

**Service Report**

**The Impacts on U.S. Energy Markets and the Economy  
of Reducing Oil Imports**

**Prepared by  
Office of Integrated Analysis and Forecasting  
Energy Information Administration  
U.S. Department of Energy**

**For  
The General Accounting Office**

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Service Reports are prepared by EIA upon special request and may be based on assumptions specified by the requestor. Information regarding the request for this report is included in the Preface.

## For Further Information...

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## Preface

This study was undertaken at the request of the General Accounting Office (GAO). Its purpose is to evaluate the impacts on U.S. energy markets and the economy of reducing oil imports. The approach and assumptions underlying this report were specified by GAO and are attached as an Appendix. The study focuses on two approaches: (1) a set of cases with alternative world crude oil price trajectories and (2) two cases which investigate the use of an oil import tariff to achieve a target reduction in the oil imports. The analysis presented uses the National Energy Modeling System, which is maintained by the Office of Integrated Analysis and Forecasting within the Energy Information Administration (EIA), and the DRI/McGraw Hill Macroeconomic Model of the U.S. Economy, a proprietary model maintained by DRI and subscribed to by EIA.

The National Energy Modeling System (NEMS) is an integrated energy-economy modeling system for U.S. energy markets, developed by the EIA as a policy analysis tool to provide an integrated framework for policymakers to understand the implications of proposed policies and alternative assumptions concerning energy markets. NEMS is used annually by EIA's Office of Integrated Analysis and Forecasting (OIAF) to produce a Reference Case and a range of alternative projections for the midterm future, which are published in the Annual Energy Outlook. The Annual Energy Outlook 1996 (*AEO96*), published in January 1996, projects energy trends to the year 2015. While the future entails many uncertainties, the *AEO96* Reference Case reflects EIA's assessment of the most likely direction of U.S. energy indicators. The Reference Case assumes that current laws and regulatory policies will continue into the future.

This analysis should not be construed as advocating or reflecting any policy position of the U.S. Department of Energy or the Energy Information Administration.

# Contents

<b>Abstract</b> .....	1
Methodology .....	1
Summary of Aggregate Results .....	1
<b>1. International Considerations</b> .....	6
World Oil Price .....	6
Worldwide Supply and Demand .....	8
North American Free Trade Agreement .....	11
<b>2. Domestic U.S. Energy Market Implications</b> .....	13
Dynamics of Changes in Production and Consumption .....	13
The Decline in Net Oil Imports .....	17
<b>3. Macroeconomic Implications</b> .....	19
World Oil Price Sensitivities .....	19
Impacts on the Aggregate Economy .....	19
Impacts on Sectors of the Economy .....	22
The Imposition of an Oil Import Fee .....	25
How Will the U.S. Government Use the Collected Revenues? .....	25
How Are the Impacts Different than from Higher World Oil Prices? .....	32
How Do Flexible Exchange Rates and Monetary Policy Affect the Results? . . .	35
<b>Appendix:</b>	
<b>Letter of Request for Study from the General Accounting Office</b> .....	38

# The Impacts on U.S. Energy Markets and the Economy of Reducing Oil Imports

## Abstract

The General Accounting Office (GAO) has responded to a request from Representative John Kasich by requesting that the Energy Information Administration (EIA) use the National Energy Modeling System (NEMS) to estimate the cost to the U.S. economy of reducing oil imports. The analysis summarized by this paper focuses on two approaches toward a target reduction in oil imports: (1) a set of cases with alternative world crude oil price trajectories and (2) two cases which investigate the use of an oil import fee.

## Methodology

What is the cost of reducing oil imports relative to the existing levels found in the Reference Case of the 1996 Annual Energy Outlook? The answer to this question depends on the mechanism for achieving the reduction. The first approach focuses on a set of world crude oil price increases. Higher prices for energy reduce energy imports but cost the economy in terms of lost output and purchasing power. Four price trajectories were developed to investigate this issue. They exceed the EIA 1996 Annual Energy Outlook (*AEO96*) Reference Case price path by \$5 per barrel, \$10 per barrel, \$15 per barrel, and \$20 per barrel by 2005. The ratio of each new 2005 world oil price and the 2005 *AEO96* Reference Case price is then maintained from 2006 through 2015 for the alternative cases (Figure 1A). These four cases will be referred to throughout the document as +\$5, +\$10, +\$15, and +\$20 to indicate that in all instances they are incremental to the *AEO96* Reference Case world oil price path.

The second approach posits an oil import fee which achieves oil import reductions in 2005 equivalent to those projected when oil prices are \$20 above the Reference Case level. Here, two basic options are investigated: (1) using the collected revenues to reduce the Federal deficit and (2) recycling collected funds to maintain the Federal deficit at the same level as in the Reference Case. The return of revenues is accomplished through a reduction in the payroll tax rate.

## Summary of the Aggregate Results

Four integrated model runs were implemented to relate oil import reduction projections to alternative world oil price increases (Figure 1B). With higher world oil prices, domestic production increases and demand is constrained. By 2005, the +\$5 case reduces oil imports by 1.2 mmbd, while the +\$20 case backs out 3.2 mmbd (Figure 1C). By 2015, the + \$5 case results in a reduction of 1.8 mmbd, while the +\$20 case results in a reduction of 4.7 mmbd. The results

Figure 1A. Alternative World Oil Price Paths

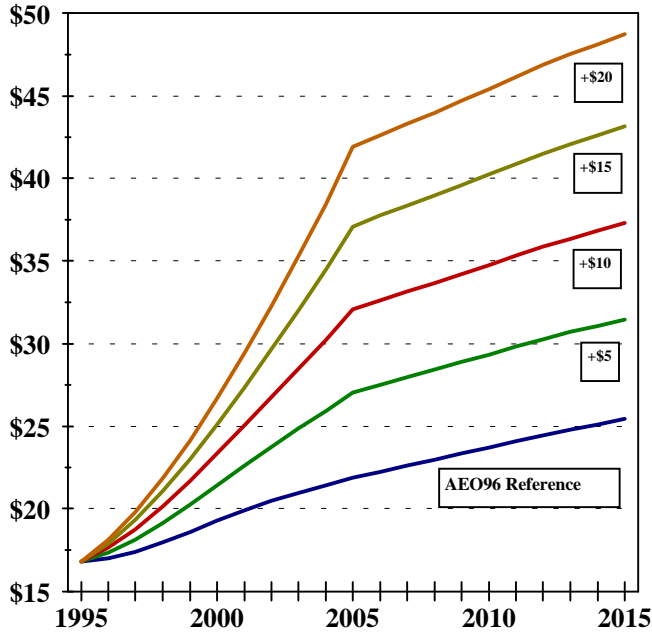


Figure 1B. Oil Imports

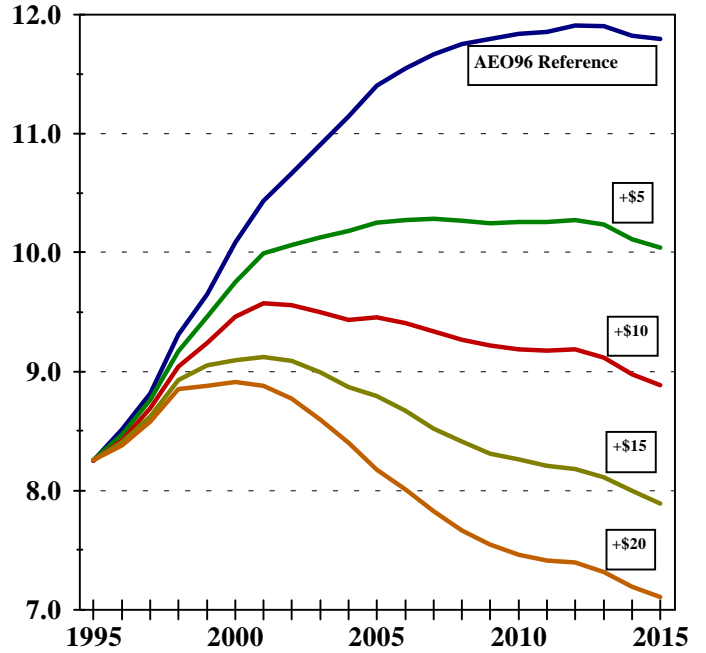
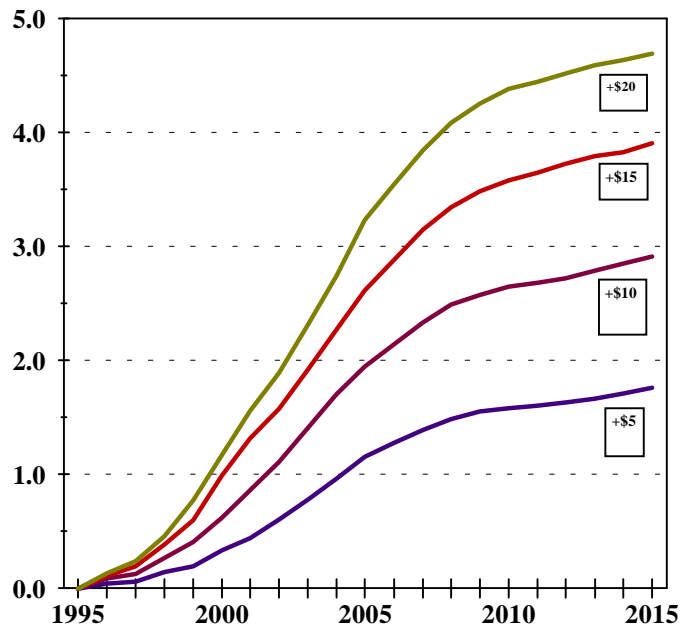
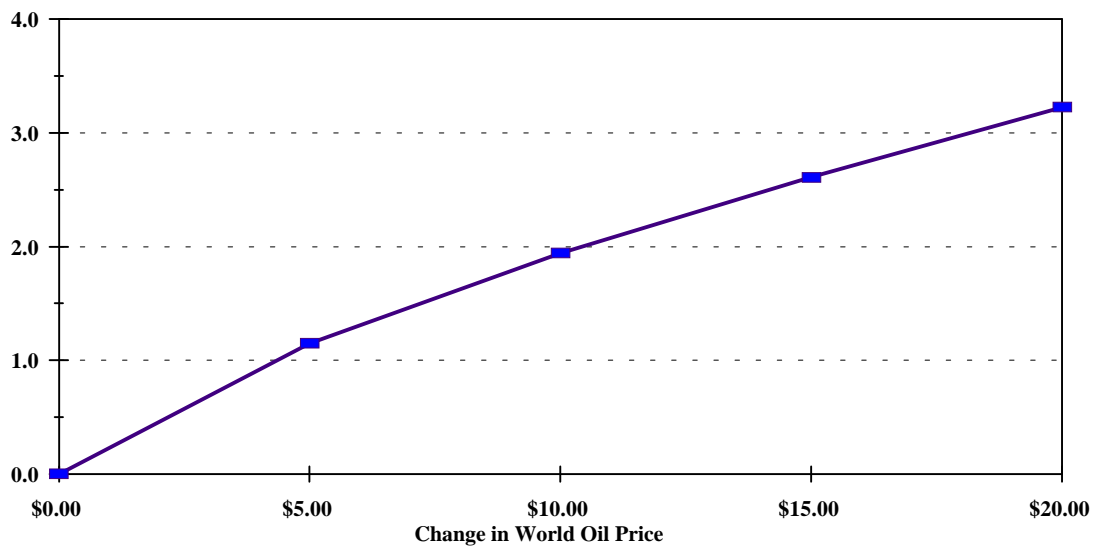


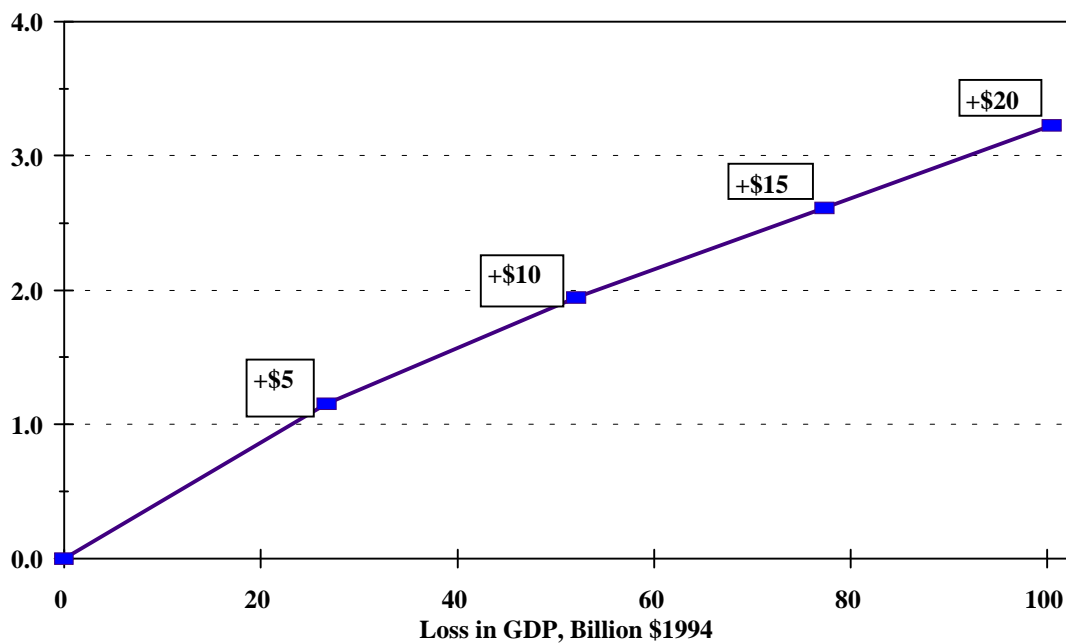
Figure 1C. Reduction in Oil Imports



**Figure 1D. Change in World Oil Price  
Relative to Import Reduction, in 2005**



**Figure 1E. Loss in GDP and  
Import Reduction In 2005**



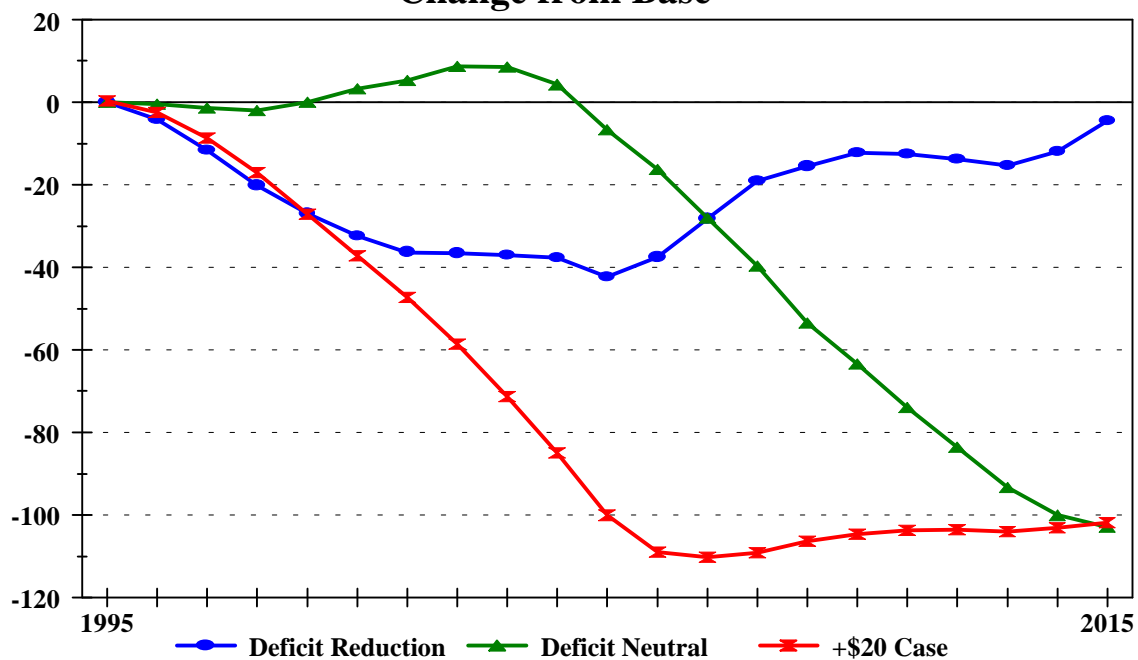
indicate that each successive reduction of one million barrels per day of oil imports can only be achieved at progressively higher costs. The first ten dollars of price increase yields a reduction in oil imports of 2 mmbd by 2005, while the next \$10 yields only an additional 1.2 mmbd (Figure 1D). Economic impacts, as reflected by changes in GDP, mirror the changes in the world oil price (Figure 1E).

The Import Fee Case experiment yields energy market effects which are fairly similar to the +\$20 case. However, the macroeconomic impacts are more complex in part because the fee generates substantial revenues. How the funds are used makes a large difference. In addition, the fee case has effects on international trade patterns and restructures U.S. imports and exports. As shown in Figure 2, when the fee revenues are used to reduce the Federal deficit, the economy is adversely affected through 2005, but begins to return to the Reference Case throughout 2015. In the early years, the economy is adversely affected by higher energy prices; in the latter years, interest rates decline in response to the lower Federal deficit, and an investment-led rebound occurs.

When the Federal deficit is targeted to remain at the Reference Case level, the economy is essentially kept at or slightly above the Reference Case through 2005, but declines thereafter. Here, the early results stem from supporting consumption expenditures by passing collected funds back to consumers. While this ameliorates the near-term effects, investment suffers and the economy begins to rapidly decline relative to the Reference Case. Also in the deficit reduction case, the impact on GDP measured over the entire forecast period is approximately two-thirds of the impact of the +\$20 case. Here, the fee adversely affects the U.S. export prices relative to import prices, whereas in the +\$20 case, all nations experience higher energy prices.



**Figure 2. Real GDP  
Change from Base**



## 1. International Considerations

### World Oil Price

Four oil price cases were defined starting with the Annual Energy Outlook 1996 (*AEO96*) Reference Case as the point of departure. Beginning with the year 1996, the world oil price was assumed to steadily increase out to the year 2005 achieving price levels that were \$5, \$10, \$15, and \$20, respectively, over the *AEO96* Reference Case world oil price (\$21.86)<sup>1</sup>. The ratio of each new 2005 world oil price and the 2005 *AEO96* Reference Case price is then maintained from 2006 through 2015 for the alternative cases.

For the purpose of assessing the impacts of an oil import fee, the +\$20 Case was chosen as the point of comparison. An Import Fee Case was defined that used the year-by-year net import levels from the +\$20 Case as targets. In order to achieve these targets, a fee on all petroleum imported into the United States is imposed over and above the world oil price. The only exceptions to the import fee are the crude oils and refined products imported from our partners (Canada and Mexico) in the North American Free Trade Agreement (NAFTA).

Figure 3A shows the three world oil price paths associated with the *AEO96* Reference Case, the +\$20 Case, and the Import Fee Case. By definition, the +\$20 Case achieves the \$20 difference with the *AEO96* Reference Case by the year 2005. The difference expands to over \$23 by the end of the forecast period. In the Import Fee Case, the decline in U.S. consumption and increase in U.S. production brought about by the imposition of the oil import fee results in levels of production from Organization of Petroleum Exporting Countries (OPEC) suppliers that are below those of the *AEO96* Reference Case. Therefore, with a diminished call on OPEC producers, the world oil price path in the Import Fee Case is expected to be slightly below that of the *AEO96* Reference Case. However, this diminished call on OPEC producers is somewhat tempered by the response of foreign consumers and producers to lower world oil prices.

Figure 3B focuses on the price implications of the Import Fee Case. The world oil price is that price realized by all oil consumers outside the United States. Due to the imposition of an oil import fee that eventually reduces U.S. net imports by over 3 million barrels per day, domestic consumers experience oil prices that exceed the world oil price by more than \$20 per barrel (\$22.36 in the year 2005 and \$24.50 in the year 2015). For any given year during the forecast period, the vertical distance in Figure 3B between the world oil price and the U.S. oil price is the oil import fee.

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<sup>1</sup>Throughout this paper, values for prices and economic concepts such as GDP and sectoral output are expressed in constant 1994 dollars.

Figure 3A. World Oil Prices, 1995-2015

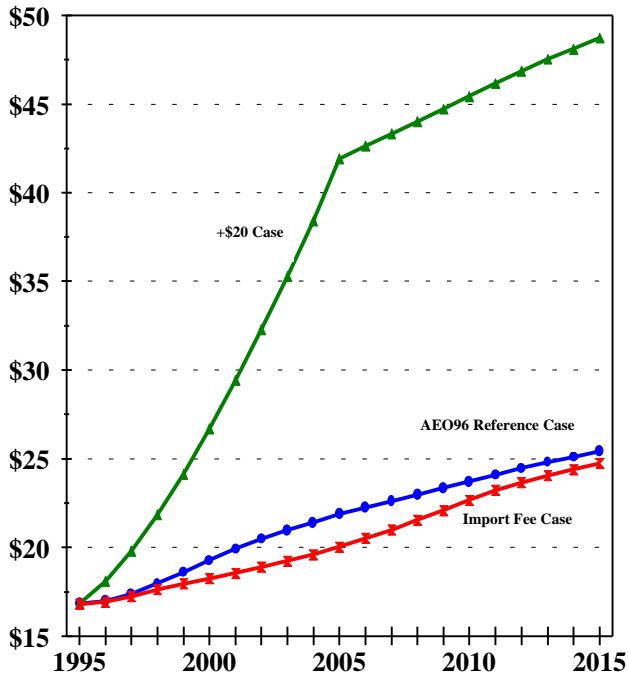


Figure 3B. Oil Prices, 1995-2015

Import Fee Case

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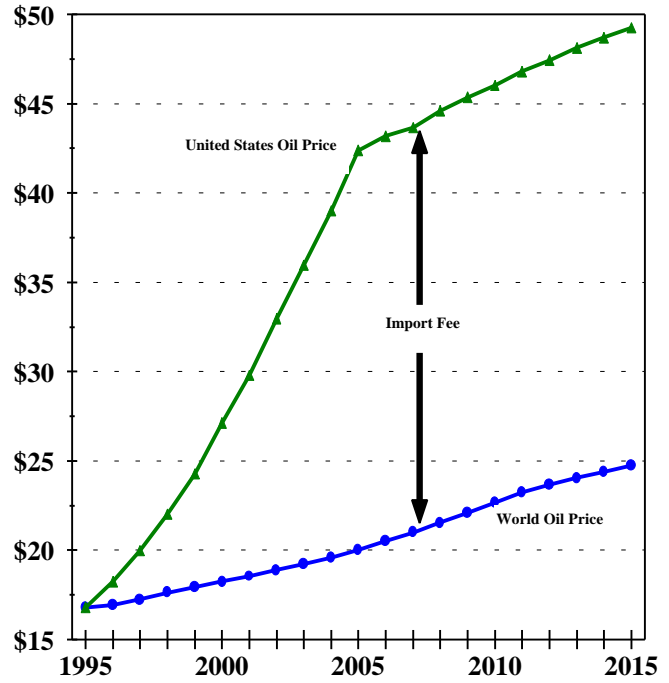


Figure 3C. World Oil Prices, 1995-2015

AEO96 Reference Case v Import Fee Case

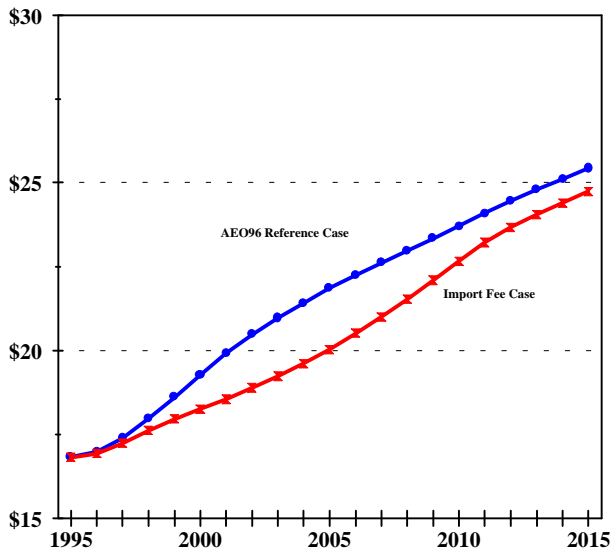


Figure 3D. U.S. Oil Prices, 1995-2015

+\$20 Case v. Import Fee Case

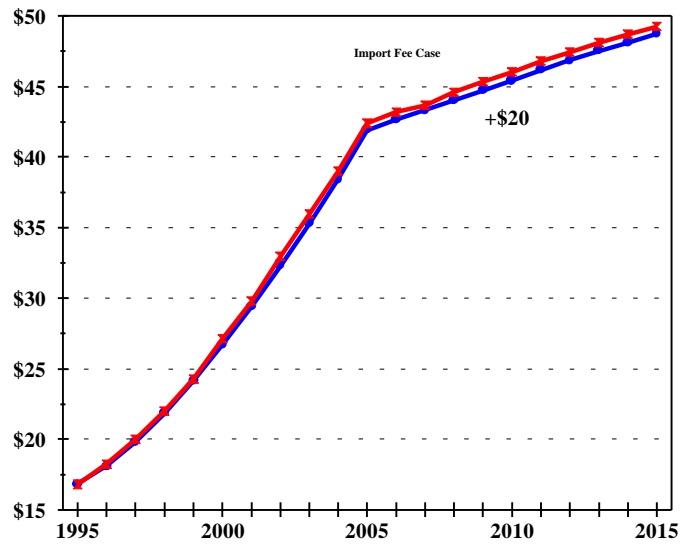


Figure 3C compares the world oil price paths associated with the *AEO96* Reference Case and the Import Fee Case. As the oil import fee rapidly escalates over the decade from 1995 to 2005, the U.S. is able to reduce their net imports of petroleum by almost 3.25 million barrels per day. Such significant import reduction directly translates into a reduced call on OPEC producers resulting in world oil prices in the Import Fee Case that are lower than those in the *AEO96* Reference Case. These two price paths tend to slightly diverge over the 1995-2005 period as the increasing oil import fee diminishes the call on OPEC producers. After the year 2005, the gap between the two price paths begins to narrow as the oil import fee stabilizes and worldwide oil demand (outside the U.S.) responds to the lower prices.

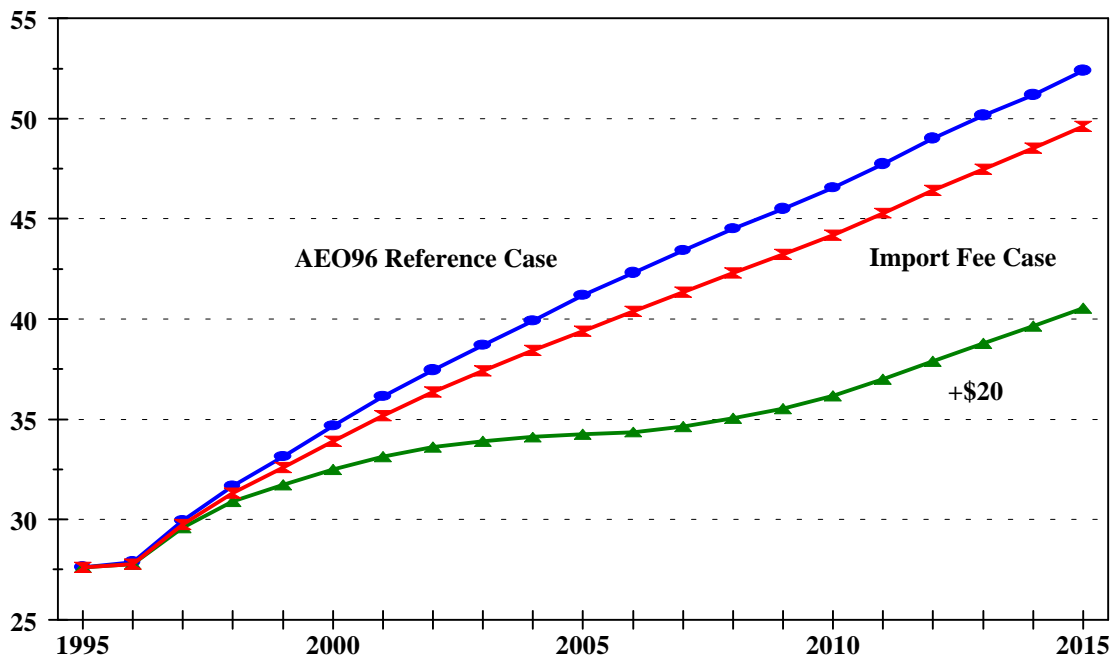
Figure 3D compares the oil price paths experienced by U.S. consumers and producers in the +\$20 Case and the Import Fee Case. Because the Import Fee Case targets the petroleum import levels associated with the +\$20 Case, these two price paths turn out to be virtually identical, as Figure 3D suggests. However, the Import Fee Case price path is consistently a little higher than the +\$20 Case. The reason for the slight difference (which never exceeds \$0.60 per barrel in any one year) is NAFTA. In the +\$20 Case, some of the imports from our NAFTA partners were part of the overall reduction in net U.S. imports. However, in the Import Fee Case, the U.S. will always import whatever petroleum is available from Canada and Mexico in order to avoid the oil import fee. Therefore, more expensive imports from non-NAFTA sources will have to be reduced in order to meet the target levels (from the +\$20 Case) in the Import Fee Case. This results in a slightly greater U.S. oil price in the Import Fee Case than in the +\$20 Case.

### **Worldwide Supply and Demand**

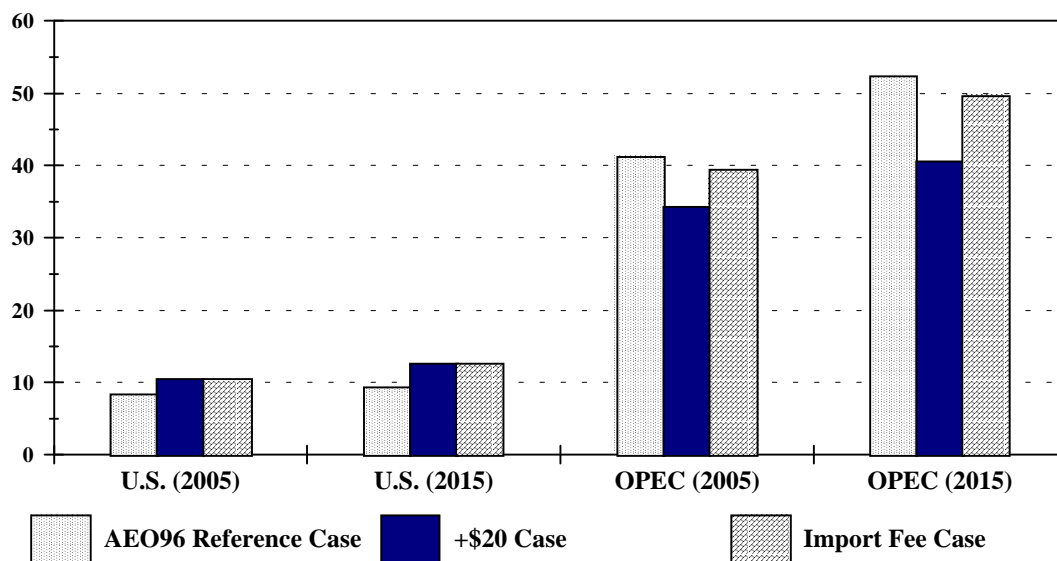
In the +\$20 Case, all consumers and producers worldwide experience the tripling of oil prices over the forecast period. In the Import Fee Case, only U.S. consumers and producers experience this tripling. Figure 4 shows OPEC production over the forecast period for the *AEO96* Reference Case, the +\$20 Case, and the Import Fee Case. OPEC production exceeds 52 million barrels per day by 2015 in the *AEO96* Reference Case; and although this level of production falls off by more than 22 percent (to about 40.5 million barrels per day) by the end of the forecast period in the +\$20 Case, the tripling of the world oil price results in an almost doubling of OPEC revenues over those realized in the *AEO96* Reference Case. In the Import Fee Case, the call on OPEC producers is reduced by more than 3 million barrels per day below the *AEO96* Reference Case due to the U.S. production and consumption response to an oil import fee, but the lower prices enjoyed by consumers outside the U.S. tend to counterbalance the U.S. response resulting in a net reduction in OPEC production that averages between 2 and 2.5 million barrels per day after the year 2005.

Figure 5A presents U.S. and OPEC oil production for the years 2005 and 2015 for the *AEO96* Reference Case, the +\$20 Case, and the Import Fee Case. With the tripling of oil prices, the U.S. shows a robust production response that is almost 25 percent higher than the *AEO96* Reference Case in the year 2005 and more than 34 percent higher in the year 2015. In the +\$20

**Figure 4. OPEC Production, 1995-2015**



**Figure 5A. U.S. & OPEC Oil Production  
Years 2005 and 2015**



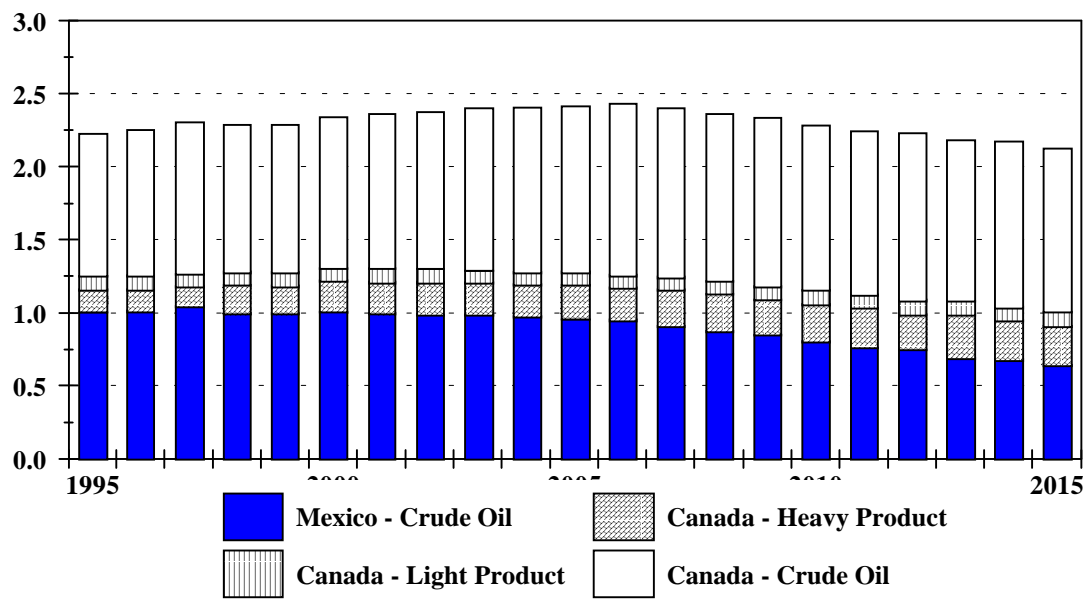
Case, the growth in OPEC production capacity is expected to be a modest 2 percent per year over the forecast period compared to the moderate 3 percent growth reflected in the *AEO96* Reference Case.

Figure 5B shows world oil consumption for the years 2005 and 2015 for the *AEO96* Reference Case, the +\$20 Case, and the Import Fee Case. With the tripling of oil prices, the U.S. shows only a modest consumption response that is about 6 percent lower than the *AEO96* Reference Case in the year 2005 and not quite 7.5 percent lower in the year 2015. The corresponding non-U.S. consumption response is only slightly more robust (averaging a little more than an 8 percent consumption decline by the year 2015) in the +\$20 Case due to the greater demand and income response of non-U.S. consumers to higher prices. While the U.S. consumption response in the Import Fee Case is similar to that of the +\$20 Case, the non-U.S. consumption response is about 1.8 percent higher than the Reference Case in the year 2005 and almost 2.3 percent higher in the year 2015 due to the lower world oil price path induced by the U.S. import fee.

### **North American Free Trade Agreement**

For the Import Fee Case, it was assumed that petroleum (both crude oils and refined products) imported from our NAFTA partners (Canada and Mexico) was not subject to the oil import fee. It was also assumed that the volumes of petroleum available for import from our NAFTA partners would be limited to the volumes that were available on the import supply curves in the Reference Case. These curves were considered reasonable for use in the Import Fee Case because they were purposefully generated to give the U.S. considerable import flexibility. Figure 6 shows the volumes that were assumed available. Without exception, these volumes were imported to their limit in the Import Fee Case. In the +\$20 Case as well as the Reference Case, import volumes from our NAFTA partners were below the upper limits for all years of the forecast period.

**Figure 6. Oil Available for Import from Canada and Mexico**





## 2. Domestic U.S. Energy Market Implications

### Dynamics of Changes in Production and Consumption

Increased crude oil prices have a predictable effect on the U.S. energy sector -- domestic oil production is expected to increase, while transportation fuel demand declines. Increased oil prices have indirect effects on natural gas and coal production and other aspects of the energy system, but these effects are modest relative to direct impacts on oil production and transportation demand for oil.

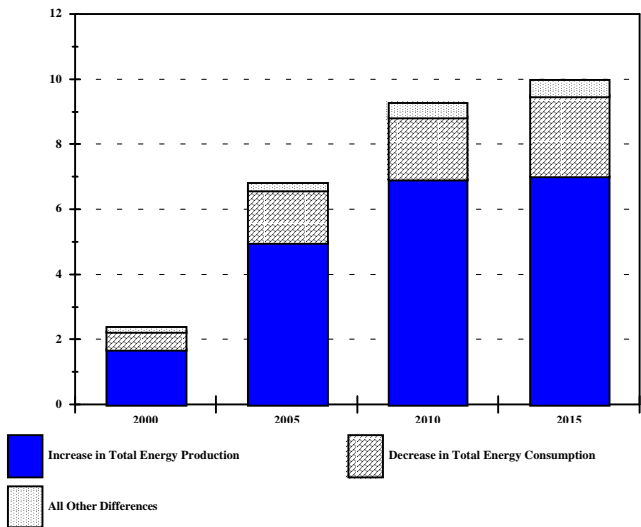
Figures 7A and 7B display the relative effects of changes in domestic energy production and consumption on reducing net petroleum imports for four time periods: 2000, 2005, 2010 and 2015. Throughout the forecast period, increasing energy production accounts for between 70 to 75 percent of the oil import reduction, while declining consumption accounts for between 20 and 30 percent.

When the focus is on domestic production and consumption of petroleum instead of total energy, a different picture emerges (Figures 7C and 7D). The reduction in oil imports is evenly split between increased domestic petroleum production and reduced petroleum consumption in the year 2000. Over time, increased domestic petroleum production accounts for more of the decrease in oil imports, stabilizing at approximately 65 percent in 2010.

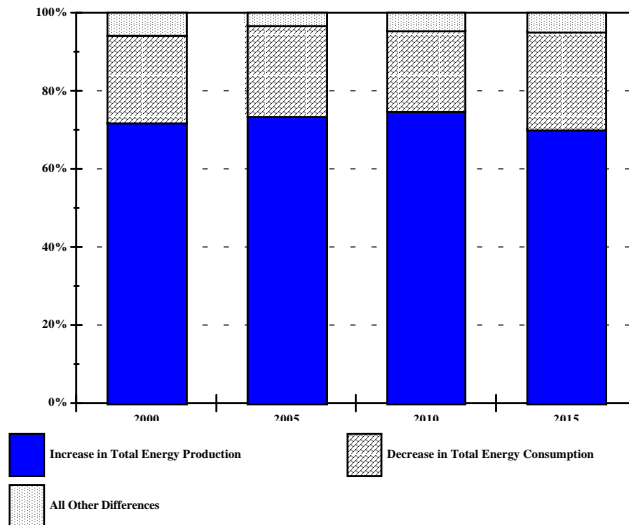
**Production.** Higher oil prices make previously unprofitable oil drilling projects more attractive to exploration and production companies and their investors. Drilling increases in smaller fields, more remote locations, or unconventional oil deposits as higher oil prices reduce the risk of previously marginal projects. More drilling leads to the discovery of more oil resources, especially with today's more accurate exploration and development techniques, such as slim hole drilling and three- and four-dimensional seismic studies. More drilling also converts more resources into producible reserves. Higher prices give producers an incentive to pump more oil out of the ground as quickly as possible. High oil prices may also make it profitable to produce oil from exotic sources, such as those investigated in the wake of the 1970's oil crises. These "backstop" technologies include extracting petroleum from oil shale and making synthetic crude oil from coal. However, such responses are not reported, as the time frame for significant development extends beyond the time horizon projected here.

With higher energy prices, domestic energy production becomes more profitable and is stimulated. Since this study focuses on the "value of imports" to the U.S. economy, the focus is on changes in the U.S. oil market and, to a lesser extent, on the gas market (Figure 8A). U.S. oil production increases in the +\$20 case over the 1995 to 2015 forecast period, while it largely

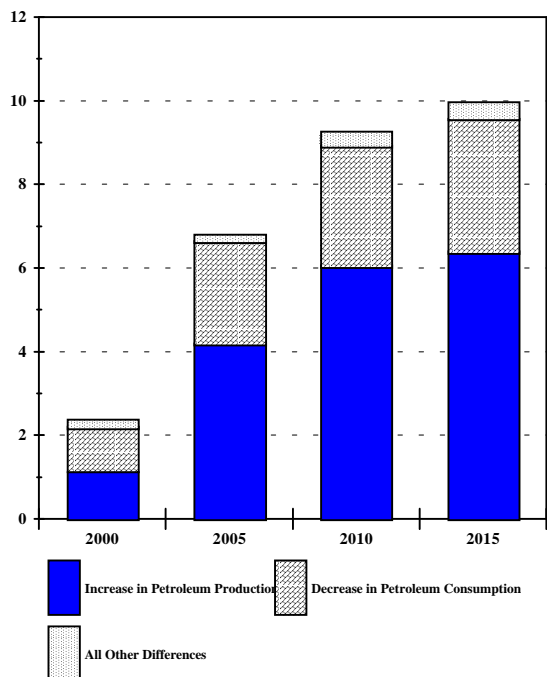
**Figure 7A. Components of the Oil Import Reduction, +\$20 Case**



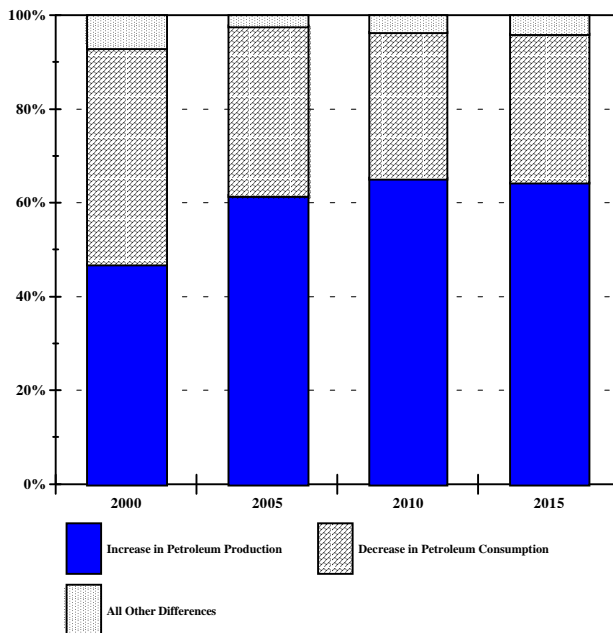
**Figure 7B. Shares of the Oil Import Reduction, +\$20 Case**



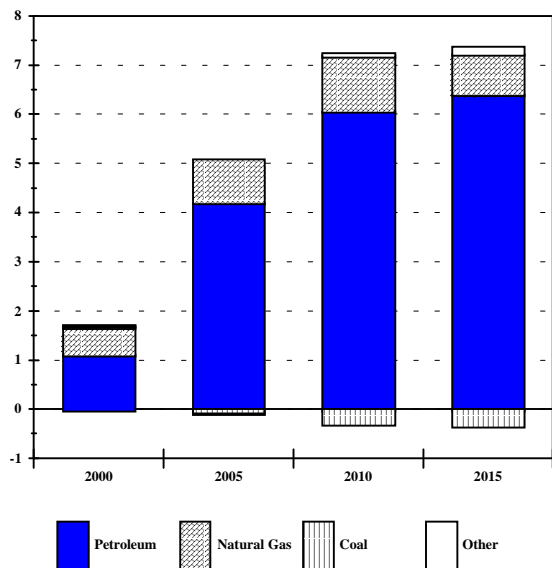
**Figure 7C. Components of the Oil Import Reduction, +\$20 Case**



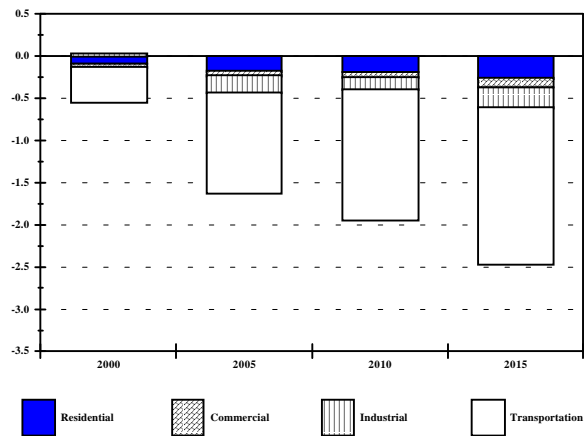
**Figure 7D. Shares of the Oil Import Reduction, +\$20 Case**



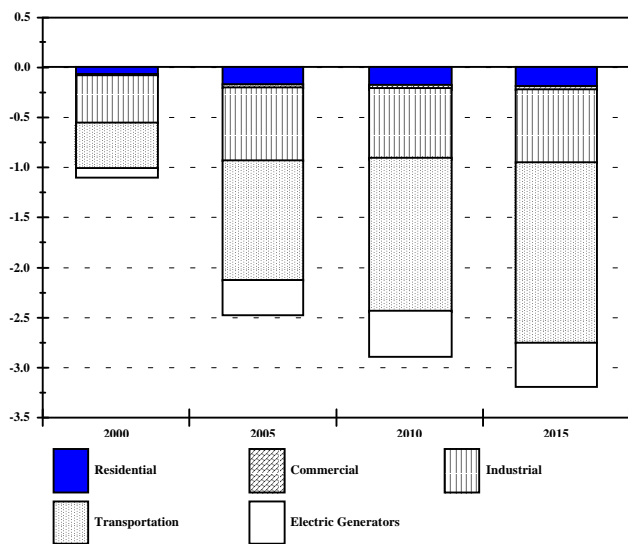
**Figure 8A. Change in Production By Fuel, +\$20 Case**



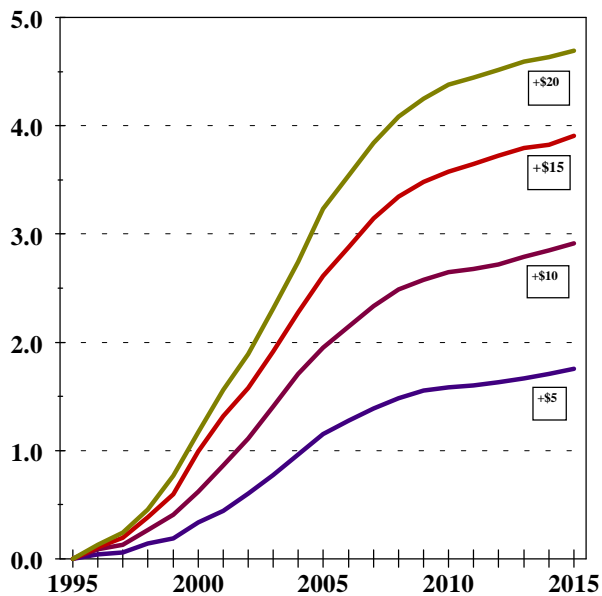
**Figure 8B. Change in Total Energy Consumption By Sector, +\$20 Case**



**Figure 8C. Change in Petroleum Consumption By Sector, +\$20 Case**



**Figure 8D. Reduction in Oil Imports**



declines in the *AEO96* Reference Case over the same period. This is because of the increased profitability of domestic oil production brought on by higher world oil prices. U.S. oil production increases in the +\$20 case at a 1.5 percent annual rate, compared to a 0.6 percent annual decrease in the *AEO96* Reference Case. In both cases the production pattern closely follows the reserve position of the industry. In the +\$20 case reserves bottom out in 1999; in the Reference Case they bottom out in 2004. The sharp rise in the oil price is the major reason for the difference in production between the AEO and the +\$20 case. Higher reserves reflect increased drilling induced by the higher oil prices. The number of oil wells drilled in 2015 is 63 percent higher in the +\$20 case than in the *AEO96* Reference Case. In 2005 oil production in the +\$20 case is 1.9 Mmbd or 37 percent higher than in *AEO96*, and in 2015 it is 3.0 mmbd or 52 percent higher.

In the early years of the forecast, conventional onshore lower 48 crude oil production accounts for more than half of the higher oil production in the +\$20 case, reflecting the dominance of conventional onshore reserves. The importance of conventional onshore production diminishes later in the forecast as enhanced oil recovery and offshore production grow and onshore supply experiences some depletion effects. Alaska production stays at a higher level in the +\$20 case than in the Reference Case throughout the forecast period, but does not exceed 1995 levels by 2015.

Natural gas production is 4 percent higher in 2005 and 3 percent higher in 2015 in the +\$20 case than in the Reference Case. Driven primarily by the oil production, the cumulative associated dissolved natural gas production from 1994 through 2015 is 18 percent higher in the +\$20 case than in the Reference Case; whereas the cumulative nonassociated production is only 1.4 percent higher.

Renewable energy production (on a Btu basis) is 2 percent higher in 2015 in the +\$20 case than in the Reference Case. This represents a limited market potential for renewables and natural gas prices remaining competitive through 2015 (at \$3.24/mcf).

The discussion above focused on the +\$20 case. In going between the price cases, there is a slight non-linearity in the relationship between the price change and the level of oil import reduction. Each successive reduction of one million barrels per day of oil imports can only be achieved at progressively higher costs. Crude oil reserve additions come primarily from upward revisions and adjustments to the reserves of older fields, not from new discoveries. The increase in the world oil price between cases stimulates more drilling and extends development efforts to more costly resources. Hence, the first ten dollars of price increase yields a reduction in oil imports of 2 mmbd by 2005, while the next \$10 yields only an additional 1.2 mmbd.

**Consumption.** In the *AEO96* forecast, end-use consumption of oil remains concentrated in providing transportation services and this sector is responsible for most of the reduction in total

energy demand in the cases addressed in this paper (Figure 8B). Transport vehicles (with the exception of electric powered trains) must carry their energy supply with them. As a result, unlike fuels used in other applications, the energy content per unit volume and weight are critical elements in the choice of transportation fuels. Given currently demonstrated technologies, petroleum products are not likely to be replaced as the transportation sector fuel of choice unless other factors (e.g. legislation mandating changes in fuel choice decisions, public concern over global warming) dominate future fuel choice decisions. Energy prices still affect transportation energy consumption, however, this is almost completely the result of improved efficiency in petroleum-based technologies, not switching to alternative transportation fuels. Based on the higher gasoline price path assumed in the +\$20 Case consumers purchase vehicles in 2015 that are more than 15 percent more fuel efficient than in the Reference Case. Gasoline prices in 2005 and 2015 are more than 30 percent higher in the +\$20 Case than in the Reference Case. Personal travel in vehicles declines by less than 2 percentage points in each of these years (compared to the Reference Case) reflecting the historic relative insensitivity of personal travel to gasoline prices and the fact that rising vehicle efficiencies dampen the actual increase in the fuel cost of driving a mile facing consumers.

Within the transportation sector the technical potential and time frame for improving the energy efficiency of the stock of equipment varies significantly by transportation mode. Marine and rail freight transport, for example, account for practically none of the reduction in transportation oil consumption in the +\$20 case even though combined they consume nearly 8 percent of transportation energy use. The slow rate of capital stock turnover in these modes serves as a natural brake limiting average efficiency improvements within the time horizon being considered.

Although the transportation sector is responsible for most of the decrease in total energy consumption, the industrial and electric generation sectors also decrease their petroleum inputs considerably (Figure 8C). These two sectors have greater potential for fuel switching, which is why the industrial sector's total energy demand falls only 0.2 quadrillion Btu per year, when petroleum consumption is 0.7 quadrillion Btu lower. The inputs to electric generation, as well as the associated transmission and distribution losses, are allocated to the four end-use sectors in Figure 8B.

### **The Decline in Net Oil Imports**

**The +\$20 Case.** Net oil imports rise during most of the forecast in the *AEO96* Reference Case, from 8.3 million barrels per day in 1995 to a peak of 11.9 million barrels per day in 2013. Net imports fall during the final two years of the forecast, as increases in domestic oil production begin to keep pace with increases in demand for petroleum products. Net oil imports follow a markedly different path in the +\$20 case. Oil imports peak in 2000 at 8.9 million barrels per day and decline for the remainder of the forecast to 7.1 million barrels per day in 2015. Imports begin to decline much more quickly in the +\$20 case, because higher oil prices encourage increasing

production beginning in 2000, instead of 6 years later as in the *AEO96* Reference Case. Net petroleum imports in 2005 are 3.2 million barrels per day lower in the +\$20 case than in the *AEO96* Reference Case; in 2015 they are 4.7 million barrels per day lower (Figure 8D).

**The Oil Import Fee.** By design, the +\$20 case and the Import Fee Case lower petroleum imports by the same amount. The primary difference between the two cases is in the mix of imports between crude oil and petroleum products. In the tariff case crude oil imports decline and petroleum product imports increase, even as total petroleum imports remain about the same. Product imports increase in the tariff case because inexpensive imports become available from Canada and Mexico under the North American Free Trade Agreement. By 2015 net crude oil imports are 440,000 barrels per day lower in the tariff case, and net product imports are 490,000 barrels per day higher, than in the +\$20-plus case.

### 3. Macroeconomic Implications

#### World Oil Price Sensitivities

##### Impacts on the Aggregate Economy

**Changes in Potential Output and Adjustment Costs.** Higher energy costs will reduce the use of energy by shifting production toward less energy-intensive sectors, by replacing energy with labor and capital in specific production processes, and by encouraging energy conservation. Although reflecting a more efficient use of higher-cost energy, this gradual reduction in energy use will tend to lower the productivity of other factors currently being used in the production process. Moreover, if higher energy prices raise interest rates or the price of capital goods relative to the wage rate, capital formation and the capital-labor ratio will be reduced over time. These factors result in a loss in the potential output of the economy.

While reducing potential output, higher energy prices also will cause short-run adjustment effects. Higher energy prices will raise production costs and lower aggregate spending. Immediately after energy prices increase, substitution away from energy is limited and the prices of other inputs do not fall. This raises the short-run production costs per unit of output for firms. Moreover, spillover effects on wages and other variable costs will further escalate production costs throughout the economy. This will place upward pressure on the nominal prices of intermediate goods and final goods and services.

A rising aggregate price level will reduce real spending on U.S. goods and services in several ways. In a direct response to higher energy prices, consumers cut back on the amount of energy consumed, but their nominal expenditures rise. As a result of higher energy expenditures, consumers reduce their expenditures on other goods and services. The general rise in all consumer prices depresses real disposable income further.

Also, with lower aggregate demand and higher production costs, businesses cut back on investment expenditures. In the near-term, investment in oil and gas structures and equipment may be expected to increase, and may offset the loss in non-energy investment. However, the decline in non-energy investment can be expected to dominate beyond the first few years and result in a net capital stock below the Reference Case levels.

Compounding this effect is the prospect that interest rates will rise with inflation, assuming that nominal money supplies remain constant<sup>1</sup>. The resultant reduction in the real money supply

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<sup>1</sup>The Federal Reserve Board may respond with an accommodating policy, such as a change in the amount of non-borrowed reserves. This analysis, however, assumes that FED policy is unchanged across all cases considered.

initially raises interest rates and may discourage investment and interest-sensitive components of consumer expenditures such as automobiles, housing and other durable purchases.

Export and import markets will also be significantly affected by the higher energy prices. While the prices of goods exported by the U.S. will rise, so too will the prices of imported goods as the world market adjusts to higher world oil prices. A priori, it is difficult to judge whether the nominal trade balance will be reduced or increased as a result of these influences.

How do these interactions play out in the +\$20 Case? The aggregate results are represented in Figure 9 below. Figure 9A indicates that the potential output of the economy falls at an increasing rate through 2005, when the maximum price increase above the *AEO96* Reference Case is achieved. After that point the price differential is maintained, yet the economy continues to lose its capability to produce maximum output. The measure of the potential output of the economy approaches a long-term equilibrium at a point below the Reference Case path, which will occur sometime in the post 2015 period. By 2015, the loss in potential output is approximately \$75 billion.

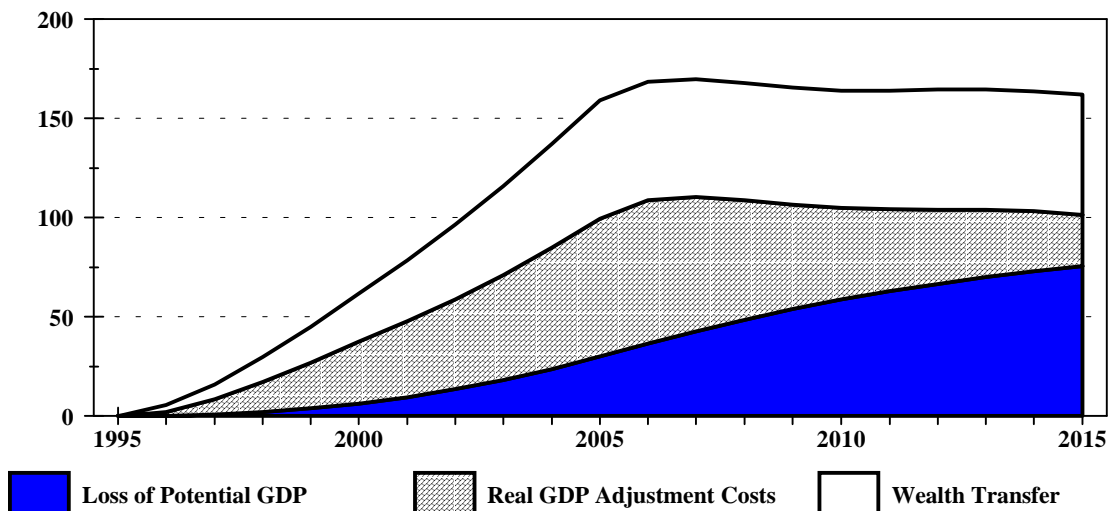
However, in achieving this long-term equilibrium path, the economy will incur substantial adjustment costs. The best way to view the second line in the chart is to consider the Real GDP impact as having two components -- the loss in potential and the adjustment costs of achieving the new equilibrium path. Hence the real GDP loss reaches just over \$100 billion by 2005 when the target price difference is attained. Thereafter, the economy begins to stabilize at a loss of approximately \$110 billion and is beginning to move back to the Reference Case somewhat. The expectation in a longer run setting past 2015 is that the loss in real output for the economy will approach the same trajectory as the loss in potential output. In essence, the adjustment component of the impact will have played out as the economy works out the short-term effects and settles into its long-run path.

The components of real GDP change are shown in Figure 9B. Consumption and investment fall through 2005 in response to higher energy prices. Consumption is lower by nearly \$85 billion in 2005 and remains below the Reference Case at this level through 2015. Investment falls by \$36 billion in 2005, recovers by a little, then declines to \$39 billion down in 2015. As expected, however, the net real trade balance is higher, as higher world oil prices create a greater claim on the output of the U.S. economy.

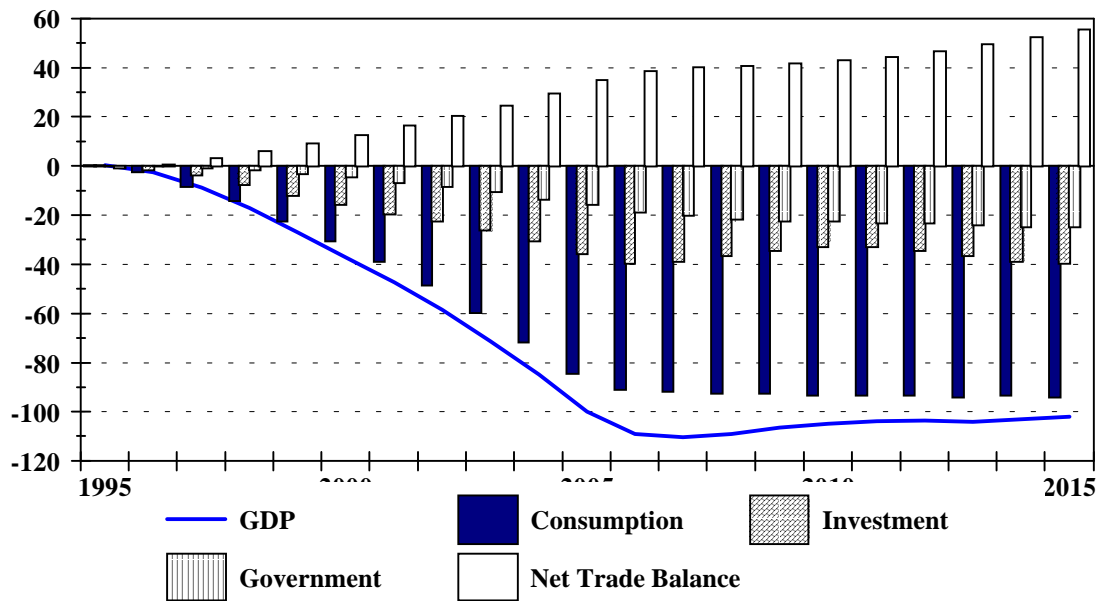
**Wealth Effects.** The effects above identify the impacts on the economy to produce output, as measured in the aggregate by Gross Domestic Product. However, the rise in energy prices not only affects what we produce, but what we have available for domestic use, both in terms of domestic consumption and the resources available to expand the productive capacity of the U.S. economy. Essentially, higher oil prices represent a transfer of wealth within the domestic economy and to OPEC and other oil producing nations.



**Figure 9A. Losses to the U.S. Economy  
+\$20 Case**



**Figure 9B. Components of Real GDP  
Change from Base, +\$20 Case**



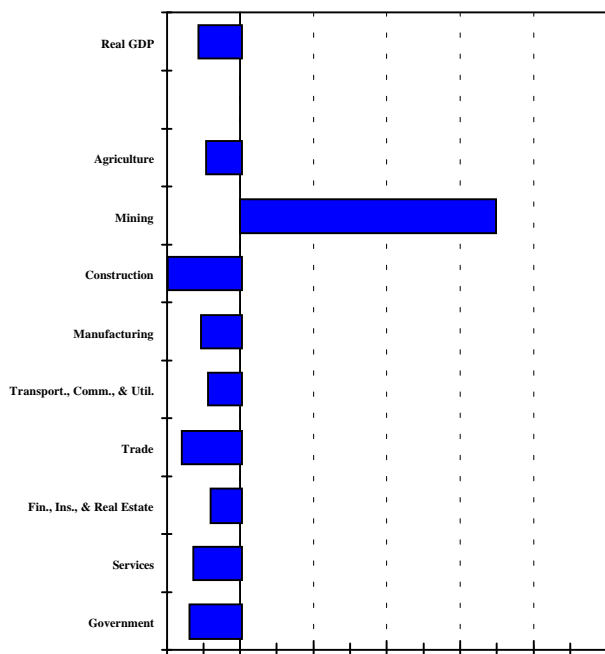
It is possible to envision a set of accommodating monetary policies that might be able to fully mitigate any loss in output in the economy from higher world oil prices and to produce exactly the same output as before. Yet the economy will be fundamentally worse off because the oil price increase reduces the quantity of foreign goods and services the country can purchase with proceeds from any given quantity of our exports. Ultimately exports must go up to pay for the more expensive oil, while domestic consumption, and investment, will fall. The wealth loss thus represents claims on U.S. goods and services by foreign producers of oil. The calculation of the wealth transfer is straightforward. Simply multiply the new world oil price minus the Reference Case price level times the volume of crude oil and petroleum products imported for each year. The calculated wealth transfer rises to approximately \$50 billion in 2005 and remains at this differential throughout the forecast period.

### **Impacts on Sectors of the Economy**

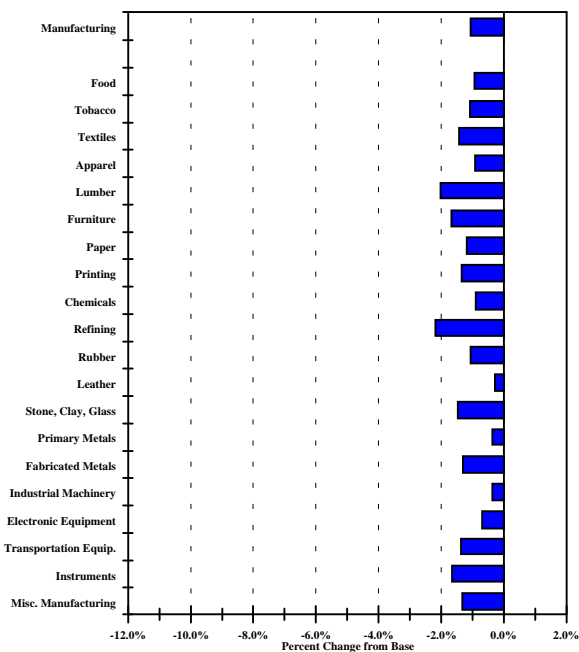
When the world oil price increases +\$20 relative to the Reference Case, all prices throughout the economy are higher because of increased production costs and the economy suffers real output losses. If the economic impacts of the increased world oil price are examined by sector, few sectors enjoy increased activity. Mining, since oil and gas mining is an important part of that sector, experiences output gains over the entire forecast period. However the output loss in the rest of the economy far outweighs the gain in this sector (Figure 10). Construction, wholesale and retail trade, and services are impacted relatively more than the manufacturing sector with increased prices and interest rates following the higher world oil prices. Residential investment is more sensitive to interest rate changes and experiences larger percentage losses. As a result, industrial output more dependent on residential investment and consumption experience relatively larger output losses. However, the differences in percentage losses among these sectors are small. In terms of dollar output loss, the manufacturing sector is the hardest hit industrial sector when oil prices remain high.

Within the manufacturing sector, transportation, refining, chemicals, and stone, clay and glass industries are among the manufacturing sectors that experience relatively higher percentage losses relative to the manufacturing sector as a whole. In addition, furniture and lumber industries are hit harder by output losses, reflecting residential investment and consumption losses in the aggregate economy. On average, the manufacturing sector experiences its greatest percent loss in output by 2005, reaching just over 1.0 percent. As the economy begins to experience less output loss by 2015, so does the manufacturing sector.

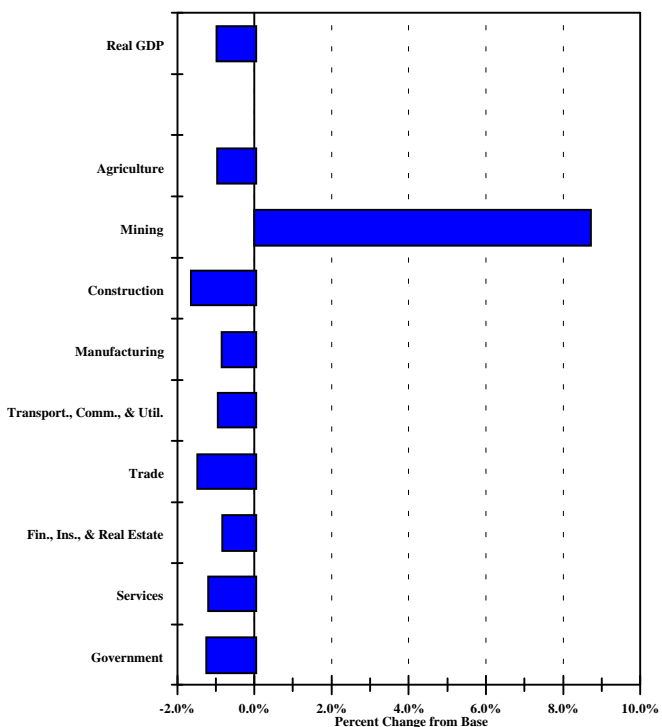
**Figure 10A. Total Gross Output Change  
In 2005, +\$20 Case**



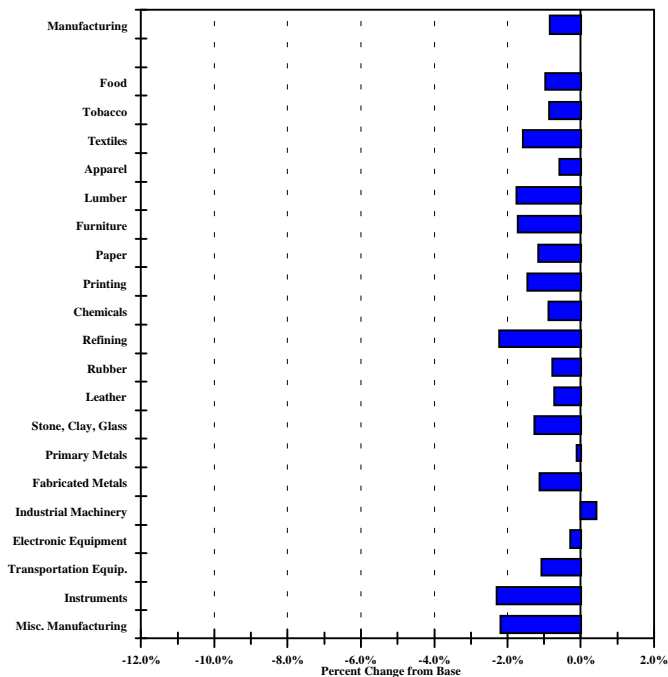
**Figure 10B. Manufacturing Output  
Change In 2005, +\$20 Case**



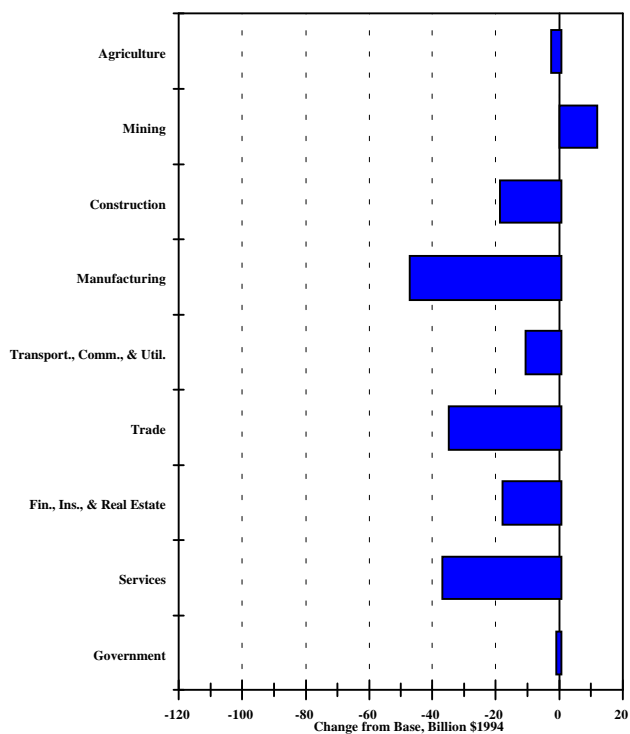
**Figure 10C. Total Gross Output Change  
In 2015, +\$20 Case**



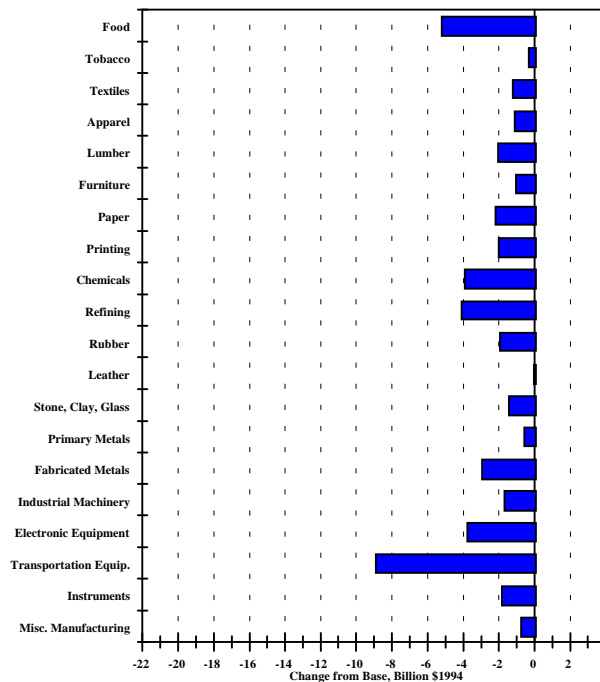
**Figure 10D. Manufacturing Output  
Change In 2015, +\$20 Case**



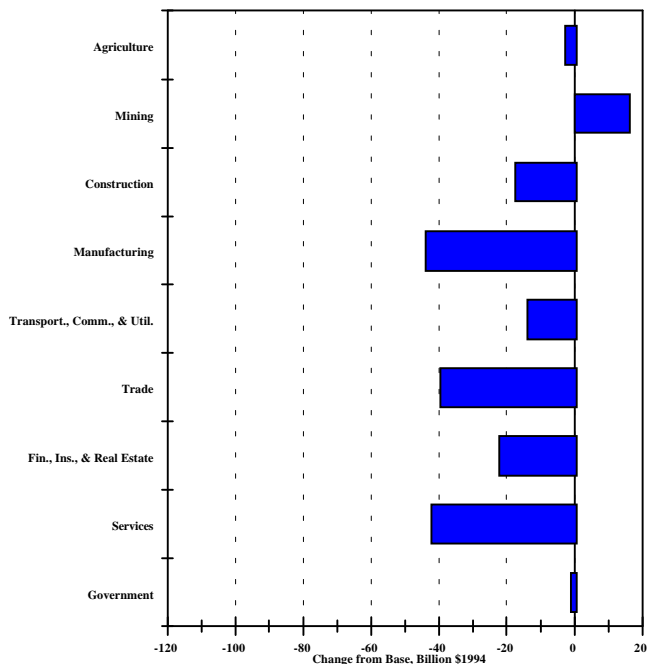
**Figure 10E. Total Gross Output Change  
In 2005, +\$20 Case**



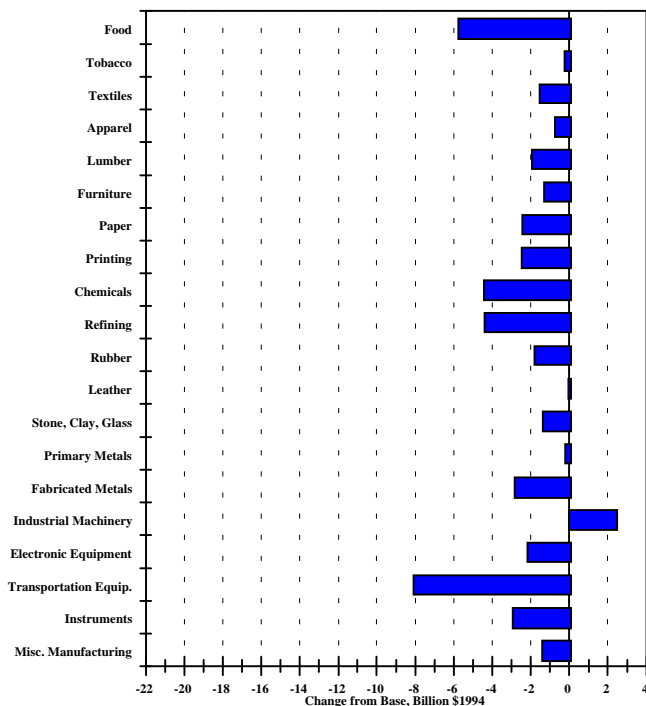
**Figure 10F. Manufacturing Output  
Change In 2005, +\$20 Case**



**Figure 10G. Total Gross Output Change  
In 2015, +\$20 Case**



**Figure 10H. Manufacturing Output  
Change In 2015, +\$20 Case**



## The Imposition of an Oil Import Fee

Imposing an oil import fee to reduce oil imports results in the collection of substantial revenues. How these funds are used has important macroeconomic effects. In addition, under a fee, the U.S. experiences a price wedge between the now higher price of U.S. exported goods relative to foreign imported non-energy goods. This price wedge will have impacts on the U.S. net trade balance and the aggregate economy. These two issues will be discussed in turn.

### How Will the U.S. Government Use the Collected Revenues?

In assessing the impact of an oil import fee on the economy, the fundamental price increase dynamics (as discussed above in the section on rising world oil prices) still hold. Namely, higher energy prices raise the aggregate price level of the economy, lower real disposable income, and raise interest rates. All of these effects contribute to a loss in real output for the economy. However, one fundamental difference occurs -- funds are generated through the collection of the fee and in the case considered is projected to collect \$1.3 trillion in tax revenues over the next 20 years. From a policy perspective a fundamental choice needs to be made: are the collected revenues used to reduce the Federal deficit or are they recycled back to the economy through a tax reduction elsewhere. If the choice is to recycle the funds, there are additional options: reduce corporate or personal income taxes; reduce the employee-or employer-paid portions of payroll taxes; and renew and increase investment tax credits or R&D credits. Each option yields different profiles of economic activity, though there are similarities among some of the options.

For this study two cases are investigated. In the Deficit Reduction mode, the gross collections from the imposition of the fee raise Federal indirect business tax revenues, and these additional revenues are assumed to be used to reduce the deficit. This highlights the effects on the economy of the price shock imposed by implementation of the fee. In the Deficit Neutral mode, the gross revenues are not used to reduce the Federal deficit. The simulation explicitly targets "full employment Federal deficit" to remain the same as the Reference Case (the path forecast when there is no fee) throughout the forecast period. The return of the energy tax revenues is accomplished through a reduction in the payroll tax rate, both the employee and the employer shares.

**Deficit Reduction.** The effect of higher energy prices on the aggregate price level is to drive up near-term nominal interest rates. The rise in interest rates helps to discourage investment and interest-rate sensitive components of consumer expenditures such as automobiles, housing and other durable purchases. However, in the longer-term, as price inflation in the economy abates, the continuing reduction in Federal government borrowing serves to moderate the adverse impacts on interest rates relative to the Reference Case (Figure 11A). Figure 11B shows the impacts on the output of the economy. Both consumption and investment are driven down in

Figure 11A. AA Utility Bond Rate

Oil Import Fee Case

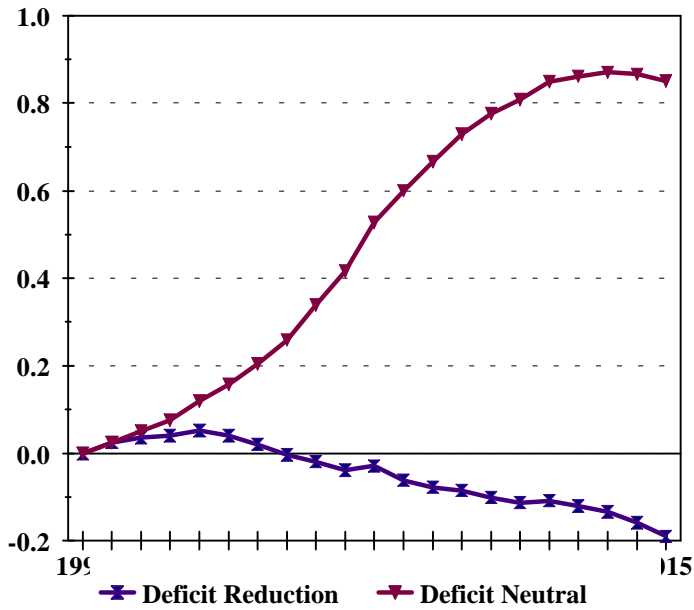


Figure 11B. Components of Real GDP

Oil Import Fee, Deficit Reduction

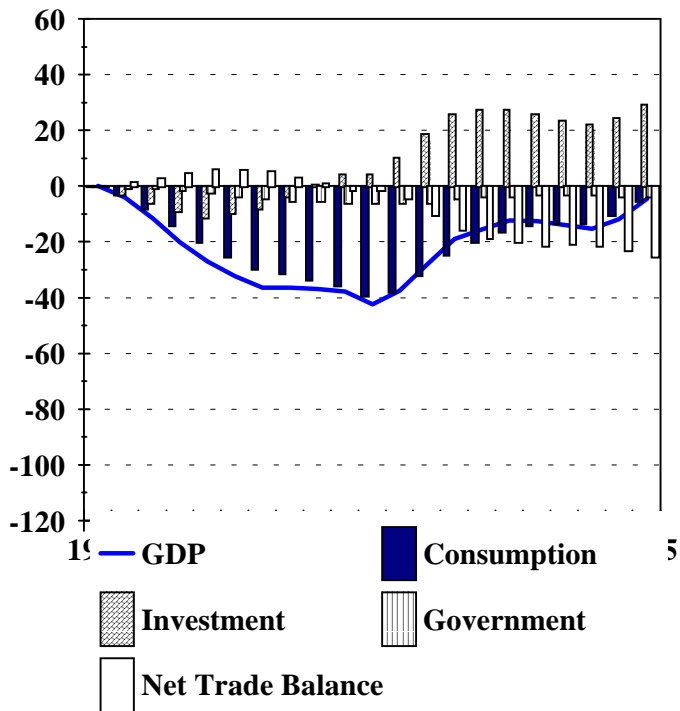
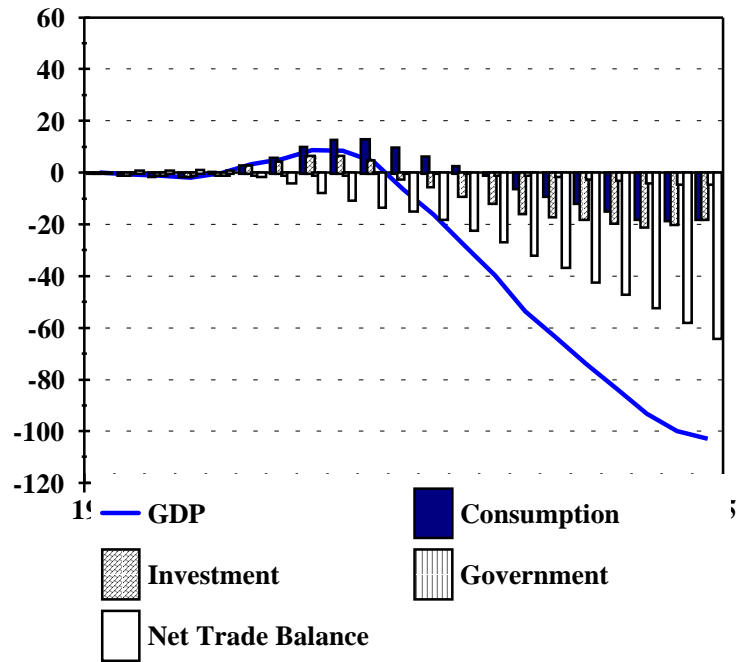


Figure 11C. Components of Real GDP

Oil Import Fee, Deficit Neutral



response to higher energy prices, and higher interest rates, particularly in the near-term through 2000. However, after 2000, investment in the economy begins to turn around given the impact of lower interest rates, and leads the recovery in the whole economy. By 2015, real GDP has almost recovered to the Reference Case value of output.

In the deficit reduction case, most of the sectors of the economy suffer output losses until 2005, (Figure 12). By 2015, when GDP has recovered about back to the Reference Case, sectoral output recovers also. The mining and construction sectors follow a different pattern. The increase in both 2005 and 2015 in oil and gas mining reflects domestic oil and gas production, which has increased 14 percent relative to base in response to the higher oil prices brought on by the Import Fee case. Early in the forecast period, the construction sector is positively affected by changes in investment, principally associated with mining and petroleum structures brought on by higher prices for domestic oil.<sup>2</sup> Later in the forecast period, with interest rates falling relative to the Reference Case, investment in structures, both residential and non-residential, results in an increase in construction activity.

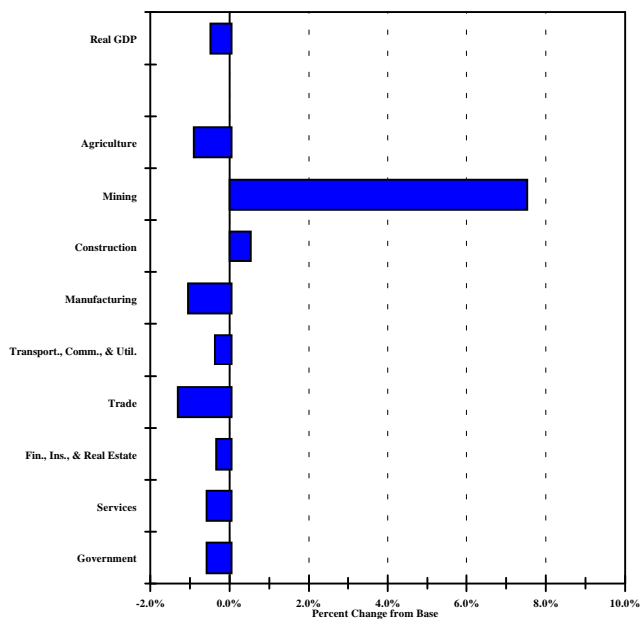
**Deficit Neutral.** Almost the exact opposite set of dynamics play out in the deficit neutral case. Here, the objective is to return funds to consumers and business in order to ameliorate the adverse impacts on the economy associated with higher energy prices. Reducing employee-paid payroll taxes replace the purchasing power drained by the oil import fee. The restoration of income increases the inflationary aspects of the policy. In reaction, interest rates rise and eventually investment suffers. Employee-paid payroll tax reductions support consumption at the expense of lower business investment and construction (curtailed by higher interest rates). Employer-paid payroll tax cuts would offset the higher energy costs from the oil import fee. Reductions in the employer-paid payroll tax would lower costs for labor, offsetting some of the energy price increases by encouraging business to substitute lower-priced domestic labor for higher-priced imported energy. However, none of the deficit neutral approaches relieve long-run federal pressure on the credit markets. This means that interest rates remain high and the ameliorating impacts of lower employee costs through reduced employer-paid payroll taxes are overshadowed by continuing increases in energy prices and overall prices in the economy.

While this policy does essentially wipe out any near-term effect, actually raising real GDP in some years, the post-2005 period suffers (Figure 11C). Lower investment translates into smaller increases in productive capital stock and lower output potential. As GDP begins to fall due to increasing pressure on interest rates and prices, output in most sectors of the economy begins to fall as well (Figure 13). The mining sector remains above its Reference Case levels throughout.

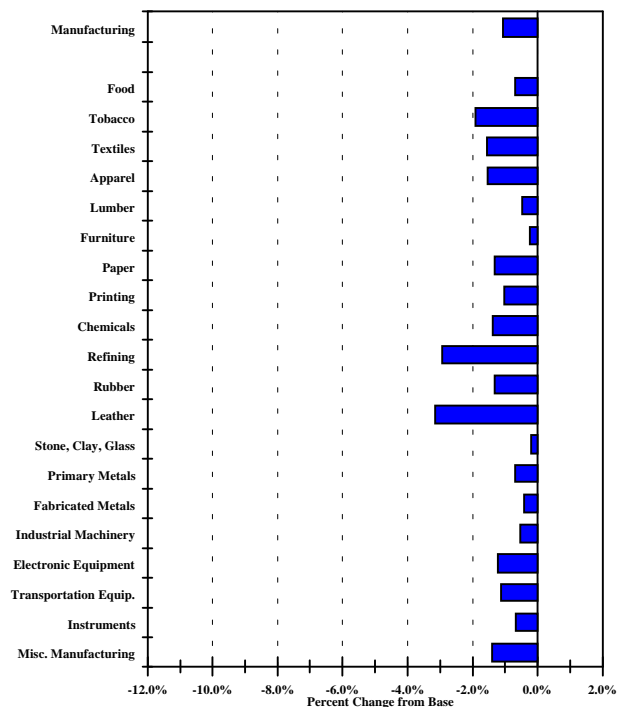
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<sup>2</sup>The DRI Macro Model contains an equation for potential output and is specified as a function of capital, labor, energy and R&D. The energy concept currently is represented as domestic energy production of oil and natural gas. In previous versions total energy demand was used. The specification of this equation is undergoing review by DRI. In this study for GAO, EIA removed domestic energy production of oil and natural gas as a determinant of movement in the potential GDP equation.

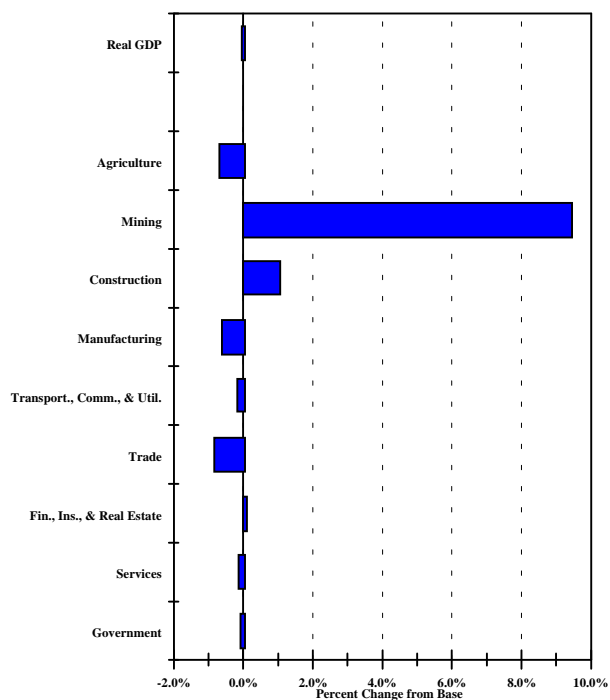
**Figure 12A. Total Gross Output Change  
In 2005, OIF Case, Deficit Reduction**



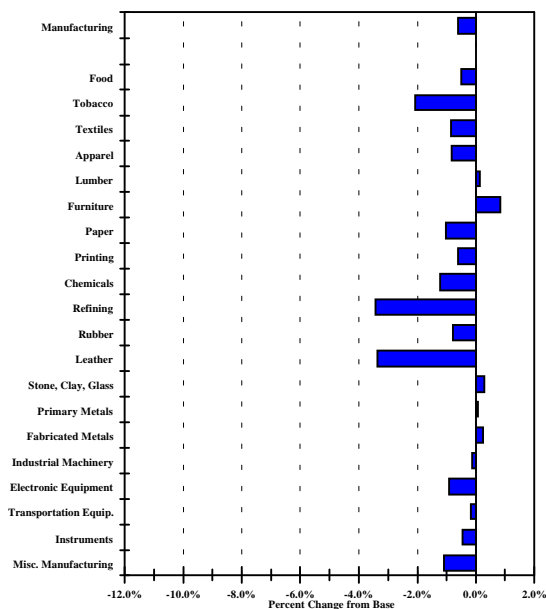
**Figure 12B. Manufacturing Output Ch.  
In 2005, OIF Case, Deficit Reduction**



**Figure 12C. Total Gross Output Change  
In 2015, OIF Case, Deficit Reduction**

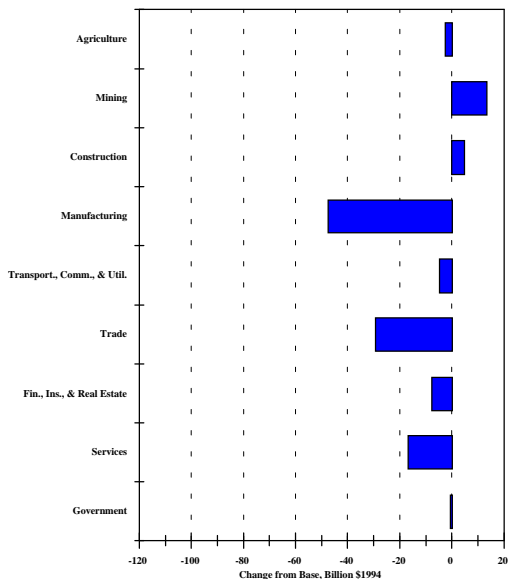


**Figure 12D. Manufacturing Output Ch.  
In 2015, OIF Case, Deficit Reduction**

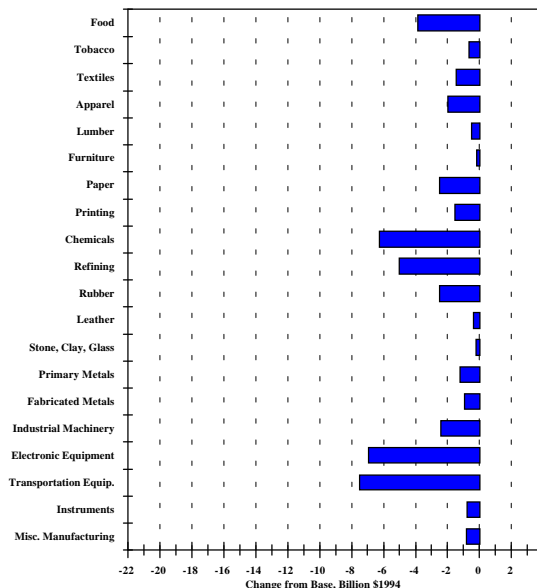




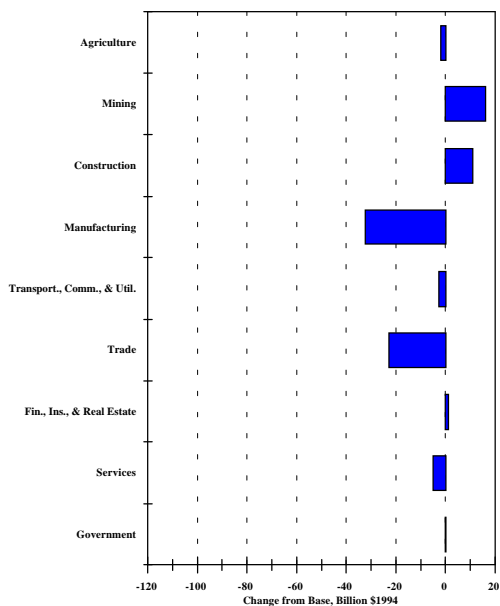
**Figure 12E. Total Gross Output Change  
In 2005, OIF Case, Deficit Reduction**



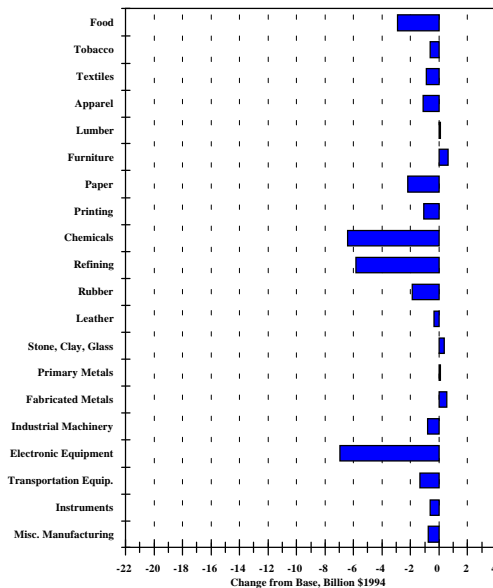
**Figure 12F. Manufacturing Output Ch.  
In 2005, OIF Case, Deficit Reduction**



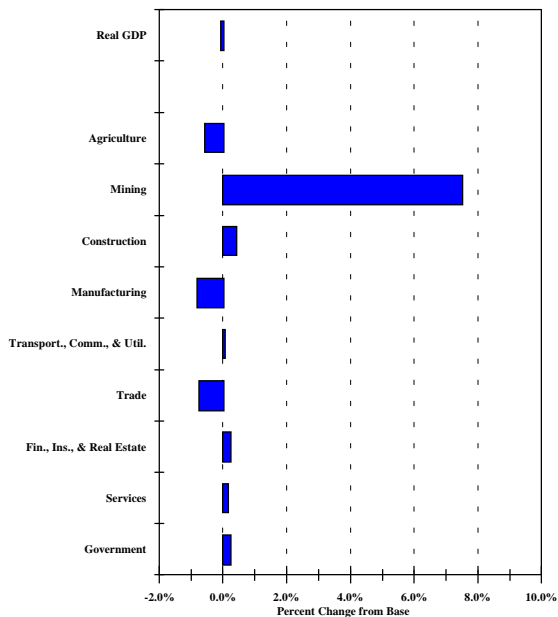
**Figure 12G. Total Gross Output Change  
In 2015, OIF Case, Deficit Reduction**



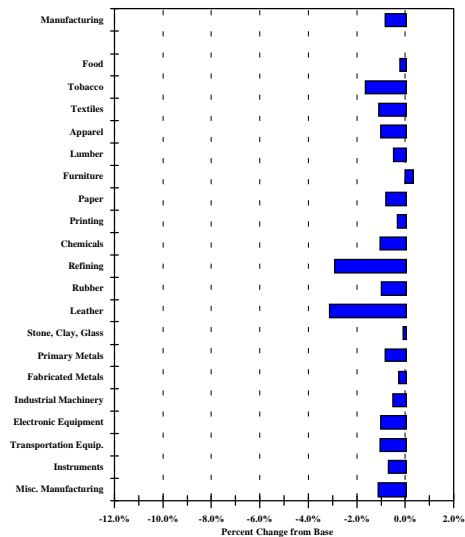
**Figure 12H. Manufacturing Output Ch.  
In 2015, OIF Case, Deficit Reduction**



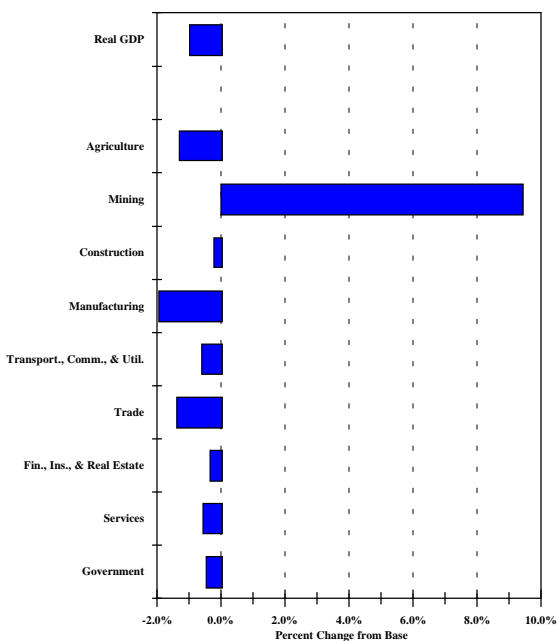
**Figure 13A. Total Gross Output Change  
In 2005, OIF Case, Deficit Neutral**



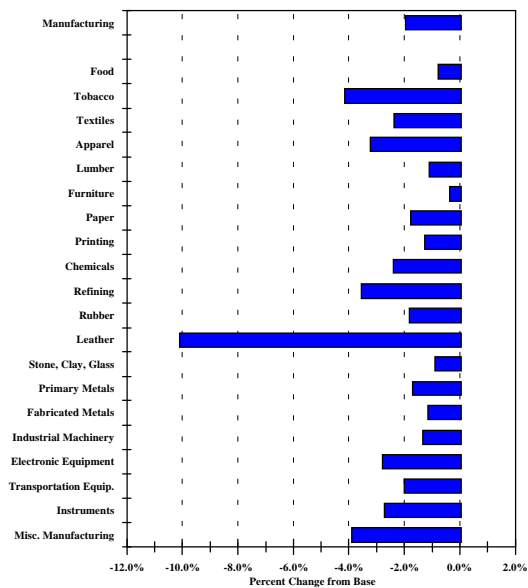
**Figure 13B. Manufacturing Output Ch.  
In 2005, OIF Case, Deficit Neutral**



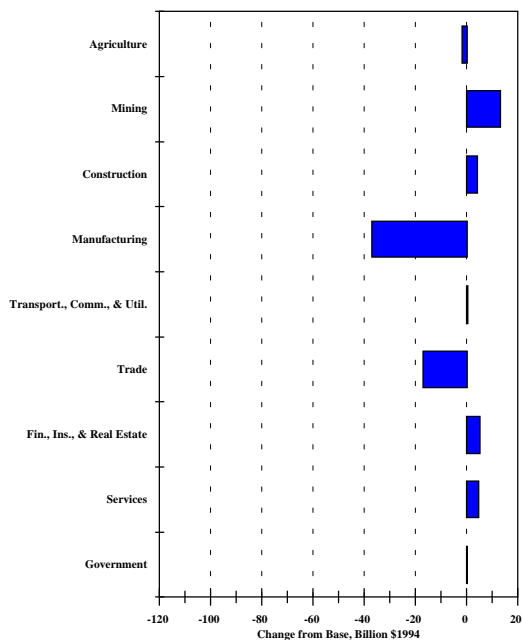
**Figure 13C. Total Gross Output Change  
In 2015, OIF Case, Deficit Neutral**



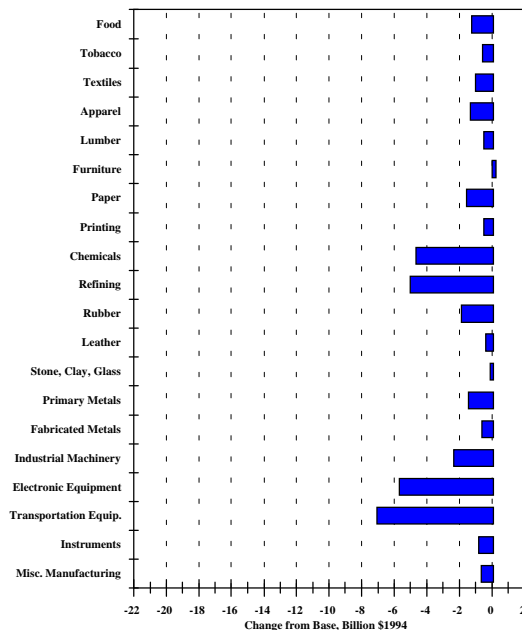
**Figure 13D. Manufacturing Output Ch.  
In 2015, OIF Case, Deficit Neutral**



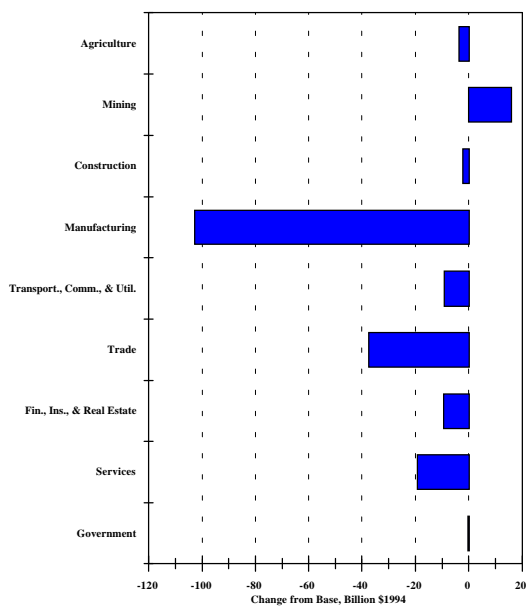
**Figure 13E. Total Gross Output Change  
In 2005, OIF Case, Deficit Neutral**



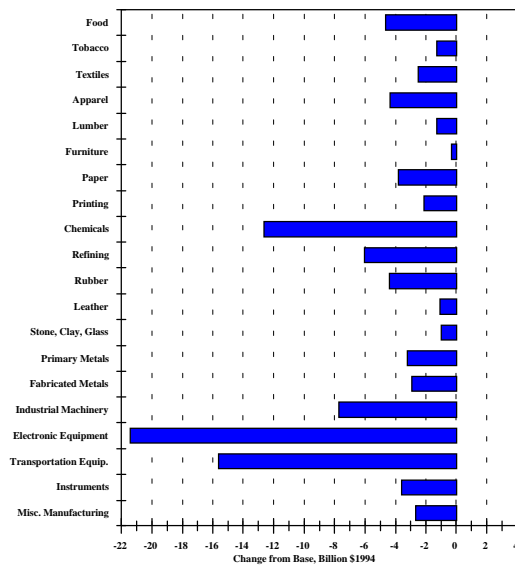
**Figure 13F. Manufacturing Output Ch.  
In 2005, OIF Case, Deficit Neutral**



**Figure 13G. Total Gross Output Change  
In 2015, OIF Case, Deficit Neutral**



**Figure 13H. Manufacturing Output Ch.  
In 2015, OIF Case, Deficit Neutral**



In comparing the two broad options in the long-term -- to recycle or not -- cuts in capital costs stimulate more growth than cuts in labor costs. Revenue recycling schemes that favor business investment in the long-term, such as investment tax credits, R&D credits or cuts in corporate income taxes, shift the economy's aggregate supply curve out more than policies aimed at reducing labor costs. While the labor force will not expand significantly in response to higher after-tax wages, business continues to add productive capital and thus increase the economy's potential to produce output when operating costs are reduced, thereby having more of an aggregate supply shift for policies stimulating business investment spending.

### **How are the Impacts Different than from Higher World Oil Prices?**

**Aggregate Economy.** Higher world oil prices impact all countries, with the increased energy expenditures from higher world oil prices going to oil-producing nations. All countries face higher prices through increasing oil prices. The relative impacts across countries depend on many factors such as: the importance of oil in the production process; whether a country is oil producer or oil consumer; the behavior of exchange rates and interest rates in response to increasing world oil prices; and the fiscal and monetary response of each country to increased prices<sup>3</sup>. This study does not attempt to estimate differential impacts of higher world oil prices on all countries; however, one fact is unalterably true: with higher world oil prices, all countries experience higher prices. This is not the case when a fee is imposed on U.S. imported oil. Indeed, because of the reduction in U.S. oil demand, the world oil price facing other nations is expected to be lower than in the Reference Case.

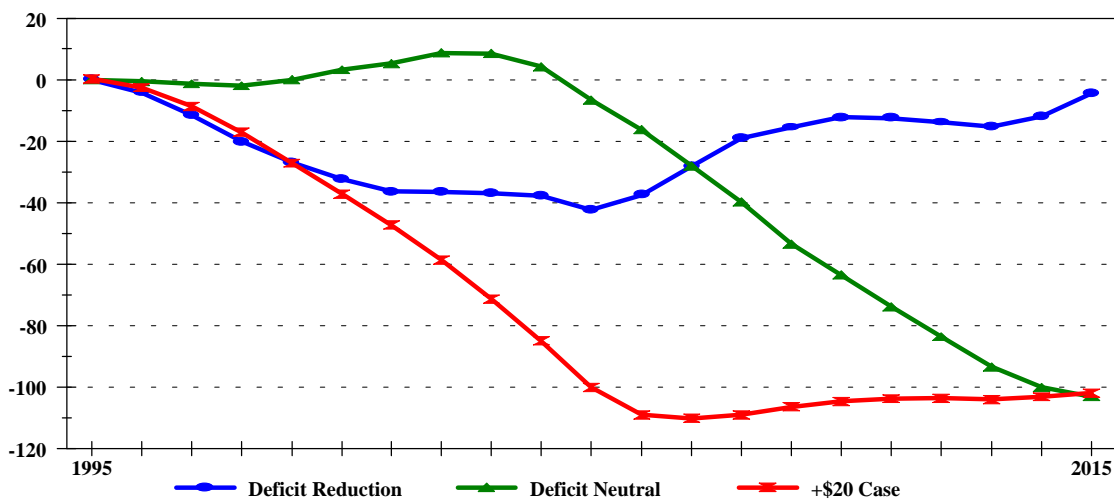
Not only are the price effects different, so is the treatment of the increased expenditure from higher oil prices. For the Deficit Reduction Case, the assumption is made that the revenue from the oil import fee is collected by the U.S. government and is used to reduce the deficit. This is in contrast to the situation where funds are transferred to oil producing nations when world oil prices rise. Consumption and fixed investment of the rest of world changes little from base during the Import Fee Case. When higher world oil prices prevail worldwide, rest of world consumption and fixed investment falls by 2.5 percent relative to base.

Imposing an oil import fee has significant impacts on the U.S. economy, although smaller than in the +\$20 case (Figure 14A). The economy experiences output losses throughout the 20 year period from 1995 to 2015; however the dynamic pattern of imposing an oil import fee differs substantially from the higher world oil price case. In the Deficit Reduction Import Fee Case, the economy begins to return to Reference Case by 2005 for two reasons: (1) the revenue from the oil import fee reduces the deficit, leading to quicker recovery in investment because of interest

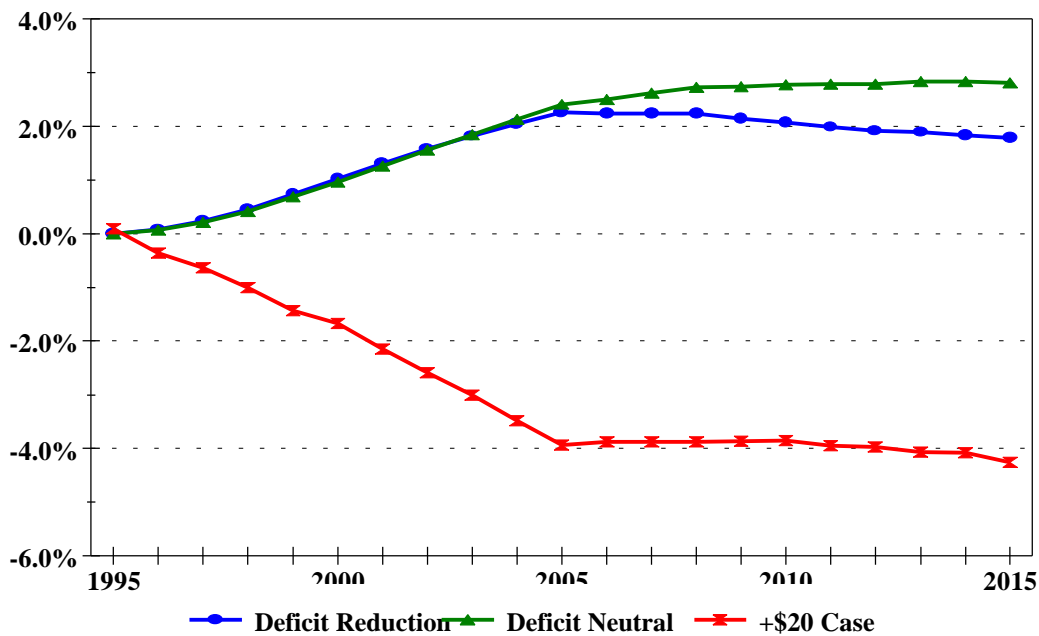
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<sup>3</sup>Both of the oil import reduction schemes abstract the impact of changing exchange rates. For both of these scenarios, it is assumed that exchange rates do not change from the Reference Case and that the Federal Reserve does not react as a result of increasing prices in either the oil import fee or higher world oil price case.

**Figure 14A. Real GDP  
Change from Base**



**Figure 14B. Terms of Trade  
(Price of Exports / Price of Imports)**



rate impacts, and (2) import prices facing the United States in the oil import fee case fall relative to base, primarily because world oil prices are lower due to the reduction in U.S. oil demand.

The U.S. imports both finished goods, which are purchased directly by consumers, and intermediate goods and equipment, which are purchased by businesses. Imported materials and components are used by U.S. firms in their production processes. Lower import prices for these inputs restrain the upward pressure on U.S. producers' price increases brought on by the fee. As a consequence, both consumer and wholesale price increases are less in the Import Fee Case than the +\$20 Case as a result of our trading partners not facing increases in their oil prices.

Since interest rates, after 2003, are lower in the Deficit Reduction Import Fee Case, investment rebounds much quicker, consumption recovers and the economy's output is close to base by 2015. The net trade balance (real exports minus real imports) remains a negative influence on GDP, since export prices are always above base.

**Sectoral Impacts.** Differences in sectoral impacts between the two import reduction schemes can be traced to differences in impacts of interest rates and prices, as well as the patterns of economic final demand losses. In the Import Fee Case, both interest rates and import prices are lower than in the world oil price increase case. Those interest-rate sensitive industries will experience relatively less impact (normalized for total industrial impact for each case); and those industrial sectors that are either export dependent or have high import penetration will experience relatively larger economic impacts compared to the higher world oil price case. The agriculture and manufacturing sectors, those sectors more affected by trade, show higher percent change from base relative to the economy's total output percent change from base, while the construction sector exhibits lower percent changes compared to total output.

The mining sector's output gains are very similar between the Import Fee Case and higher world oil price cases, both in terms of time profile of changes and magnitude. The more interest rate and trade sensitive industrial sectors exhibit the greater differences of economic output changes.

Within the manufacturing sector, the chemical, apparel, leather, and electronic equipment industries exhibit percent changes from base higher than the overall manufacturing sector's percent impacts for the Import Fee Case. These industries tend to be more trade oriented. The industries affected more by construction, such as lumber and stone, clay and glass, experience lower percentage changes relative to total manufacturing sector output in the Import Fee Case.

If one examines these industries' percent changes from base in the higher world oil price case, these statements about relative impacts are reversed. Since import prices and interest rates increase in the higher world oil price case and imports are reduced more relative to base, the trade oriented industries experience lower percentage reductions from base and the construction-sensitive industries show higher percentage reductions from base compared to manufacturing. The mining sector (which includes oil and gas mining) is the clear winner in terms of changes in either output or employment resulting from the imposition of an oil import fee, regardless of

whether the money collected is used to reduce the deficit or to allow the social security tax rate to be reduced in order to insure deficit neutrality.

Imposing an oil import fee is not costless to the manufacturing sector. If one focuses on percent losses in 2005 (close to the largest loss in GDP), most industries show between 1 to 2% loss in real output. Most of the dollar amount of output lost in that year is concentrated in four industries: transportation equipment, chemicals, food and electronics. These sectors have a large share of total gross output, so small percent losses in these industries mean larger dollar change in output. The general results do not change significantly if employment rather than output is examined. Certain industries, such as industrial machinery and fabricated metals, show smaller employment losses (in percentage terms) than output losses, but the overall conclusions of the impacts of imposing an import fee remain the same whether employment or output is used.

### **How Do Flexible Exchange Rates and Monetary Policy Affect the Results?**

All of the macroeconomic impacts described so far have used the same two assumptions: (1) the exchange rate remains at baseline levels and (2) there is no Federal Reserve reaction to any change in energy prices resulting from either an import fee or higher world oil prices. The following section reports results if these two assumptions are relaxed. The DRI model has exchange rate and a Federal Reserve reaction function equations that respond to differential inflation and interest rates. The exchange rate responds to international differences in inflation, interest rates, trade deficits, and capital flows between the United States and its competitors. The Federal Reserve reaction function looks at the tradeoff between increased inflation and unemployment and will change the key federal funds rate depending on this tradeoff. The economic impacts will vary, depending on which of the assumptions are relaxed. Three experiments are described in the following section and the GDP impacts are shown in Figure 15. Each experiment investigates both the deficit reduction and deficit neutral cases of the oil import fee:

1. Assume that neither the exchange rate nor the Federal Reserve reaction equations are operating (the methodology used in the simulations reported earlier);
2. Assume that the exchange rate equation is operating but not the Federal Reserve reaction function; and
3. Assume that both the exchange rate and Federal Reserve reaction equations are operating.

A U.S. imposed oil import fee raises domestic interest rates and inflation. Both of these influence the magnitude and direction of movement in the exchange rate. Higher interest rates cause the exchange rate to appreciate as foreign capital flows to the U.S. economy. However, higher inflation and lower U.S. economic activity tend to cause the exchange rate to depreciate. The GDP impacts of changing exchange rates ultimately depend on the price elasticity of demand for

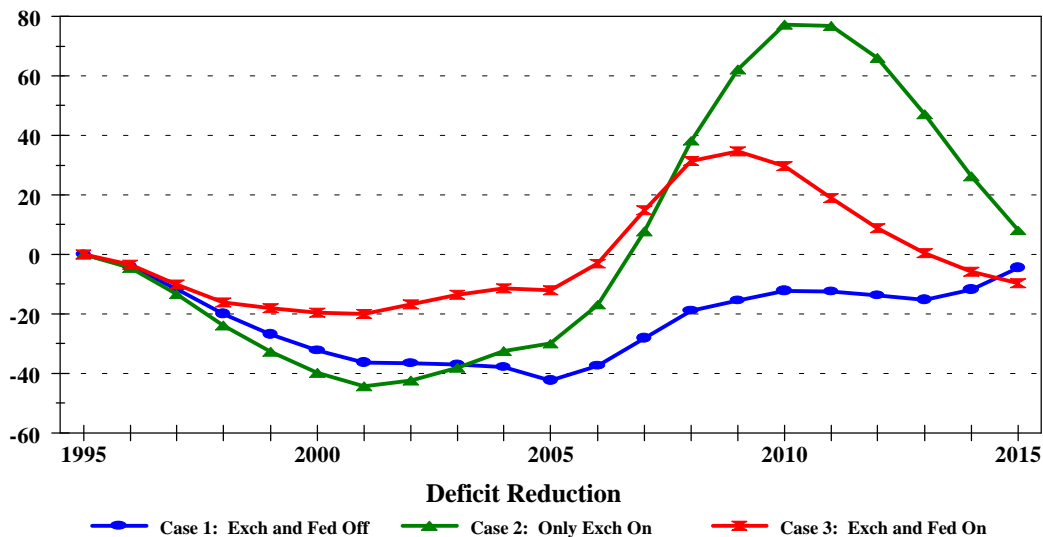
both imports and exports, and how fast markets react to changing international prices. The exchange rate for Case 2 first appreciates early in the forecast period and the U.S. GDP impacts initially worsen. Then as prices in the U.S., the exchange rate depreciates leading to amelioration of the GDP losses as export demand recovers.

When the Federal Reserve reaction function is operating through interest rate variation, income losses associated with adverse exchange rate behavior is moderated early in the forecast. The Federal Reserve reaction decreases interest rates, leading to a more rapid exchange rate depreciation and a quicker boost to U.S. export demand compared to the case where only exchange rate variations occur. In the deficit reduction case, where both the exchange rate and Federal Reserve reaction function are operating, the exchange rates devalue throughout the forecast interval. This is because real interest rates are below base case levels for most of the forecast interval, as the Federal Reserve pursues policy to stimulate increases in aggregate demand.

How well the Federal Reserve reaction function ameliorates GDP losses depends on the tradeoff between increased inflation and increased unemployment forecast in each simulation. In the deficit reduction case, inflation is high and unemployment increases. Given both conditions, the Federal Reserve reaction function works to ameliorate real GDP impacts by reducing interest rates. However, in the deficit neutral case, higher inflation is the primary concern since adverse employment changes have already been minimized by rebating collected taxes back to consumers and business. The Federal Reserve thus tries to contain inflationary prospects in the economy by raising interest rates, thereby making the real GDP impacts worse early in the period.



**Figure 15A. Real GDP, Change from Base  
Sensitivity Analysis**



**Figure 15B. Real GDP, Change from Base  
Sensitivity Analysis**

