited by Its High Level of Aggregation

Another important limitation of the model lies in its high level of aggregation. One example is how TRIP models refinery configurations and capacities. In reality, a refining region may have many individual refineries with different sizes, degrees of sophistication (diversity of downstream units), and transportation access to crude streams. Some of these refineries may be owned by integrated oil companies, which produce their own crude and operate their own tankers, while others are independents. But TRIP aggregates all refineries in one region into one refinery whose capacity in the various activities (e.g., crude and distillation, thermal operations, hydrocracking, etc.) is the sum of the individual refineries' capacities for the same activities. The model does not, therefore, capture the diversity in size and technical sophistication among refineries, nor is it cognizant of possible ownership relationships that may influence the allocation of crude from producers to refiners.[7]

[6]This limitation, however, should not be considered a serious one for the purpose at hand. As mentioned above, changes in 1988 prices of refined products due to the lifting of the ban are probably too small to result in any significant responses on consumption. In 1995, price changes are even smaller.

[7]EIA dealt with this limitation by testing the sensitivity of model results to progressive restrictions on the level of exports permitted.

TRIP May Exaggerate the Degree and Speed of Adjustment

TRIP does not explicitly account for institutional factors that may limit the extent and speed with which petroleum markets adjust to changed conditions. For example, TRIP does not fully capture the influence of complex ownership relationships within the petroleum industry; nor does it explicitly model government regulations that may influence petroleum markets. EIA chose to run TRIP scenarios with progressively increasing upper limits on exports because the unconstrained export case might overstate the amount of ANS crude exports.

Tabulated TRIP Model Results

The following tables contain results from the TRIP model runs that are most relevant to our analysis. Note that the computer runs for 1988 had actual data as inputs and the 1995 runs relied on available estimates. Also, "Maximum Allowable ANS Exports" refers to the constraint levels EIA imposed during the computer runs. A maximum of 0 refers to the export ban remaining in place, and the "Unconstrained" case indicates that EIA imposed no limit on exports for that computer run.

Complete results from the TRIP model runs are contained in EIA Service Report SR/EMEU/90-3. Copies are available from the National Energy Information Center, (202) 586-8800.

Table III.1: West Coast Price-Quantity Relationships for ANS Crude Oil in 1988 and 1995

Maximum allowable ANS export levels, in MBD	ANS shipments to West Coast, in MBD	West Coast ANS refinery acquisition cost (RAC), per barrel	RAC increase over "No Exports Case," per barrel
		1988	
0	1,381	$13.49	[a]
400	1,381	$13.74	$0.25
800	1,191	$14.43	$0.94
Unconstrained	466	$15.65	$2.16
		1995	
0	1,255	$20.98	[a]
400	855	$21.17	$0.19
Unconstrained	849	$21.17	$0.19

Notes: MBD=thousand barrels/day.
All dollar figures are in 1988 dollars.
[a]No exports case.
Source: EIA TRIP model solutions.

Table III.2: Changes in U.S. Crude Oil Exports and Imports in 1988 and 1995

	Maximum allowable ANS crude oil exports				
	1988			1995	
Destination/ source	400 MBD	800 MBD	Unconstrained case	400 MBD	Unconstrained case
			Exports		
Japan	220	501	886	309	315
Other Asia	180	299	639	91	91
Total	**400**	**800**	**1,525**	**400**	**406**
			Imports		
Ecuador	0	148	162	0	0
Mexico	337	461	377	0	0
Trinidad	0	38	68	0	0
Bolivia/Peru	63	111	149	0	0
Kuwait	0	0	0	(101)	(101)
UAE/Qatar	0	42	502	515	519
Iraq	0	0	0	(138)	(143)
Malaysia	0	0	238	99	98
All other	0	0	29	23	32
Total	**400**	**800**	**1,525**	**398**	**405**

Notes: MBD=thousand barrels/day.
Negative numbers (in parentheses) indicate a decline in imports from these countries.

Source: EIA TRIP model solutions.

Table III.3: West Coast Refinery Gate Product Prices in 1988 and 1995

	Product price per barrel	
Maximum allowable ANS crude exports, in MBD	Premium gasoline	87 octane unleaded
	1988	
0	$22.26	$20.80
400	$22.21	$20.76
800	$22.38	$20.92
Unconstrained	$22.80	$21.28
	1995	
0	$28.83	$27.28
400	$28.47	$27.13
Unconstrained	$28.47	$27.13

Note: MBD=thousand barrels/day.

Source: EIA TRIP model solutions.

Impacts of Lifting the ANS Export Ban on the Maritime Industry

The U.S.-flag tanker fleet relies heavily on the ANS crude oil trade. MARAD estimates show that the tanker fleet faces significant losses by 1995. These losses will occur with or without the ANS oil export ban in place because of declining Alaskan oil production. Lifting the ban, however, will accelerate tanker losses.

Background

Demand for U.S.-flag tankers rose with the need to transport ANS crude to U.S. ports, but recently, as ANS production has declined so has demand for U.S.-flag tankers. From 1988 to 1989, U.S.-flag tanker employment on all ANS routes has declined from the full-time equivalent of approximately 55 ships and 5.4 million deadweight tons to 39 tankers totaling 4.6 million deadweight tons. Over these same years, ANS crude oil production decreased from 1,974 MBD in 1988 to 1,832 MBD in 1989.

ANS crude oil production and the employment of U.S.-flag tankers are linked because the Export Administration Act of 1979 effectively prohibits the export of ANS crude and the Jones Act (the Merchant Marine Act of 1920) requires that U.S.-built, U.S.-flag vessels transport all cargoes between U.S. ports.

Furthermore, the U.S. tanker fleet now relies heavily on the ANS crude trade. U.S. tankers generally cannot compete on international routes with foreign-flag tankers because U.S.-flag tankers have higher associated costs and therefore higher rates.

Results of GAO's Tanker Demand Analysis

Tables IV.1-4 present MARAD's estimates of future U.S.-flag tanker requirements based on four scenarios of ANS oil distribution that we supplied. Table IV.1 assumes that the export ban stays in place and Alaskan production declines according to EIA base case estimates. This decline results in a loss of 7 tankers in 1990 and a loss of 25 more by 1995.

Table IV.1: Export Ban in Place

Yearly oil averages in MBD

Scenario variables	1989	1990	1995
Alaskan production estimates[a]	2,010	1,960	1,290
Total ANS crude oil loadings	1,984	1,934	1,264
West Coast destinations	1,258	1,258	1,005
Total, U.S. destinations[b]	1,851	1,801	1,131
Total exports	0	0	0
U.S.-flag tankers required	50	43	18

Source: MARAD estimates.

[a]Alaskan production estimates do not equal ANS loadings because the production estimates include non-ANS crude produced in-state and ANS oil that is consumed in-state and is not loaded onto tankers.

[b]Figures include ANS crude shipped to Alaska and Hawaii.

Table IV.2 is based on EIA estimates that assume a higher world oil price in the future than in the base case[1] and has a higher ANS crude oil production level and higher loading levels in 1995 as compared with table IV.1. Table IV.2 reflects a possible "best case" scenario for the maritime industry because the higher associated production levels would sustain higher levels of tanker employment than with the export ban in place and lower production levels. This table shows a loss of 7 tankers in 1990 and a net loss of 21 more by 1995.

Table IV.2: Export Ban in Place, High Production Estimates

Yearly oil averages in MBD

Scenario variables	1989	1990	1995
Alaskan production estimates[a]	2,010	1,960	1,530
Total ANS crude oil loadings	1,984	1,934	1,504
West Coast destinations	1,258	1,258	1,245
Total, U.S. destinations[b]	1,851	1,801	1,371
Total exports	0	0	0
U.S.-flag tankers required	50	43	22

Source: MARAD estimates.

[a]Alaskan production estimates do not equal ANS loadings because the production estimates include non-ANS crude produced in-state and ANS oil that is consumed in-state and is not loaded onto tankers.

[b]Figures include ANS crude shipped to Alaska and Hawaii.

Table IV.3 assumes that the export ban is lifted in 1990 and that ANS crude oil exports occur in 1991. As in table IV.1, ANS production declines

[1]EIA assumed world crude oil prices of $15.00 in 1990 and $20.60 in 1995 for its base case estimates and $18.00 in 1990 and $24.40 in 1995 for its high price estimates. These assumptions were made before the August 1990 Iraqi invasion of Kuwait.

according to EIA base case estimates. In table IV.3, when the export ban is lifted, all the oil that would have gone via Panama to the eastern United States with the ban in place is exported instead in foreign-flag tankers. The West Coast continues to receive ANS oil at the same level as in table IV.1. These assumptions result in tanker requirements in 1990 and 1995 that are the same as those in table IV.1. This occurs because in 1995 ANS production will have declined to the extent that no oil will be shipped to the eastern United States, either with or without the ban. However, tanker requirements during the period 1990-1995 would decline more slowly under the scenario shown in table IV.1 than under the table IV.3 scenario.

Table IV.3: Export Ban Lifted, Minimum Exports Scenario

Yearly oil averages in MBD

Scenario variables	1989	1990	1995
Alaskan production estimates[a]	2,010	1,960	1,290
Total ANS crude oil loadings	1,984	1,934	1,264
West Coast destinations	1,258	1,258	1,005
Total, U.S. destinations[b]	1,851	1,801	1,131
Total exports[c]	0	0	0
U.S.-flag tankers required	50	43	18

Source: MARAD estimates.

[a]Alaskan production estimates do not equal ANS loadings because the production estimates include non-ANS crude produced in-state and ANS oil that is consumed in-state and is not loaded onto tankers.

[b]Figures include ANS crude shipped to Alaska and Hawaii.

[c]Exports begin in 1991 at a level of 257 MBD and decline to 0 by 1993.

Table IV.4 reflects the assumption that the export ban is lifted in 1990 and that large amounts, 945 MBD, are exported beginning in 1991. We assume that certain institutional factors, such as contractual agreements and producers supplying their own West Coast refineries, result in a minimum level of 570 MBD continuing to flow to West Coast refineries. These assumptions result in a loss of 7 tankers in 1990 and 32 more by 1995.

Table IV.4: Export Ban Lifted, Maximum Exports Scenario

Yearly oil averages in MBD

Scenario variables	1989	1990	1995
Alaskan production estimates[a]	2,010	1,960	1,290
Total ANS crude oil loadings	1,984	1,934	1,264
West Coast destinations	1,258	1,258	570
Total, U.S. destinations[b]	1,851	1,801	696
Total exports[c]	0	0	435
U.S.-flag tankers required	50	43	11

Source: MARAD estimates.

[a]Alaskan production estimates do not equal ANS loadings because the production estimates include non-ANS crude produced in-state and ANS oil that is consumed in-state and is not loaded onto tankers.

[b]Figures include ANS crude shipped to Alaska and Hawaii.

[c]Exports begin in 1991 at a level of 945 MBD.

Under all of the scenarios, the first tankers to feel the effects of decreased demand will be the tankers used on the most expensive routes: those transporting ANS crude to the U.S. East Coast, Gulf Coast, and Carribbean ports (in descending order from highest cost to lowest cost routes). This will occur because Alaskan producers effectively pay the price of transporting crude to their customers and when faced with a diminishing supply of oil will cut off their most distant customers first in order to pay the smallest possible transportation costs.

Related Maritime Issues

The loss of U.S.-flag tankers, whether the ban is lifted or not, will affect the national defense, the federal budget, and seafarer employment.

Effects on Tanker Requirements for the National Defense

U.S.-flag tankers play an important role in U.S. defense plans, and the loss of these ships could also reduce the availability of U.S. tankers for national defense purposes. In 1988, the Commission on Merchant Marine and Defense, a presidential commission made up of active and former government and industry officials, most recently defined the characteristics of a "militarily useful" tanker and the U.S. tanker requirements to support a global war. A "militarily useful" tanker is one of less than 100,000 deadweight tons and is "coated," i.e., capable of carrying military petroleum products. The 1988 requirements for coated tankers to support the military and the economy to meet defense global war requirements was 9.9 million deadweight tons.

MARAD's analysis of the GAO scenarios shows that the demand for tankers involved in transporting ANS crude oil from the eastern terminus of the Panama Pipeline to U.S. East Coast, Gulf Coast, and Carribbean ports is likely to disappear, with or without the ban. The Commission expects additional militarily useful tankers to be supplied by the Military Sealift Command, the Ready Reserve Fleet, the Effective U.S. Controlled Fleet, and those ships in the tanker fleet in addition to those employed in the transport of ANS crude to U.S. East Coast, Gulf Coast, and Carribbean ports.

Budgetary Implications

As U.S.-flag tanker demand continues to decline, the federal government is exposed to possible loan defaults under the Title XI loan program.[2] Of the 32 ships designated by MARAD as likely to be lost under the minimum exports scenario,[3] 17 had outstanding loan balances totaling $493 million at the end of 1989, but none of the additional 7 that could be lost if maximum exports occur had any outstanding balances. The possible budgetary impacts from defaulted loans will continue to decline over time as outstanding balances are reduced. For example, between June 1988 and June 1989, the total Title XI outstanding balances declined from $962.7 million to $860.4 million.

Maritime Employment Effects

Declining tanker demand on domestic routes will have negative effects on seafarer employment. On the basis of export scenarios we supplied, MARAD estimates of ship losses would force the loss of from 797 to 961 seafarer billets or employment losses of from 1,881 to 2,268 seafarers.[4] The 797 billets represent an estimate of the billets lost as a result of declining Alaskan production if the export ban remains in place or under the minimum exports scenario. The 961 billets represent the total loss if maximum exports occur.

[2]Under Title XI of the Merchant Marine Act of 1936, as amended in 1970, and its accompanying regulations, the Maritime Administration is authorized to grant mortgage insurance on ships built in U.S. shipyards.

[3]MARAD expects these same 32 ships to be lost even if the export ban stays in place.

[4]MARAD multiplies the number of billets on a ship by 2.36 in order to estimate the number of seafarers required to fill a billet on a yearly basis.

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