The Long-Term Economic Impacts of Implementing the Energy Security Leadership Council's *Recommendations to the Nation on Reducing U.S. Oil Dependence*

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Executive Summary

The University of Maryland Inforum LIFT model of the U.S. economy was used to perform a detailed examination of the Energy Security Leadership Council's (ESLC) policy package, which is designed to reduce America's oil dependence. This package includes proposals to significantly improve the fuel efficiency of the transportation sector, to promote alternative fuels, such as ethanol, and to expand domestic petroleum production. This new study estimates the economic effects of the ESLC policy package on the U.S. economy over the period 2007 to 2030.

The Inforum LIFT model is an extremely detailed economic simulation and forecasting model that captures the effects of purchases and sales among nearly 100 industry groups. It is especially suitable for a study of this kind, because it models the interaction between detailed industry flows in the economy, such as energy use, with macroeconomic aggregates, such as GDP, consumption, employment and the trade balance. To analyze the impacts of the ESLC program over the 2007 to 2030 period, the LIFT model was used to simulate the impact of its policies compared to a LIFT baseline projection that was generally consistent with the forecast of the Department of Energy's (DOE) *Annual Energy Outlook* (AEO) 2006 Reference Case.

The main findings of the study are:

- The U.S. economy becomes significantly less oil intensive under the ESLC package. By 2030 the oil demand of the U.S. economy is 5.9 million barrels per day (mbd) less than in the baseline, a reduction of 22.8 percent.

- The nation conserves 4.8 MBD[2] of the 5.9 MBD through efficiency measures such as redesigned and stricter corporate average fuel economy (CAFE) standards. Another 0.9 MBD of the savings is the result of substitution measures that displace oil through greater production of ethanol and biodiesel fuels. Finally, an additional 0.94 TCF of natural gas extracted from the outer continental shelf (OCS) replaces 0.2 MBD of oil demand in 2030.

- In cumulative terms over the 2007 to 2030 period, the ESLC policy package reduces consumption by 22 billion barrels of crude oil equivalent through conservation and the use of alternative fuels. This aggregate figure is about three times the 7.4 billion barrels of crude oil consumed by the United States in 2006.

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[2] The ESLC program actually envisions that new transportation energy-consumption standards such as CAFE can produce oil demand savings approaching 5.8 MBD. The model simulations, however, show that the actual savings will be somewhat less at 4.8 MBD. The lower result comes through two dynamic effects captured by the LIFT model. First, higher real GDP and income levels mean that the consumption of energy and oil will be higher, all other things being equal. Also, the substantial production of ethanol and biodiesel will require more energy consumption by the agricultural and chemical sectors than under the baseline scenario.

- In terms of oil intensity, or the amount of oil consumed to generate a unit of GDP, the ESLC policy package will accelerate the rate of reduction to achieve a figure of 0.27 barrels per $1,000 of GDP (2006 dollars) by 2030, 24.5 percent less than the baseline figure of 0.36 barrels. The oil intensity of the US economy in 2006 was 0.56 barrels per $1,000 of GDP.

- Increased access to the OCS for purposes of oil and natural gas production and support for enhanced oil recovery (EOR) techniques boost domestic crude oil production substantially over the projection horizon when compared to the AEO baseline. The annual incremental improvement in domestic oil production reaches 2.3 MBD by 2030. Over the 2007 to 2030 forecast horizon, the cumulative augmentation to domestic crude oil supply by EOR and OCS is 10.2 billion barrels.

- Compared to the baseline case, the supply enhancements and conservation measures combine to reduce imports of crude oil by 8.2 MBD by 2030, a 47.3 percent decrease. Cumulatively over the 24-year period, the U.S. would import 32.2 billion fewer barrels of foreign oil. By way of context, this figure exceeds estimated proved reserves of 4.3 billion barrels for Prudhoe Bay in Alaska and less than 30 billion barrels for the entire United States.

- Reduced U.S. demand on the global oil supply should lead to modestly lower world oil prices throughout the projection horizon. The baseline case assumes a nominal price of oil of $107 by 2030. This study estimates that the price of oil would be $95 per barrel, or about 13 percent lower, with the ESLC policy package.

- The reduction of import volume and lower world oil prices mean that by 2030, oil imports will be lower by $278 billion per year. Over the 2007 to 2030 period, the nation's economy will avoid the expenditure of $2.5 trillion for imported crude oil. These savings can be spent on other imports, or they can stay at home—to be spent on domestic output or invested in domestic productive capital.

- This study estimates that, in 2030, the policy package will improve the U.S. current account deficit by about $175 billion dollars, or about 0.4 percent of GDP. (These figures indicate that approximately $103 billion of the savings from avoided oil imports will be spent on the import of other good and services.)

- Enhanced energy efficiency also provides a significant boost to real income. By using less energy, productive processes in general—and transportation in particular—become more competitive. Moreover, more domestic income stays in the country. Therefore, U.S. real GDP and U.S. real income are higher. The GDP is increased by 0.2 percent by 2030 and the level of real personal disposable income is enhanced by 0.8 percent.

- With the ESLC policy package, the typical U.S. household in 2030 should be receiving $1,103 (2006 dollars) more income than it would in the reference case. Cumulatively during the 2007 to 2030 period, households would experience an increase in income of almost $1.7 trillion (2006 dollars)—money that could be spent on goods and services, or saved for a more comfortable retirement.

- By 2030, the typical U.S. household would be spending fewer dollars directly on energy for transportation. The combination of higher income and less spending on energy means that the average household would be able to enjoy about $1,835 (2006 dollars) in incremental real discretionary purchasing power. That is, they will have $1,835 more income to use for savings or for the purchase of consumer goods and services other than energy. The 24-year cumulative enhancement in this "non-energy purchasing power" is nearly $2.9 trillion.

- Because of the higher levels of income and GDP that result from the ESLC energy policy package, the U.S. federal budget deficit would improve by a cumulative (2007 to 2030) $578 billion when compared to the baseline case. Estimating the policy package's cumulative nominal cost to the U.S. Treasury at $180 billion, this yields a benefit-to-cost ratio for the U.S. government fiscal balance of over three. That is, in federal budget terms, the energy policy package would pay for itself three times during the course of the next 24 years.

- The more energy-efficient economy enjoys a higher level of GDP and lower energy prices, which translate into an increase in overall jobs of 1.2 million, or 0.7 percent, by 2030. Among the employment effects expected by 2030, the model projects 139,000 more manufacturing jobs, 91,000 more jobs in professional services, and 199,000 more jobs in travel and tourism.

- This study assumes that the cost of domestic motor vehicle manufacturing relative to the baseline increases steadily, adding an incremental 1.0 percent in 2010, an incremental 9.3 percent by 2020, and an incremental 16.9 percent in 2030. These cost increases are the result of the incorporation by auto and truck manufacturers of more expensive motors/engines, lightweight materials, advanced electronics, and other new technologies that help achieve higher fuel efficiency.

- The adoption of the ESLC policy package can significantly reduce the economy's vulnerability to an oil supply shock. Experiments were conducted in which the price of oil was doubled in 2026, with the price 66 percent higher in 2027 and 25 percent higher from 2028 through 2030 when compared to the baseline oil price. Such a shock would harm the economy regardless of the energy policies in place, but the ESLC policy measures reduce the damage to income and employment by 30 to 40 percent.

- Assuming the AEO baseline as a point of departure, the price shock produces a real disposable income loss of almost $600 billion in 2006 dollars by 2027. The maximum income loss under the ESLC policies is only $366 million, 63 percent of the damage without lower oil dependence. Under the baseline, a doubling of oil prices results in the loss of over 4 million jobs by the second year of the shock, while the loss under ESLC policies is 2.5 million jobs.

- The cumulative shock-induced negative impact on GDP over the period 2026-2030 is estimated at $1,348 billion under the AEO baseline but only $871 billion in the ESLC case (all in 2006 dollars). The cumulative negative impact on real disposable income over the same period is estimated at $1,559 billion in the AEO baseline and $1,002 billion in the ESLC case (again in 2006 dollars).

The Long-Term Economic Impacts of Implementing the Energy Security Leadership Council's *Recommendations to the Nation on Reducing U.S. Oil Dependence*

1. Introduction

In December 2006, the Energy Security Leadership Council (ESLC), a collaboration of prominent business and retired military leaders organized by Securing America's Future Energy (SAFE), unveiled its *Recommendations to the Nation on reducing U.S. Oil Dependence*. Broadly speaking, the ESLC program contains recommendations in three areas: reducing petroleum demand, expanding the use of alternative fuels, and enhancing domestic petroleum supply. The demand reduction provisions concern the transportation sector, which is where most oil is consumed in the United States. The alternative fuels measures envision large expansion of domestic ethanol and biodiesel production. The supply enhancements include increased access to crude oil and natural gas reserves from the Outer Continental Shelf (OCS) and accelerated development of enhanced oil recovery (EOR).

This study uses the Inforum LIFT model to estimate the economic effects of the ESLC policy package on the U.S. economy over the period 2007 to 2030. LIFT is an extremely detailed general equilibrium simulation model that captures the effects of purchases and sales among nearly 100 industry groups.[3] It is especially suitable for a study of this kind, because it models the interaction between detailed industry flows in the economy, such as energy use, with macroeconomic aggregates, such as GDP, consumption, employment and the trade balance. Appendix A contains an overview of the LIFT model.

To analyze the impacts of the ESLC program over the 2007 to 2030 period, a LIFT scenario including the policy elements of the plan is compared to a LIFT baseline projection calibrated to be generally consistent with the forecast of the Department of Energy's (DOE) 2006 *Annual Energy Outlook* (AEO 2006). Comparing this baseline projection to the ESLC scenario reveals substantial direct benefits that flow from the reduction in oil dependence; these benefits include higher energy productivity, reduced petroleum imports, and slightly lower global oil prices. Direct benefits translate into higher real income and employment, a lower current account deficit, and a reduced federal government deficit. Another important benefit is a buffering of the economy against oil price shocks. That is, as the ESLC measures reduce the petroleum dependence of the economy, any given sudden spike in global oil prices will be less harmful to the economy than would have been the case without the policies.

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[3] Economists use the term "general equilibrium" to denote a model that contains a representation of the entire economy. Such models allow analysis of how changes in one sector, such as energy, will impact the developments in other sectors, such as motor vehicles, and on the evolution of the economy as a whole.

2. Methodology

The Base Case ("Business as Usual")

The base case was developed to be consistent in a broad sense with the Department of Energy (DOE), Energy Information Administration's (EIA) *Annual Energy Outlook* (AEO) 2006 base forecast (or reference case). In this projection, real GDP growth averages 2.9 percent from 2004 through 2030. The average growth of the GDP deflator over this period is 2.4 percent, and the crude oil price grows 1.3 percent faster than this, at an average of 3.7 percent. The AEO projects a gradual rise in the world oil price (light sulfur crude) from $61.8 per barrel in 2006 to about $107 per barrel in 2030, or about $55 per barrel in constant 2006 dollars (Table 5).

It is customary for the AEO to account for energy supply and demand in British Thermal Units (BTU), or, in the case of liquid fuels, in terms of millions of barrels per day (MBD) in crude oil equivalent. Since the ESLC proposal is primarily concerned with liquid fuels, this report uses the MBD convention to report supply and demand impacts.

To replicate the macroeconomic growth and energy use indicated by the AEO forecast, the LIFT model was calibrated in terms of productivity and labor force trends, final demand projections, and input-output coefficients for transportation sectors. Personal consumption expenditures for gasoline were adjusted accordingly. Though the LIFT baseline to 2030 does not exactly replicate the AEO 2006 scenario, it is very close, especially in terms of energy usage.

ESLC Policy Package: Reducing the Demand for Transportation Fuel

The first components of the ESLC package can be grouped under the general heading of energy efficiency improvements in the transportation sector (see Table 1). These savings come through conservation measures such as redesigned and stricter corporate average fuel economy (CAFE) standards. These also include fuel-economy standards for medium- and heavy-duty vehicles, as well as mandating the FAA to adopt more efficient traffic routing of commercial aircraft.

The first step in introducing these fuel conservation measures to the Inforum LIFT model was to modify the energy input requirements for light truck and auto use, the truck transportation sector, and the airline transportation sector. These adjustments are made through modifications in the model's input-output coefficients. Input-output coefficients are a key feature of the Inforum LIFT model. They show how each industry uses other industries' products to make its final products. For example, the input-output coefficient for "petroleum refining into truck transportation" shows the amount of refined petroleum products required to produce one dollar of truck transportation services. The LIFT model projects coefficients into the future based on past trends, expert advice, and government publications such as the AEO. In this case, the coefficients are modified to examine the effects of alternative levels of efficiency for fuel consumption. In addition, to simulate the higher fuel-economy standards for automobiles and light trucks, the demand for gasoline in volume from the consumer expenditure sector was reduced. The targeted fuel consumption reductions, by transportation sector, are indicated in Table 2.

Table 1
Increases in Efficiency in Transportation Energy Use under the ESLC Program
(Figures shown are savings relative to AEO 2006.)

Transportation Efficiency Policy Elements	Projected Oil Savings BY 2030
1. Significantly reform and strengthen fuel efficiency standards for *passenger cars and light-duty trucks* by mandating 4% annual increases in mpg performance. Allow “off-ramps” to relax the mandate in years when 4% increases are not cost-effective, technically infeasible, or unsafe. Employ manufacturing and consumer incentives.	4.3 MBD
2. Set and then annually strengthen fuel efficiency standards for *medium-duty vehicles* employing Federal subsidies as suitable.	0.2 MBD
3. Set and then annually strengthen fuel efficiency standards for *heavy-duty vehicles* employing Federal subsidies as suitable.	0.9 MBD
4. Require the Federal Aviation Administration (FAA) to improve air traffic routing to increase safety and decrease fuel consumption.	0.4 MBD
Total Primary Demand Savings	5.8 MBD
Total Realized Primary Demand Savings (see text below)	4.8 MBD

These adjustments for intermediate and final consumer demand were calibrated to reach the 5.8 MBD savings of the ESLC policy program, *all other things being equal.* However, in a general equilibrium model like LIFT, targeted demand adjustments such as these cannot be realized in practice. In contrast to the 5.8 MBD fuel reduction envisioned by the ESLC policy proposal, the model simulations find that the actual savings are approximately 4.8 MBD. This lower result comes through two dynamic channels captured by the LIFT model. First, the higher real GDP and income levels generated by lower energy intensity mean that energy demand should increase relative to the income levels of the baseline scenario, even given the higher energy efficiency implied by the ESLC conservation measures. Also, the substantial production of ethanol and biodiesel, as well as additional production of crude oil and natural gas from the OCS (see below), will require more energy consumption by the agricultural and chemical sectors than under the baseline scenario.

Table 2
MBD in Transportation, AEO 2006 and ESLC Oil Reduction

		2004	2025	2030
Light-Duty Vehicles, Commercial Light Trucks	Base	8.92	11.72	12.47
	ESLC		8.83	7.97
	Difference		2.89	4.50
Freight Trucks and Bus transportation	Base	2.37	3.62	4.02
	ESLC		3.02	3.15
	Difference		0.60	0.87
Air Transportation	Base	1.37	1.90	1.92
	ESLC		1.62	1.53
	Difference		0.28	0.39
Total Transportation Oil Use	Base	14.10	19.50	20.95
	ESLC		15.83	15.19
	Difference		**3.67**	**5.76**

ESLC Policy Package: Increasing Production of Alternative Fuels

The second set of components of the ESLC policy package concern the acceleration of the domestic production of ethanol and biodiesel. As indicated in Table 3, the total additional supply of alternative fuels above and beyond that already envisioned by the AEO 2006 is 0.9 MBD of crude oil equivalent by 2030 (1.7 for ethanol, and 0.2 for biodiesel). This additional production is more than double the AEO 2006 baseline for ethanol and biodiesel. Under this scenario, ethanol production alone will be about 30 billion gallons, requiring the use of 5.5 million bushels of corn valued at about $18 billion in 2006 dollars. If corn alone were relied upon to produce ethanol, there would doubtless be significant restructuring of agricultural production, to shift acreage away from other crops into corn. However, the ESLC policy package foresees new technologies that will allow ethanol to be produced from other feedstocks.[4]

Despite its high level of industrial detail, the Inforum LIFT model does not have separate sectors for specific crops. Production of these items is part of the overall Agriculture industry. The increase in ethanol as a replacement for gasoline produced from petroleum was modeled in 3 steps:

1. Increase the input-output coefficient of “Agriculture, forestry and fisheries” into “Other chemicals,” which contains the sector that produces ethanol.

2. Increase the input-output coefficient of “Other chemicals” into “Petroleum refining.”

[4] The corn-to-ethanol conversion rate is currently 2.7 gallons per bushel. We assume that technology improvements that enable the conversion of cellulosic biomass and switchgrass to ethanol will yield a 30% improvement in agriculture-to-ethanol conversion by 2030.

3. Reduce the input-output coefficient of “Crude petroleum” to “Petroleum refining.”

These coefficient changes result in increased production of Agriculture and Other chemicals and reduced requirements for Crude petroleum, whether imported or domestically produced. Note that these output increases in the Agriculture and Chemical sectors will entail more energy consumption than would have otherwise been required under the baseline.

Table 3
Enhanced Production of Alternative Fuels under the ESLC Program
(Figures shown are increases relative to AEO2006.)

Alternative Supply Enhancement Policy Element	Projected Oil Savings by 2030
1. Expand production of ethanol for motor fuels	0.7 MBD
2. Grow the biodiesel market	0.2 MBD
Total expanded production of alternative fuels	0.9 MBD

ESLC Policy Package: Enhancing the Domestic Petroleum Supply

The policy package includes several important elements to enhance the U.S. domestic crude oil and natural gas supply, including increased access to the Outer Continental Shelf (OCS) and support to accelerate production from Enhanced Oil Recovery (EOR) techniques. The increased supply capacity from the Outer Continental Shelf and enhanced oil recovery was calibrated in the LIFT model by assuming that each increment in production, compared to the baseline, displaces an equivalent volume in imports. Assumed enhancements to supply occur only gradually through 2015, accelerate rapidly through 2025, and level off thereafter.

As displayed in Table 4, the improvement in domestic oil production from the OCS supply reaches 1.3 MBD in 2030, a bit down from an assumed peak of 1.5 MBD in 2026. For natural gas, we assumed that the production boost will peak at about 1.1 trillion cubic feet (TCF) in 2026, which is about 5.2 percent of domestic production expected in the AEO2006. By 2030, the increase recedes to 0.94 TCF, or 4.5 percent of production by 2030.

To determine the effect of this natural gas supply boost on overall oil dependence, we used the LIFT model to compute how this gas might displace the use of other primary energy sources, mainly coal and oil used for electricity generation and for heating. We found that, by 2025, the natural gas supply enhancement could displace the use of 0.3 MBD per day. In terms of absolute energy (i.e., in BTU terms), this means that about half of the increase in the natural gas supply will go towards replacing the use of oil, while the other half will go toward the replacement of other energy sources, mostly coal. By 2030, this oil savings figure would be closer to 0.2 MBD as displayed in Table 4.

Table 4
Domestic Petroleum Supply Enhancements Under the ESLC Program

Expanded Supply Policy Elements	Projected Oil Production by 2030
1. Expanded crude oil supply, Outer Continental Shelf (OCS)	1.3 MBD
2. Expanded OCS natural gas, displacement of oil use	0.2 MBD
3. Enhanced oil recovery (EOR)	1.0 MBD
Total projected increase to supply	2.5 MBD

Finally, and as also indicated by Table 4, support for EOR as envisioned by the ESLC program is expected to increase domestic crude oil supply by 1.0 MBD by 2030. Compared to the AEO2006 base scenario, the three supply measures could increase domestic oil production by 2.7 MBD, or 28 percent, by 2025, and by about 2.5 MBD, or 25 percent, by 2030.

ESLC Polices: Reducing the World Oil Price

The AEO reference case projects a world production capacity of about 123 MBD and a nominal world oil price of $107 per barrel in 2030. The combination of transportation demand reductions and enhancements to supply due to ESLC policies result in a total reduction of 8.2 MBD in U.S. crude oil imports. This is roughly equivalent to an increase in supply of 8.2 MBD for the rest of the world market, or almost 6.7 percent of the total. The lower U.S. demand on the global oil supply should lead to modestly lower world oil prices throughout the projection horizon.

The 2006 AEO presents alternative scenarios for world oil prices based on changes assumptions of global supply. The “low price case” assumes that supply is 15 percent higher than in the reference case, resulting 40% lower world oil price. The AEO “high price case” posits that global supply 15 percent lower than in the reference case, with the oil price about 70 percent higher. These scenarios imply that DOE’s assumed elasticity of price with respect to changes in supply is between 2.7 (40%/15%) and 4.7 (70%/15%).

We assume that a 6.7 percent reduction of the U.S. claim on non-U.S. production by 2030 will lower the world price of oil to $95 per barrel, of about 11.5 percent. Therefore, the implied elasticity of price with respect to supply is 1.7 (11.5%/6.7%), a conservative assumption compared to the AEO's elasticity assumptions. Note in Table 5 that this prices change appears gradually and linearly over the forecast horizon.

Fuel Standards Compliance Costs

Complying with new CAFE and other standards generates costs as auto and truck manufacturers are forced to incorporate expensive motors or engines, lightweight materials, electronics, and other new technologies to help achieve higher fuel efficiency. To simulate these impacts in the LIFT model, input-output coefficients from several key industries into the motor vehicle manufacturing sectors were increased. The industry pattern and magnitude of these adjustments were guided with information supplied by *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, a study published by the National Academy of Sciences in 2002. The input industries adjusted in this fashion include: Plastics, Engines and turbines, Electrical equipment and batteries, Electronic components, Motor vehicle parts, Other instruments, and Professional services (research).

These input cost requirements increase domestic motor vehicle production costs relative to the baseline of about 1.0 percent in 2010, increasing to 9.3 percent by 2020, and reaching 16.9 percent in 2030. These production cost increases result in an escalation in motor vehicle retail prices by 0.5 percent in 2010, to 5.7 percent in 2020, and to 10.6 percent by 2030.

Revenue Neutrality

The ESLC package includes approximately $180 billion of additional federal expenditure, compared to business as usual. These outlays include various subsidies for auto manufacturers and ethanol production, as well as losses of gasoline tax revenues due to lower consumption of gasoline. We have assumed revenue neutrality, that is, any worsening of the federal deficit due to these measures is countered by increases federal revenues, especially through the income tax. Because of this assumption, additional federal expenditures do not stimulate the economy through income effects.

3. Simulation Results

Energy Demand, Supply and Imports

Comparing ESLC policies to the baseline business-as-usual projections from 2007 to 2030 the study finds the following results.

First, the U.S. economy becomes significantly less oil intensive under the ESLC package. As shown in Table 5, by 2030 oil demand of the U.S. economy is 5.9 MBD less than in the baseline. Instead of consuming 25.9 MBD of oil as in the base case, demand would be 20.0 MBD, a reduction of 22.8 percent. As described above, 4.8 MBD of the 5.9 MBD conserved come through measures such as redesigned and stricter corporate average fuel economy (CAFE) standards (Figure 1), and another 0.9 MBD of oil savings is the result of greater production of ethanol and biodiesel fuels (Figure 2). In addition, as described above and as indicated in Table 5, an additional .94 TCF of natural gas extracted from the OCS displaces, or is substituted for, 0.2 MBD of oil requirements in 2030.

In cumulative terms over the 2007 to 2030 period the ESLC policy package reduces the consumption of 22 billion barrels of crude oil equivalent through conservation and the use of alternative fuels. This aggregate figure is about three times the 7.4 billion barrels of crude oil consumed by the United States in 2006.

In terms of oil intensity, or the amount of oil consumed to generate a unit of GDP, the ESLC policy package should accelerate the rate of reduction to achieve a figure of 0.27 barrels per $1,000 of GDP in 2006 dollars by 2030—24.5 percent less than the baseline figure of 0.36 barrels (Figure 4).

Also as described above, increased access to the Outer Continental Shelf (OCS) and support to accelerate Enhanced Oil Recovery (EOR) techniques boost domestic crude oil production substantially over the projection horizon compared to the AEO baseline. As displayed in Table 5 and Figure 3, the improvement in domestic oil production supply reaches 2.3 MBD by 2030. Over the 2007 to 2030 forecast horizon, the cumulative augmentation to domestic crude oil supply by EOR and OCS is 10.2 billion barrels—well over current annual consumption of 7.4 billion barrels.

Compared to the baseline case, the supply enhancements and conservation measures combine to reduce imports of crude oil by 8.2 MBD by 2030, a 47.3 percent decrease (Table 5 and Figure 1). Cumulatively, during the 24-year period, the U.S. would import 32.2 billion fewer barrels of foreign oil. This figure is similar to estimated remaining proved reserves of 4.3 billion barrels for Prudhoe Bay in Alaska and less than 30 billion barrels for the entire United States.

Compared to the baseline, the reduction of import volume and lower world oil prices mean that by 2030 oil imports will be lower by $278 billion per year. Over the 2007 to 2030 period, the nation’s economy will avoid the expenditure of $2.5 trillion for imported crude oil (OPEC taxes) over the projection horizon. These savings can be spent on other imports or they can stay at home—to be spent on domestic output or invested in domestic productive capital.

Table 5
Crude Oil Energy Balance: ESLC Policy Compared to Baseline

Line 1 is baseline level in MBD or $.
Line 2 is difference from baseline level in MBD or $.
Line 3 is difference from baseline level in percent.

Liquid Fuels Supply and Demand Disposition (Millions bbls per day, crude oil equivalent)	2006	2010	2015	2020	2025	2030	avg. ann. growth (%) 07-30
Domestic production	7.9	8.0	8.4	8.9	9.3	9.9	1.1
(excl. ng, ethanol & biodiesel)		0.2	0.4	1.3	2.4	2.3	2.0
		2.7	4.4	15.0	25.3	23.3	
Ethanol and biodiesel production	0.3	0.7	0.7	0.8	0.9	0.9	4.0
		0.1	0.3	0.5	0.8	0.9	6.8
		7.2	33.8	60.8	99.9	94.4	
OCS NG displacement of oil demand	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0	0.0	0.1	0.3	0.2	
					2.6	2.5	
Total domestic production	8.2	8.7	9.2	9.6	10.2	10.8	1.3
(incl. nat gas, ethanol & biodiesel)		0.3	0.7	1.9	3.5	3.4	2.4
		3.2	7.4	20.1	34.2	31.1	
Oil product exports	1.3	1.2	1.2	1.3	1.3	1.4	0.9
		0.0	0.0	0.0	0.0	0.0	
Total crude and refined imports	13.7	13.7	14.4	15.3	16.3	17.3	1.1
		-0.5	-1.8	-4.0	-6.7	-8.2	-1.6
		-3.6	-12.1	-26.0	-41.3	-47.3	
Total primary demand	20.6	21.2	22.4	23.7	25.2	26.8	1.2
		-0.2	-1.1	-2.0	-3.3	-4.8	0.3
		-1.0	-4.8	-8.6	-12.9	-18.1	
Oil demand	20.3	20.5	21.6	22.9	24.3	25.9	1.1
(excl. nat gas, ethanol & biodiesel)		-0.3	-1.4	-2.7	-4.4	-5.9	0.0
		-1.4	-6.4	-11.6	-18.0	-22.8	

Global Oil Prices ($ per barrel, low sulfur imports)	2006	2010	2015	2020	2025	2030	growth (%) 07-30
Nominal	61.8	53.5	61.2	74.2	90.1	106.9	2.6
		-0.4	-1.4	-4.2	-8.5	-11.9	-0.5
		-0.8	-2.3	-5.7	-9.5	-11.2	
Real (2006$)	61.8	48.3	47.8	49.8	52.5	54.6	-0.2
		-0.4	-1.2	-3.1	-5.4	-6.6	-0.5
		-0.8	-2.5	-6.2	-10.2	-12.1	

Figure 1
ESLC Policy Impacts on Oil Consumption and Imports

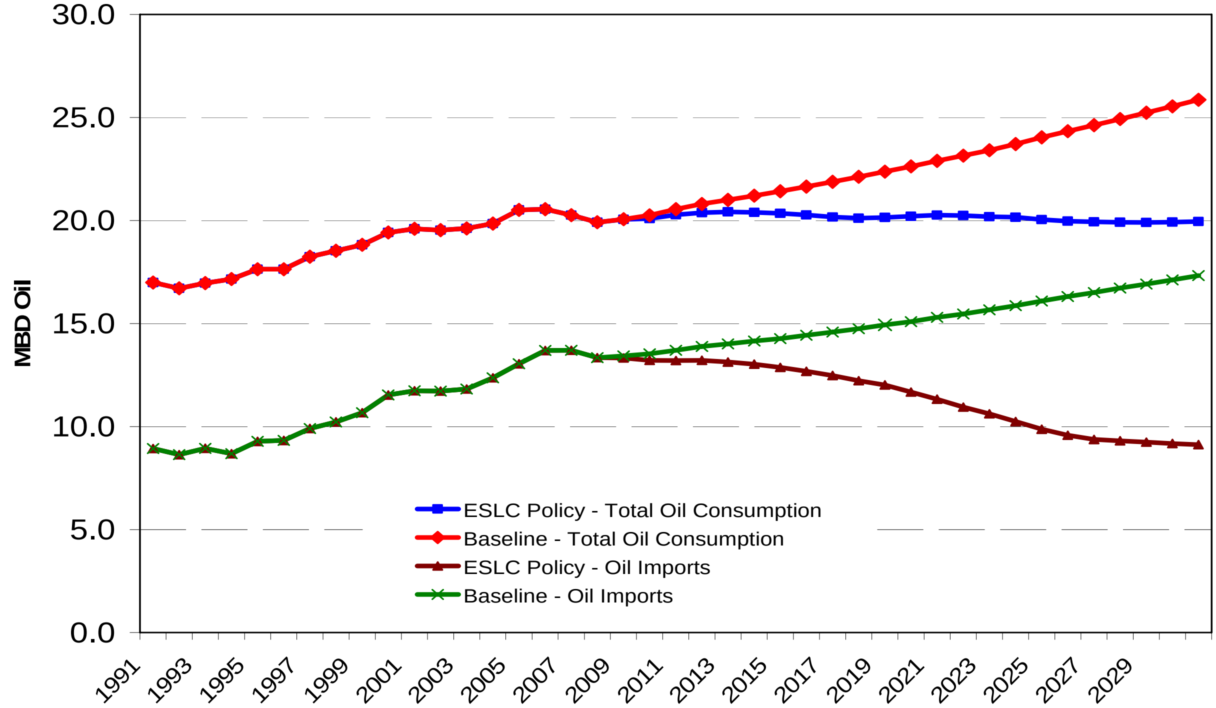


Figure 2
ESLC Policy Impacts on Ethanol and Biodiesel Production

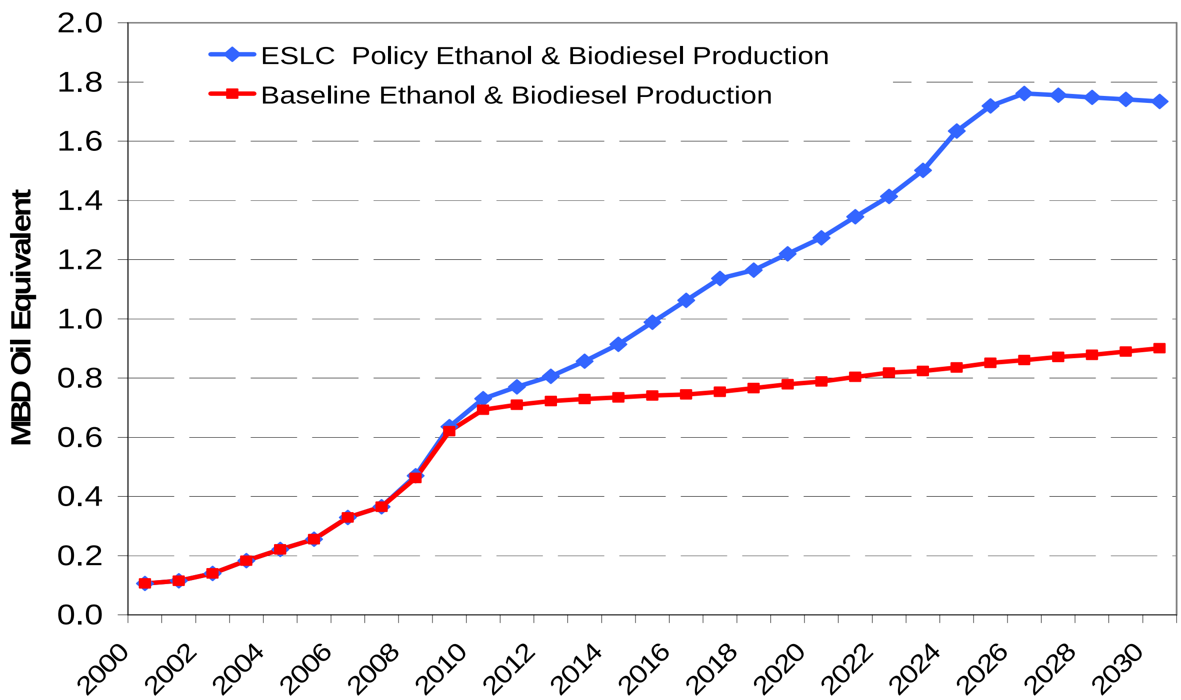


Figure 3
ESLC Policy Impacts on Domestic Production

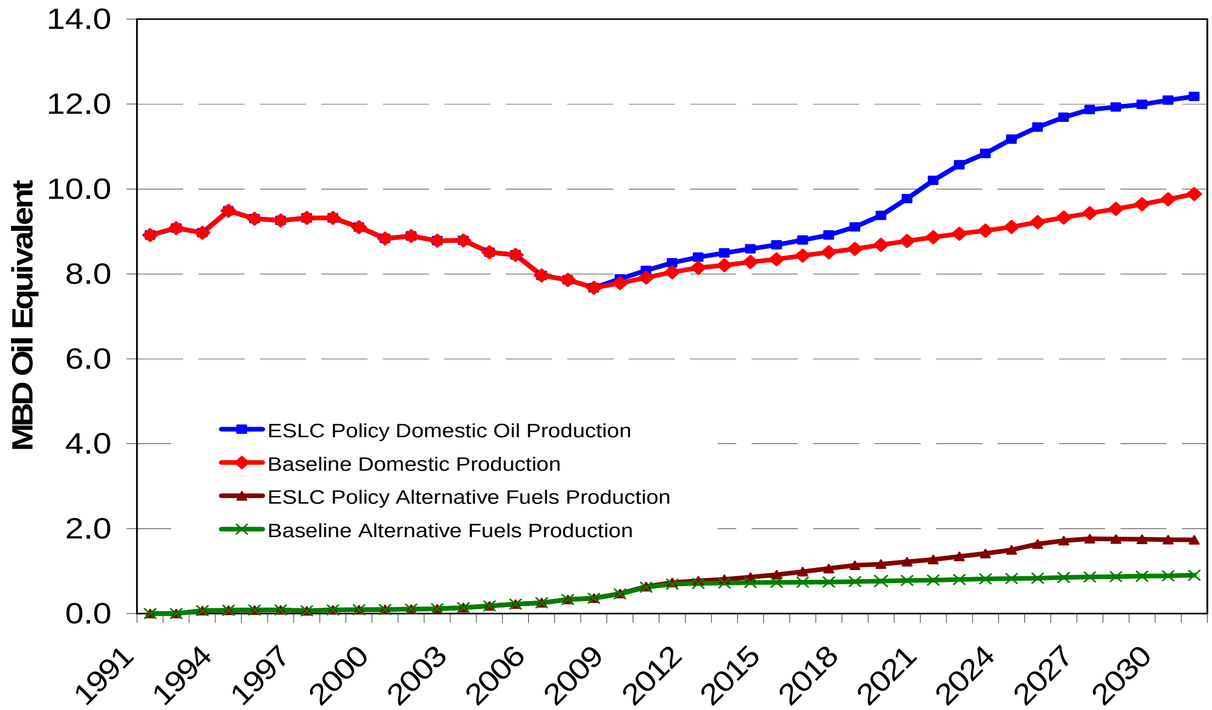
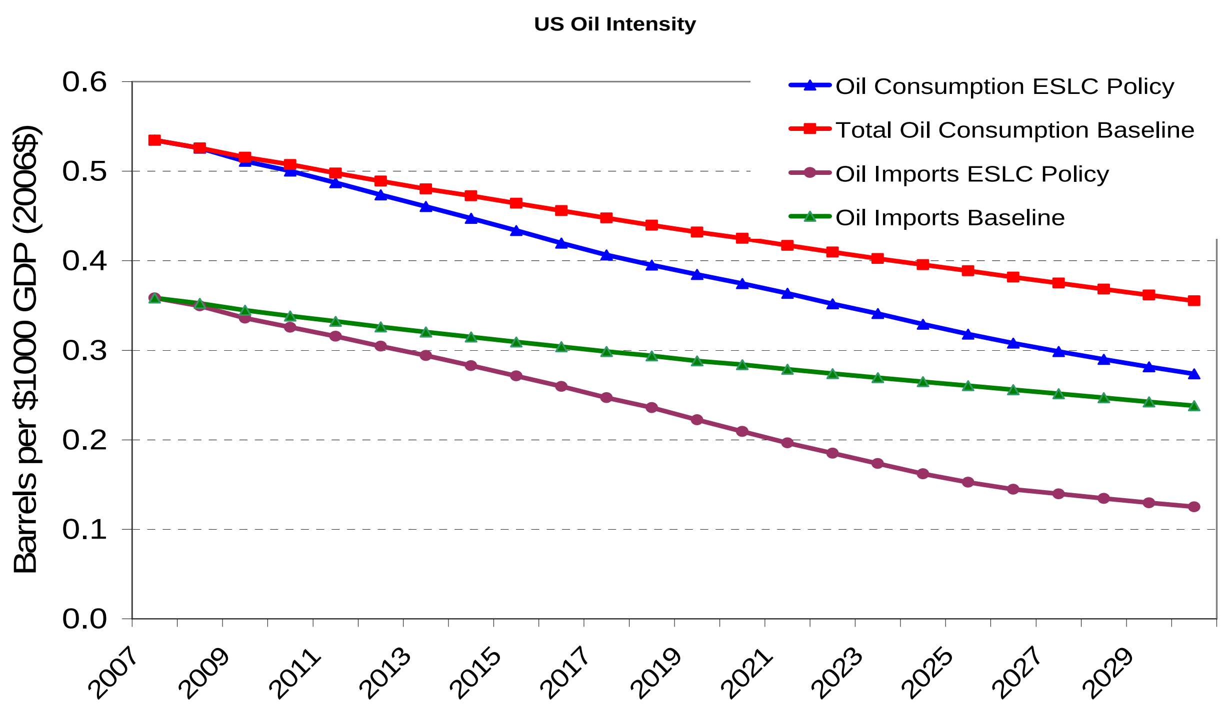


Figure 4
Oil Consumption and Imports Intensity of GDP



Macroeconomic and Welfare Effects

The macroeconomic impacts of the ESLC policy package versus the baseline are illustrated in Table 6. The policy package reduces imports and by 2030 the U.S. current account deficit would improve by about $175 billion dollars, or about 0.4 percent of GDP, attaining a more sustainable level. (Given the $278 billion per year decrease in oil imports, this figure indicates that approximately $103 billion of the avoided oil imports would be spent on the import of other good and services.)

The reduction of oil consumption is even more remarkable when one considers that enhanced energy efficiency also provides a significant boost to real income. By using less energy, productive processes in general—and transportation in particular—become more competitive. Moreover, more domestic income stays in the country. Therefore, U.S. real GDP and U.S. real income are higher. In this case, as Table 6 illustrates, the level of GDP is increased by 0.2 percent by 2030 and the level of real personal disposable income is enhanced by 0.8 percent, both compared to the baseline.

By 2030, the typical U.S. household would be receiving $1,103 (2006 dollars) more real income with the ESLC/ policy package than it would have without it. Cumulatively over the 2007 to 2030 period, households should experience an increase of almost $1.7 trillion (2006 dollars) in aggregate income—money that could be spent on goods and services, or saved for a more comfortable retirement.

By 2030, the typical U.S. household would be spending fewer dollars directly on energy for transportation. The combination of higher income and less spending on energy means that the average household would be able to enjoy about $1,835 (2006 dollars) more in real discretionary purchasing power. That is, they will have $1,835 more income to use for savings or for the purchase of consumer goods and services other than energy. The 24-year cumulative enhancement in this "non-energy purchasing power" is nearly $2.9 trillion.

Because of the higher levels of income and GDP with the energy policy package, the U.S. federal budget deficit would improve by a cumulative (2007 to 2030) $578 billion when compared against the baseline case. Estimating the nominal Treasury cost of the energy initiatives at $180 billion (2007 to 2030), the benefit-cost ratio for the U.S. government fiscal balance is over 3. That is, in federal budget terms, the energy policy package would pay for itself 3 times over the next 24 years.

Table 6
Macroeconomic Impacts: ESLC Policy compared to baseline

Line 1 is baseline level in 2006$, unless noted.

Line 2 is difference from baseline level in percent, unless noted.

	2006	2010	2015	2020	2025	2030	07-30
Gross Domestic Product	13264	14785	17024	19671	22848	26562	2.91
	0.0	0.1	0.2	0.4	0.3	0.2	2.92
GDP Components							
Personal Consumption	9256	10362	11936	13720	15695	17964	2.75
	0.0	0.1	0.3	0.4	0.4	0.3	2.76
Gross Private Fixed Investme	2207	2418	2817	3336	3984	4786	3.26
	0.0	0.1	0.1	0.2	-0.2	-0.4	3.24
Government Spending	2685	2832	2968	3132	3358	3603	1.22
	0.0	0.0	0.0	0.0	0.0	0.0	1.22
Exports	1429	1798	2411	3196	4223	5432	5.56
	0.0	0.0	0.1	0.2	0.3	0.4	5.58
Imports	2230	2460	2880	3386	3932	4525	2.93
	0.0	-0.1	0.1	0.0	-0.1	0.2	2.94
Price Indices (2000 = 1.0)							
GDP Chain Price Index	1.16	1.29	1.49	1.73	1.99	2.27	2.82
		0.0	0.2	0.4	0.8	1.2	2.87
Import Price Index	1.15	1.27	1.47	1.71	1.98	2.27	2.89
		0.0	0.0	-0.1	-0.1	-0.2	2.88
Consumer Price Index	1.14	1.27	1.45	1.66	1.89	2.13	2.60
		0.0	0.1	0.3	0.6	0.9	2.64
Household Welfare							
Real Disposable Pers Income	9619	10897	12728	14833	17286	20178	3.06
Percent difference		0.1	0.3	0.6	0.7	0.8	3.09
Diff 2006$ level (bill $)		12	43	86	117	165	
Diff 2006$ per household		99	329	628	816	1103	
Real Disposable Pers Income							
after transport fuel purchases	9188	10530	12337	14402	16804	19623	3.10
Percent difference		0.2	0.5	0.9	1.2	1.4	3.16
Diff 2006$ level (bill $)		16	64	136	198	275	
Diff 2006$ per household		134	493	992	1381	1835	
International and Government Balances (billions of $)							
Oil imports (bill $)	296	259	305	376	467	582	
Diff in $bill		-14	-41	-102	-194	-278	
Current Account Balance	-822	-1034	-1064	-1123	-1109	-808	
Diff in $bill		7	9	44	108	175	
As % of GDP	-6.2	-6.3	-4.9	-3.8	-2.8	-1.6	
Diff in % of GDP		0.1	0.1	0.2	0.3	0.4	
Federal Surplus (Deficit)	-246	-270	-242	-97	-148	-120	
Diff in $bill		2	5	30	45	53	
As % of GDP	-1.9	-1.6	-1.1	-0.3	0.4	1.0	
Diff in % of GDP		0.0	0.0	0.1	0.1	0.1	

Employment Impacts

Table 7 displays some employment impacts by industry. Because the economy is more energy efficient, a higher level of GDP and lower energy prices allow the economy to stimulate an increase in overall jobs of 1.2 million, or 0.7 percent, by 2030. Among the interesting industry effects, the model projects 139,000 more manufacturing jobs, 91,000 more jobs in professional services, and 199,000 more jobs in travel and tourism.

Table 7
Industry Employment Impacts: ESLC Policy compared to baseline

Line 1 is baseline level in thousand of jobs
Line 2 is difference from baseline level in thousands of jobs
Line 3 is difference from baseline level in percent.

	2006	2010	2015	2020	2025	2030
Total Employment	148020	153061	159167	164953	170737	176318
	0	189	558	1021	1196	1242
		0.1	0.4	0.6	0.7	0.7
Manufacturing Employment	15565	15965	16515	17123	17933	18826
	0	23	65	115	134	139
		0.1	0.4	0.7	0.7	0.7
Professional Services	5844	6077	6270	6489	6785	7106
	0	8	31	58	76	91
		0.1	0.5	0.9	1.1	1.3
Agricultural Employment	3612	3671	3662	3682	3681	3625
	0	39	62	78	94	84
		1.1	1.7	2.1	2.5	2.3
Travel & tourism [1]	15292	16268	16966	17506	17839	18042
	0	17	69	127	167	199
		0.1	0.4	0.7	0.9	1.1

[1] Travel & tourism industry includes Air transportation (62), Eating & drinking places (71), Hotels (75) and Movies and amusements (82).

4. Reducing the Vulnerability to Oil Price Shocks

The adoption of the ESLC policy package to reduce oil dependence can significantly reduce the economy's vulnerability to an oil supply shock. Experiments were conducted in which the price of oil was doubled in 2026, with the price 66 percent higher in 2027 and 25 percent higher from 2028 through 2030 compared to the baseline oil price (Figure 5). Such a shock would harm the economy regardless of the energy policies in place, but the ESLC policy measures reduce the damage to income and employment by 30 to 40 percent.

Assuming the AEO baseline as a point of departure, the price shock produces a loss of 1.8 percent of GDP in the first year and 2.4 percent in the second year. Under ESLC policies, the same percentage price shock results in a GDP loss of only 1.2 percent 2026 and 1.5 percent in the second year. Under existing policy, the oil shock produces a real disposable income loss of almost $600 billion in 2006 dollars by 2027. The maximum income loss under the ESLC policies is only $366 million, only 63 percent of the damage without the policy changes. Under the baseline policies, a doubling of oil prices results in the loss of over 4 million jobs by the second year of the shock, while the loss under ESLC policies is 2.5 million jobs.

As Shown in Figure 6, the cumulative shock-induced negative impact on GDP over the period 2026-2030 is estimated at $1,348 billion under the AEO baseline but only $871 billion in the ESLC case (all in 2006 dollars). The cumulative negative impact on real disposable income over the same period is estimated at $1,559 billion in the AEO baseline and $1,002 billion in the ESLC case (again in 2006 dollars).

Figure 5
Oil Price Shock 2026- 2030: Nominal Price per Barrel

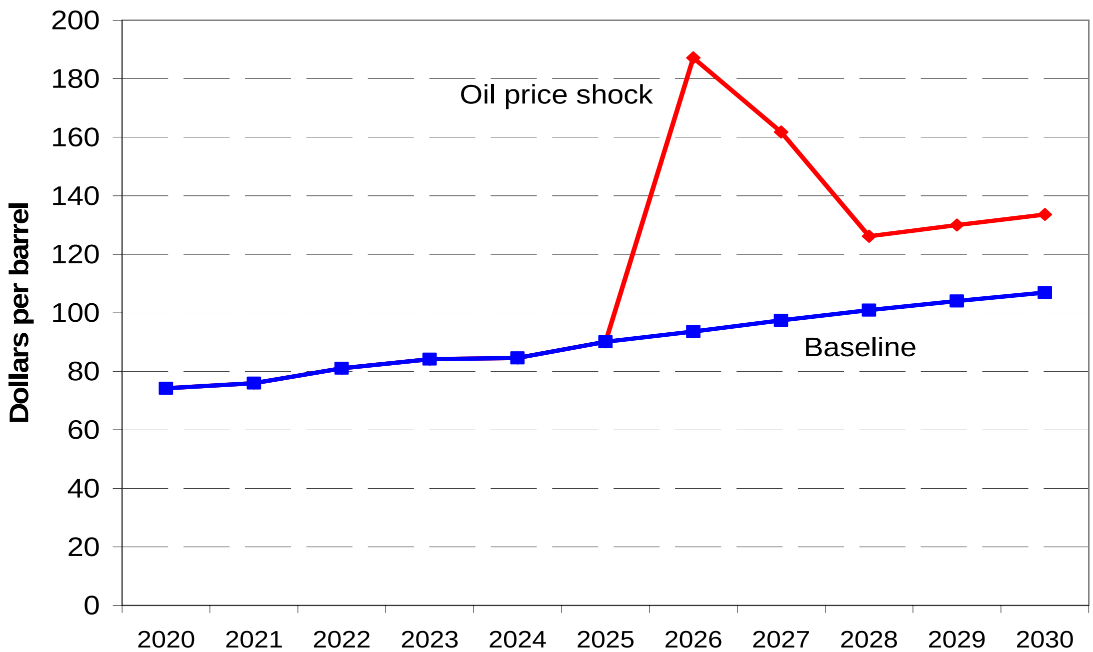
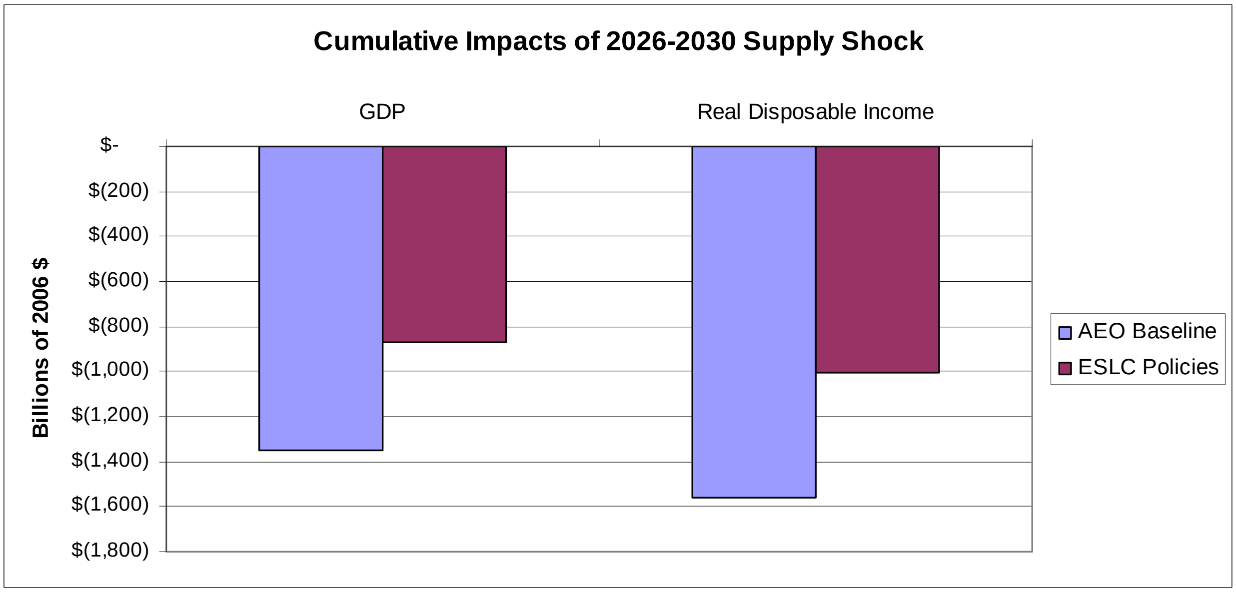


Figure 6
Oil Price Shock: Cumulative Impacts of 2026-2030 Supply Shock



Appendix A
The Lift Model of the U.S. Economy

Inforum's flagship model, **Lift (Long-term Interindustry Forecasting Tool)**, is a 97-sector general equilibrium representation of the U.S. economy. It is unique among large-scale models of the U.S. economy. Combining an interindustry (input-output) formulation with extensive use of regression analysis, it employs a "bottom-up" approach to macroeconomic modeling. For example, aggregate investment, total exports, and employment are not determined directly, but are computed by the sum of their parts: investment by industry, exports by commodity, and employment by industry. Indeed, Lift contains full demand and supply accounting for 97 productive sectors. (See below for Lift sector titles.)

The demand/production block of Lift uses econometric equations to predict the behavior of real final demand (consumption, investment, imports, exports, government) at a detailed level. Then, the detailed predictions for demand are used in an input-output production identity to generate gross output (total revenue adjusted for inflation). Lift's approach to projecting industry prices is similar. Behavioral equations estimate each value-added component (e.g., compensation, profits, interest, rent, indirect taxes) for each industry. Value added per unit of output is then combined with the prices of intermediate goods and services with the input-output price identity to form industry prices. Prices by industry are also dependent on measures of slack in each industry, and, in some cases, international prices. Thus, income and prices are directly related and are consistent. In turn, relative price terms and income flows are included as independent variables in the regression equations for final demand, creating a simultaneity between final demand and value-added.

This bottom-up technique possesses several desirable properties for analyzing the economy. First, the model works like the actual economy, building the macroeconomic totals from details of industry activity, rather than distributing predetermined macroeconomic quantities among industries. Second, the model describes how changes in one industry, such as increasing productivity or changing international trade patterns, affect related sectors and the aggregate quantities. Third, parameters in the behavioral equations differ among products, reflecting differences in consumer preferences, price elasticities in foreign trade, and industrial structure. Fourth, the detailed level of disaggregation permits the modeling of prices by industry, allowing one to explore the causes and effects of relative price changes.

Despite its industry basis, Lift is a full macroeconomic model, with more than 800 macroeconomic variables determined consistently with the underlying industry detail. This macroeconomic "superstructure" contains key functions for household savings behavior, interest rates, exchange rates, unemployment, taxes, government spending, and current account balances. Like in an aggregate macroeconomic model, this structure insures that Lift exhibits "Keynesian" demand driven behavior over the short-run, but neoclassical growth characteristics over the longer term. For example, while monetary and fiscal policies and changes in exchange rates can affect the level of output in the short-to-intermediate term, in the long term, supply forces -- available labor, capital and technology -- will determine the level of output.

Another important feature of the Lift model is the importance given to the dynamic determination of endogenous variables. For example, investment depends on a distributed lag in the output growth of investing industries and imports and exports depend on a distributed lag of foreign price changes. Therefore, Lift model solutions are not static, but are fully capable of projecting a time path for the endogenous quantities.

Finally, the Lift model is linked to other, similar models with the Inforum Bilateral Trade Model (BTM). Countries included in this system include the U.S., Japan, China, South Korea and the major European economies. Through this system, sectoral exports and imports of the U.S. economy respond to industry-level demand and price variables projected by models of U.S. trading partners. In summary, the Lift model is particularly suited for examining and assessing the macroeconomic and industry impacts of the changing composition of consumption, production, foreign trade, and employment as the economy grows through time.

LIFT's data foundations are drawn from a number of sources. A summary of the most important sources follows:

U.S. Bureau of Economic Analysis (BEA):
Input-output tables
National Income and Product Accounts (NIPA)
Industry output and value added
International trade deflators

U.S. Bureau of the Census
Population
International trade
Recent industrial and service sector activity

U.S. Bureau of Labor Statistics
Employment (aggregate and industrial)
Consumer and producer prices

U.S. Federal Reserve Board
Interest rates
Exchange rates
Industrial production
Money supply and credit

The current LIFT model is the fourth discrete version of a modeling framework that has been in continuing existence since 1967. Since its inception, Lift has continued to develop and change. The structure and properties of the model have been modified with the experience of working with clients with partners in other countries. A detailed description of the Lift model can be found at: http://www.inforum.umd.edu/WorkPaper/INFORUM/wp01002.pdf

Table A-1: Producing Sectors of the Lift Model of the U.S. Economy

1 Agriculture, forestry, & fish

Mining
2 Metal mining
3 Coal mining
4 Natural gas extraction
5 Crude petroleum
6 Non-metallic mining

Construction
7 New construction
8 M & R construction

Non-Durables
9 Meat products
10 Dairy products
11 Canned & frozen foods
12 Bakery & grain mill product
13 Alcoholic beverages
14 Other food products
15 Tobacco products
16 Textiles and knitting
17 Apparel
18 Paper
19 Printing & publishing
20 Agric fertilizers & chemicals
21 Plastics & synthetics
22 Drugs
23 Other chemicals
24 Petroleum refining
25 Fuel oil
26 Rubber products
27 Plastic products
28 Shoes & leather

Durable Material & Products
29 Lumber
30 Furniture
31 Stone, clay & glass
32 Primary ferrous metals
33 Primary nonferrous metals
34 Metal products

Non-Electrical Machinery
35 Engines and turbines
36 Agr., constr., min & oil equip
37 Metalworking machinery
38 Special industry machinery
39 General & misc. industrial
40 Computers
41 Office equipment
42 Service industry machinery

Electrical Machinery
43 Elect. industry equipment
44 Household appliances
45 Elect. lighting & wiring eq
46 TV's, VCR's, radios
47 Communication equipment
48 Electronic components

Transportation Equipment
49 Motor vehicles
50 Motor vehicle parts
51 Aerospace
52 Ships & boats
53 Other transportation equip

Instruments & Miscellaneous Manufacturing
54 Search & navigation equip
55 Medical instr & supplies
56 Ophthalmic goods
57 Other instruments
58 Miscellaneous manufacturing

Transportation
59 Railroads
60 Truck, highway pass transit
61 Water transport
62 Air transport
63 Pipeline
64 Transportation services

Utilities
65 Communications services
66 Electric utilities
67 Gas utilities
68 Water and sanitary services

Trade
69 Wholesale trade
70 Retail trade
71 Restaurants and bars

Finance & Real Estate
72 Finance & insurance
73 Real estate and royalties
74 Owner-occupied housing

Services
75 Hotels
76 Personal & repair services
77 Professional services
78 Computer & data processing
79 Advertising
80 Other business services
81 Automobile services
82 Movies & amusements
83 Private hospitals
84 Physicians
85 Other medical serv & dentists
86 Nursing homes
87 Education, social serv, NPO

Miscellaneous
88 Government enterprises
89 Non-competitive imports
90 Miscellaneous tiny flows
91 Scrap & used goods
92 Rest of the world industry
93 Government industry
94 Domestic servants
95 Inforum statistic discrepancy
96 NIPA statistical discrepancy
97 Chain weighting residual