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Five Alternatives that Make More Sense than Offshore Oil

Whitney Angell Leonard

By decreasing energy demand rather than increasing supply, energy alternatives could reduce or eliminate the need to expand offshore oil production.

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Contents

Acronyms

CAFE	Corporate Average Fuel Economy
DOE	Department of Energy
DOI	Department of the Interior
EIA	Energy Information Administration
GHG	Greenhouse gas
HEV	Hybrid-electric vehicle
MMS	Minerals Management Service
OCS	Outer Continental Shelf
OECM	Offshore Environmental Cost Model (used by MMS)
PHEVx	Plug-in hybrid-electric vehicle (x denotes the distance that a PHEV can travel on its electric charge alone)

Summary

Foreign oil currently fuels 55 percent of all transportation in the United States. As it struggles to reduce its dependence on foreign oil, the United States will have to completely rethink its energy policies. Instead of replacing imported oil with domestic oil, extracted at high environmental costs from new rigs offshore and across the western states, the country could opt for cleaner alternatives like higher fuel economy standards, hybrid-electric vehicles, plug-in hybrids, cellulosic ethanol, and new commuting patterns. By decreasing demand rather than increasing supply, energy alternatives could reduce or eliminate the need to expand offshore oil production. This paper explores the economic and environmental costs of offshore oil and investigates a range of cleaner energy options.

Key Findings:

- Using simplistic risk assessment models, official cost-benefit analyses consistently underestimate the risks and costs of offshore oil development.
- Increasing the fuel economy of conventional passenger vehicles is the single most effective and most cost-effective way to reduce petroleum consumption. Raising the average fuel economy of all cars in the United States from 23 to 35 mpg could reduce petroleum consumption by 1.2 billion barrels per year, and raising the average to 50 mpg could nearly double these savings. Since this is more than the total quantity of offshore oil predicted to be produced in 2030, increased fuel economy could reduce or even eliminate the need to expand offshore oil production.
- Hybrid-electric vehicles (HEVs) could also be a cost-effective means of reducing petroleum consumption on a large scale. If HEVs made up half of the vehicles on the road in 2030, the annual petroleum savings would similarly amount to 1.2 billion barrels. Again, this is more than the annual quantity of oil predicted to be produced offshore by 2030, so HEVs could have a major impact on the need for offshore drilling.
- Plug-in hybrids (PHEVs) may have a role to play in the future, but current cost and technology constraints make PHEVs a less attractive option than HEVs. Cellulosic ethanol likewise needs more work before it becomes commercially viable, but it might be a cost-effective and environmentally beneficial option in the next several years.

- Alternative commuting patterns, such as four-day workweeks and telecommuting, are a cost-effective way for some commuters to reduce their petroleum consumption, though the total petroleum savings may be modest compared to other clean transportation options.

Introduction

The United States consumes 20.7 million barrels of petroleum every day, adding up to a staggering 7.5 billion barrels per year. Of this, 58 percent comes from imports, making the United States the largest net oil importer in the world.[1] Because a large portion of this oil comes from the Middle East and other regions that are unstable or unfriendly to the United States, it is easy to see why concerns about energy insecurity resonate so strongly with many Americans.

The transportation sector accounts for nearly three quarters of all petroleum used in the United States, consuming 9.3 million barrels of gasoline every day, in addition to several million barrels of diesel and aviation fuel.[2] Indeed, 96 percent of the transportation sector is fueled by petroleum in some form.[3]

This means not only that the transportation sector in the United States is heavily dependent on imported oil, but also that transportation accounts for a large portion of our total greenhouse gas (GHG) emissions. In 2008, the transportation sector emitted one-third of total U.S. emissions, weighing in at 1.91 billion metric tons of GHGs per year.[4] Given that an overwhelming 98 percent of all transportation emissions come from petroleum, the transportation sector is an obvious place to look for ways to reduce our oil imports and our impact on the climate.

Not everybody agrees on the best way to reduce our dependence on foreign oil. While many people favor a reduction in oil consumption altogether, others prefer to decrease oil imports by replacing them with greater quantities of domestically produced oil. This raises the inevitable question of where this new domestic oil should come from. There are efforts to expand production in many locations across the country, but drilling in the Outer Continental Shelf (OCS) has been the subject of particular enthusiasm and has become something of a symbolic goal for those who believe the United States should "drill our way to energy independence." In recent years, amid highly volatile oil prices and more urgent calls to disentangle ourselves from foreign oil regimes, this renewed push for offshore drilling has reopened the decades-long debate over the complex costs, risks, and benefits of offshore oil.

History of Offshore Oil

Background

The battle over offshore oil dates back to 1969, when a massive oil spill off the coast of Santa Barbara, California sparked the first major public outcry against offshore drilling. The spill, which resulted from an underwater blowout at an offshore drilling rig, flowed virtually uncontained for the first eleven days and ultimately spilled three million gallons (70,000 barrels) of oil as it continued to seep out for several months. Over 650 square miles of ocean were covered by the resulting oil slick, affecting 155 miles of coastline as it drifted and slowly dispersed. All told, the spill killed 8,000 birds and an unknown number of dolphins, seals, and fish.

Residents of the affected area suddenly found their coastline blanketed with black oil and their coastal ecosystems devastated—along with the fisheries and recreation industries that depended on them. Beginning in local communities and gradually expanding outward, citizens launched an awareness campaign to publicize the hazards of offshore oil production. When it was discovered that the federal government had waived certain requirements for protective infrastructure on the rig where the blowout occurred, many people blamed the government for the disaster, calling for tighter safety regulations and better enforcement.[5, 6] Other subsequent rig blowouts and oil spills added fuel to the fire, and the movement spawned a growing consensus that the hazards of offshore drilling outweighed the benefits.

In 1982, campaigners against offshore oil won a congressional moratorium on offshore drilling in most of the OCS, as part of the annual funding bill for the Department of the Interior. The moratorium effectively closed large swaths of the OCS to oil and gas exploration by prohibiting the Minerals Management Service (MMS) from spending money to plan or conduct lease sales for these areas. In 1990, President George H. W. Bush added a presidential moratorium that overlapped most of the congressional moratorium, and in 1998 President Clinton extended this executive moratorium to 2012.[7]

These restrictions stayed in place for over two decades with relatively little controversy. But amid rising oil prices and increasing concern over our dependence on foreign oil, and fading memories of Santa Barbara and other offshore spills, some Americans have begun to see OCS drilling as a newly attractive option.

Supporters of offshore drilling argue that it is a catch-all solution to the simultaneous security and economic issues associated with foreign oil. Our country is now engaged in two wars in the tumultuous, oil-rich Middle East, and politicians on both sides of the aisle have highlighted the fact that some of the money we pay for imported oil ends up in the hands of terrorists. To cut off this inadvertent support for terrorism, many have argued, we should drill more at home to eliminate our oil imports from countries that fund terrorist groups. From an economic perspective, some proponents argue that tapping our domestic resources will lower the price of oil for American consumers, freeing them from the burden of high and variable fuel prices.

The growing public pressure to reconsider offshore drilling reached a tipping point in the summer of 2008, as oil climbed to unprecedented prices above $140 per barrel. President George W. Bush withdrew the presidential OCS moratorium on July 14, 2008, just three days after light sweet crude reached a record price of $147[8] per barrel, and he called on Congress to revoke its OCS drilling ban as well. Under intense public pressure, Congress allowed its ban to expire on October 1, 2008, potentially clearing the way for a new era of energy exploration.[9]

The MMS was already operating under a five-year plan that allowed oil and gas leasing in the areas exempted from the congressional ban, mostly in the Gulf of Mexico and Alaska. The plan covered the period from 2007–2012, but with so many newly opened OCS areas, the Bush administration was eager to accelerate the leasing process. It directed the MMS to draft a new five-year plan for 2010–2015, rather than wait for the current plan to expire in 2012. This new expanded program was published on January 16, 2009, just four days before President Bush left office.[10]

Outlook Under the Obama Administration

Immediately after taking office, the Obama administration made it clear that it intends to take a more careful and measured approach to energy development, although it will still likely consider offshore oil as an option. Obama's Secretary of the Interior Ken Salazar immediately put a hold on the new leasing plan and vowed to reinstate more cautious decision-making standards. He stressed that the Bush administration's last-minute plan had been drafted "with very limited information about the nature of offshore resources."[11] Salazar is now moving forward with much broader participation and more careful analysis: he extended the comment period and organized four regional meetings to seek more public and stakeholder input. He also ordered MMS to compile a report on the state of the existing information on U.S. offshore resources and follow with a plan for filling the existing data gaps.

A U.S. federal appeals court has since reaffirmed Salazar's assertion that parts of the Bush-era leasing plans lacked sound informational basis, declaring that even the earlier 2007–2012 leasing plan failed to consider the "relative environmental sensitivity" of all the relevant offshore areas. In its April 2009 decision, the court remanded the 2007–2012 leasing program to Secretary Salazar for reconsideration, in effect ordering the U.S. government to undertake a more extensive environmental analysis before publishing a new leasing plan.[12]

Secretary Salazar also directed his agency to complete the final rulemaking on offshore renewable energy, which had been stalled during the previous administration. The new rulemaking, officially issued on April 29, 2009, has now created a stable regulatory environment that will increase investment potential and will allow for the development of large-scale renewable energy projects offshore.

These early indications leave us with several key insights regarding the direction of U.S. energy development. Most importantly, both the court decision and Salazar's stated intentions make it clear that the Obama administration will strive to collect all available scientific information and widespread public input — most notably at a recent nationwide series of public forums on offshore energy — before making important energy policy decisions. But it is also clear that the administration has not taken any energy options off the table, and offshore oil is likely to be considered as the president's team works to develop a comprehensive energy plan.

The Risks and Costs of Offshore Oil

Inadequate Assessment Methods

The U.S. government regularly prepares an environmental impact statement assessing the impact of each five-year plan on offshore leasing areas, using a model called the Offshore Environmental Cost Model (OECM).[13] This model quantifies the expected costs and benefits, and the MMS uses this information to make sure that its leasing plans yield the highest possible net benefits.

To quantify expected costs, the model calculates damages according to categories of "cost drivers," which reflect the different aspects of the drilling and oil production process. It is relatively easy to generate reasonable estimates of the effects caused by infrastructure and other predictable elements of the process. Even so, the existing MMS analyses only considered effects on coastal areas and failed to consider impacts on the OCS itself. This failure is the basis for the District of Columbia Circuit Court of Appeals' decision to vacate the MMS 2007–2012 leasing plan on the grounds that that the plan did not adequately assess the "relative environmental sensitivity and marine productivity of different areas of the [OCS]."[14]

Oil spills, the other major cost driver, yield damages that are much harder to predict and so even harder to represent accurately in a simple quantitative model. The OECM uses an "expected value" approach to predict the average expected cost of oil spills per unit produced. Basing its analysis on nationally averaged historical oil spill data, the model essentially ignores the fact that average cost is an extremely imprecise measure of potentially catastrophic events like oil spills. The model also makes a blunt attempt to differentiate between spills of different sizes and types, but again these averages are a poor representation of the wide range of spills in each category. The Santa Barbara platform blowout and the Exxon-Valdez tanker accident, for instance, both spilled more than ten times the average volume for their respective categories.[15]

Ultimately, the model combines this cost-per-spill with nationally averaged spill probabilities to calculate an "expected value" metric for spills in each leasing area.[16, 17] The problem with this approach is that it relies on probability to calculate the *expected* value of damages and therefore undervalues the risk of rare—*unexpected*—events like huge catastrophic oil spills. By multiplying spill damages by the probability of each spill, the simple expected value approach treats high-probability, low-consequence events as commensurate with low-probability, high-consequence events.[18] So a small oil spill that is relatively likely but will cause little damage has the same expected value as an unlikely spill that will cause catastrophic damages if it does occur. This is a poor representation of true damages, since these two events have very different effects, which have very different implications for risk management policies. Furthermore, simple expected value is a particularly poor estimate in the case of oil spills, since (as even the OECM notes) damages increase nonlinearly with spill size.[19]

Accurate Assessment of Risk and Costs

The potential for rare but catastrophic spills is poorly represented in the government's current cost-benefit modeling, but there are other, better ways to represent risk. Haimes (2004) proposes a more accurate conditional modeling approach, one which would incorporate the relatively rare but devastating costs of huge spills like the Santa Barbara and Exxon-Valdez disasters. The government's model considers only "average" events, which are ten times smaller than these disasters, and thus fails to quantify risks accurately.

Given that large spills can have catastrophic effects, this risk may be unacceptable for many stakeholders and some policy makers. The question that sober analysts must ask is whether there are some catastrophes that must be avoided at all costs, no matter how unlikely they are.

The philosophy of avoiding unacceptable risks has long dictated the construction of dams, bridges, and other necessary structures whose failure would be catastrophic, and the formal literature on risk management increasingly supports this approach.[20] Policy makers now have the chance to apply this risk management philosophy to offshore oil development. If they begin to see devastating oil spills like Santa Barbara and Exxon-Valdez as an unacceptable catastrophic risk, policy makers can protect citizens' safety and economic interests by declining to allow expanded drilling on the OCS.

Moreover, the argument that we need offshore oil to protect Americans against skyrocketing oil prices is unfounded. Contrary to popular belief, opening new areas of the OCS to offshore drilling will do little to lower gas prices for consumers.

Quantitative estimates of OCS resources have varied widely and are currently based on decades-old data. While the MMS estimates that there are 115 billion barrels of oil and 634 trillion cubic feet of gas available in the OCS areas, only 25 percent of these oil resources are actually in proven reserves. The other 75 percent are listed as "undiscovered resources." Essentially, no one really knows how much oil is available. In addition, not all of the technically recoverable oil will prove to be economically recoverable, so the quantity of realistically available resources is subject to even greater uncertainty.

Gas prices are determined in large part by the price of oil on the world market, and, according to experts in the U.S. Energy Information Administration, newly authorized offshore areas would not produce enough oil to have a significant impact on oil prices in the world market.[21] Even by 2030, estimates of new production capacity on the U.S. outer continental shelf range from less than 1 percent to 1.3 percent of global daily production, or about 1.4 million barrels per day compared to the 105 million barrels produced worldwide each day.[22, 23] At best, offshore drilling would supply far too little oil to reduce U.S. oil dependence or to bring down oil prices for consumers.

Finally, the offshore drilling risks typically considered do not account for the environmental and societal cost of the downstream emissions associated with oil consumption. There is a wide range of estimates of the true cost of carbon, but it is indisputable that carbon dioxide (CO_2) released into the atmosphere causes damage that inflicts serious costs on the global society. Because emissions trading schemes are heavily influenced by regulatory environments and auction conditions, the full societal cost of global warming is actually much higher than these prices indicate; rigorous analyses such as the Stern Review show that the true cost to society may be around $85 per metric ton of CO_2.[24]

The United States is the second largest greenhouse gas emitter in the world, and fully 42 percent of our emissions — 2.5 billion metric tons per year — come from petroleum consumption.[25] This means that petroleum use in the United States annually causes billions of dollars of damages, some of which are already affecting our society, and some of which will affect us more in the coming years. If we attempt to replace our imported oil with domestic offshore oil, we will continue to add to the societal damages caused by carbon emissions. As the MMS evaluates petroleum exploration and development projects, it could consider incorporating the cost of downstream emissions into the total costs and benefits of each project. At the true societal cost of $85 per ton, CO_2 emissions would add $35 to the true cost (though not necessarily the price) of each barrel of oil produced, making offshore drilling a much less attractive option for our society. Even at the far lower $30 per ton seen in some carbon markets, CO_2 emissions could still add more than $12 to the true cost of each barrel.

Offshore oil is not the only energy source that emits carbon, of course, and shunning offshore oil in favor of carbon-intensive fuels like liquefied coal would be even more environmentally damaging. But the risk of climate change helps to explain why, in looking to reduce U.S. dependence on foreign oil, we should take advantage of this opportunity to replace foreign oil with clean energy rather than with domestic offshore oil.

Clean Alternatives to Offshore Oil

There is already a wide range of alternatives that are both cheaper and cleaner than offshore oil. The best options are ones that would begin to wean the transportation sector off oil by increasing fuel efficiency and reducing the amount of fuel needed. Both increasing the fuel economy of conventional cars and also putting more hybrid-electric vehicles (HEVs) on the road will play an important role in achieving this objective. Other technologies can reduce petroleum consumption and emissions by replacing gasoline with cleaner or more efficient fuels, including cellulosic ethanol and plug-in hybrids running on clean electricity. Finally, behavioral shifts such as four-day workweeks, telecommuting, and greater use of public transportation could also reduce transportation emissions if employers and commuters prove willing to adopt these practices. It should be noted that smart growth planning and compact development, though beyond the scope of this paper, can also significantly reduce petroleum consumption by decreasing average commute distance.

Conventional Vehicle Fuel Economy

The easiest and cheapest way to reduce transportation fuel consumption is simply to increase the efficiency of conventionally fueled passenger vehicles. The average fuel economy of U.S. passenger vehicles currently hovers around 23 miles per gallon (mpg),[26] among the lowest in the developed world. With 231 million cars and light trucks on the road today,[27] increasing average fuel economy to 35 mpg—to reach the standard now mandated for 2016—could reduce petroleum consumption by 1.2 billion barrels per year.[28] Easily achievable with existing technology, this change would reduce U.S. gasoline consumption by 35 percent and total U.S. petroleum consumption by over 15 percent, equivalent to taking 84 million cars off the road for an entire year (see Table 1).

These relatively simple changes would do more to reduce our dependence on foreign oil than would new offshore drilling, as the petroleum savings from improved fuel economy surpass the amount of oil we could obtain by expanding offshore drilling. Annual offshore oil production is predicted to increase by 514 million barrels by 2030, less than half of the 1.2 billion barrels that could be saved through fuel efficiency. Even including already existing capacity, total offshore oil production in 2030 falls just short of the quantity of petroleum that could be saved through the 35 mpg standard now mandated for 2016.[29]

Improving fuel economy is also the cheapest option for American consumers. Even at a modest $40 per barrel, the petroleum savings associated with a 35 mpg fuel economy standard would translate into annual gas savings worth $48 billion for American consumers. At the higher prices of $130 per barrel predicted in the long run,[30] these fuel savings would add up to $156 billion per year. Fuel-efficient vehicles would lessen the strain on consumers' pockets by reducing the amount of gas they have to purchase over the course of a year, whereas new sources of offshore oil would do little to help consumers at the pump.

Reducing petroleum consumption through greater fuel efficiency would also benefit the climate by reducing CO_2 emissions. A fuel economy standard of 35 mpg could reduce U.S. emissions by 532 million metric tons, or 27 percent of total transportation emissions.[31]

The government's main tool for improving fuel efficiency has traditionally been the Corporate Average Fuel Economy (CAFE) standard, initially introduced in 1975 as part of a short-lived attempt to increase the country's energy efficiency in multiple sectors. The policy initially brought major gains in fuel economy, but these improvements ended in the late 1980s and were followed by years of stagnation, finally giving way to small increases in light truck standards after 2000. In 2007 Congress raised the CAFE standard from 27.5 mpg for cars and 22.2 mpg for light trucks to 35 mpg for cars and light trucks combined, but the full mandate was not set to take effect until 2020.[32, 33] It is also important to note that the CAFE rating system gives cars a higher fuel economy rating than the EPA rating that is listed on new car labels, so the actual fuel efficiency gains through the CAFE system are about 20 percent smaller than they appear.

President Obama announced in May 2009 a new federal fuel efficiency policy that mandates an average fuel economy standard of 35.5 mpg by 2016, four years earlier than the latest legislation passed by Congress. The policy is projected to save 1.8 billion barrels of oil over the lifetime of the cars purchased during the program's five-year span, increasing U.S. national security and shrinking U.S. emissions. The new fuel-efficient cars will, on balance, save consumers an average of $2,800 over the lifetime of each vehicle.[34]

Yet this policy lasts for just five years and does not set long-term targets. To build on this policy, Congress could enact increasingly strict standards that would take effect after the President's program ends in 2016.

Even raising the standard to 50 mpg for a second phase of the program would not be out of the question. Passenger vehicles in Europe have already reached an average of nearly 45 mpg, and even China's young automobile market has an average of around 37 mpg.[35] As Table 1 shows, an average fuel economy of 50 mpg would save 1.9 billion barrels of oil, which is nearly twice the quantity of total offshore oil predicted for 2030, and nearly four times the predicted quantity of *new* offshore production by that date. A fuel economy standard of 50 mpg could also save $76 to $248 billion for American consumers, as well as cut emissions by 846 million metric tons per year.

Raising fuel economy standards could therefore reduce our dependence on foreign oil far more than drilling for more offshore oil would, and it would be much cheaper. More ambitious fuel economy legislation in the United States would ensure that our country continues on the path toward increased efficiency, which is the most cost-effective way to improve our energy security as well as our economic and environmental security.

Table 1. Benefits From Increased Fuel Economy: Annual Gains Compared to Current Average Fuel Economy

	CO_2 Abated (metric tons)		Gas Saved		$ Savings (at $40–$130/bbl)	
	35 mpg	50 mpg	35 mpg	50 mpg	35 mpg	50 mpg
Benefits per car	2.3	3.7	218 gal	347 gal	$208–$675	$330–$1073
Total benefits: today's passenger vehicle fleet	532 million	846 million	1.2 billion barrels	1.9 billion barrels	$48–$156 billion	$76–$248 billion
Growth in offshore oil production, 2008–2030			*514 million barrels*			
Total offshore oil production, 2030			*1.1 billion barrels*			

Source: Calculations based on simulation using Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, Version 1.8.b, Argonne National Laboratory.

Hybrid-Electric Vehicles (HEVs)

Hybrid-electric vehicles also offer enormous potential for cost-effective fuel savings. Since its commercial debut in 1999, hybrid technology has gradually improved in efficiency and decreased in cost, so that the latest models have already attained ratings of 45–50 mpg[36] with a relatively modest price premium of $3,000.[37]

Even studies with relatively conservative assumptions regarding HEV fuel economy find that HEVs provide huge potential for fuel savings and emissions reductions. A cost-benefit analysis by the National Renewable Energy Laboratory, for instance, estimates that HEVs use 25 percent less gasoline than current conventional vehicles, saving an average of 165 gallons per vehicle per year. Moreover, absolute fuel savings are rising as the average fuel economy of HEVs improves. HEVs that get 50 mpg, like the latest Toyota Prius model, can save around 350 gallons of gasoline per vehicle each year. With 39 million

HEVs predicted to be on the road in 2030,[38] hybrids across the nation could save nearly 320 million barrels of oil each year, compared to today's conventional vehicles (see Table 2).[39] These fuel savings add up to more than half the predicted offshore production growth by 2030, significantly decreasing the need to tap new offshore resources.

Furthermore, studies show that the right mix of policy measures could help the HEV market exceed these estimates in both scale and pace. If HEVs one day achieved a 50 percent market share, they would save 1.2 billion barrels of oil each year — fully 16 percent of total national oil consumption and more than the total quantity of offshore oil predicted to be produced in 2030. This is equivalent to more than twice the quantity of new offshore production predicted for 2030, thereby reducing the need for new offshore drilling and providing a cost-effective option that would benefit consumers more than offshore oil would.

At the $4 per gallon price seen in the summer of 2008, annual fuel savings could reach $1,130 per vehicle, even accounting for the annualized price premium of an HEV. At a much more modest $2 per gallon, annual fuel savings would still amount to around $440 net. With such large fuel savings, consumers would recover the initial hybrid price premium in three to seven years, respectively. Nationwide, at $130 per barrel (as predicted by the Energy Information Administration for 2030[40]), these fuel savings could translate into $32 billion of annual net savings for American consumers, even accounting for the annualized initial price premium. If HEVs one day attained a 50 percent market share, annual net savings could reach $160 billion, depending on global oil prices. Expanded offshore drilling, meanwhile, would do little if anything to reduce consumers' fuel costs.

On the emissions side, even conservative HEV fuel economy assumptions of just under 35 mpg would result in annual emissions reductions of over 30 percent, or more than 2 metric tons of CO_2 per vehicle per year, compared to today's conventional vehicles. By 2030, the predicted 39 million HEVs could result in 87 million metric tons of abated emissions. Furthermore, HEVs could nearly double these emissions reductions if they all attained a higher fuel economy, on par with today's 50 mpg models, annually saving 54 percent or 3.7 metric tons per car. With 39 million HEVs achieving an average of 50 mpg, these cars would save an impressive 144 million metric tons of emissions every year; with a 50 percent market share (148 million vehicles), abated CO_2 emissions could total 555 million metric tons per year.

Hybrid vehicles clearly have the potential to create huge fuel and emissions savings, and they are a much cleaner and more cost-effective option than offshore drilling. A range of policy mechanisms — including, again, strict fuel economy mandates — could help HEVs reach their full market potential and achieve the economic and environmental benefits that are within reach.

Table 2. Benefits From Hybrid-Electric Vehicles (50 mpg): Annual Gains Compared to Conventional Vehicles With Current Average Fuel Economy

	CO_2 Abated (metric tons)	Gas Saved	$ Savings* at $40–$130/bbl
Benefits per car	3.7	347 gal	$74–$817
Total benefits: today's fleet (1.6 million HEVs)	6.0 million	13.2 million barrels	$0.1–$1.3 billion
Total benefits: 2030 projected fleet (39 million HEVs)	144 million	319 million barrels	$2.9–$32 billion
Total benefits: 50% market share, 2030 (150 million HEVs)	555 million	1.2 billion barrels	$11–$121 billion
Growth in offshore oil production, 2008–2030		*514 million barrels*	
Total offshore oil production, 2030		*1.1 billion barrels*	

* Amount saved on gas, accounting for annualized price premium for vehicle

Source: Calculations based on simulation using Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, Version 1.8.b, Argonne National Laboratory.

Plug-In Hybrid-Electric Vehicles (PHEVs)

Plug-in hybrid technology has the potential to reduce petroleum consumption even further by replacing gasoline with electricity, drawing much of its power from the electric grid rather than from a gasoline-powered engine.

Plug-in hybrids using today's technology can save 350 gallons of gasoline each year compared to conventional vehicles, roughly 50 percent greater than the petroleum savings achieved by comparable HEVs (see Table 3). If PHEV technology improved so that engine efficiency (when not running on electricity) matched the best HEVs at 50 mpg, petroleum savings would rise another 25 percent to 444 gallons per year.[41] Based on the EIA's prediction of 4.3 million PHEVs nationwide by 2030, these fuel savings translate into 45 million barrels of oil saved each year.

While these savings are not insignificant, they appear relatively low compared to the amount of new offshore oil production predicted by 2030. This discrepancy results primarily from the fact that current trends predict the PHEV market will expand relatively slowly, but some studies anticipate a changing policy environment and a much larger role for PHEVs. If PHEVs eventually accounted for 50 percent of the total vehicle stock, these 150 million vehicles could save 1.6 billion barrels of oil per year—about 30 percent more than the same number of HEVs.[42] This is 1.5 times the total offshore production capacity predicted by 2030, and fully three times the predicted quantity of *new* offshore production by that date.

The most difficult hurdle for PHEVs is not that they lack the potential to reduce petroleum consumption; it is that the technology—particularly battery technology—is still extremely expensive. With current battery technologies, the price premium for a PHEV40[43] is about $11,000 more than a comparable conventionally fueled vehicle.[44] This price tag is too high to be cost-effective for consumers, as the additional cost outweighs the fuel savings over the vehicle's fifteen-year lifespan. In addition, electricity costs of around $375 per year cut into annual savings.

As battery prices fall and fuel prices rise in the long run, some studies predict that the payback period could fall to 7–12 years, making PHEVs somewhat more attractive to consumers even in the absence of any policy changes.[45,46] The economic stimulus legislation passed in February 2009 allocated $2 billion for advanced battery development in hopes of bringing down costs[47] and instated a tax credit of up to $7,500 for PHEVs.[48] If declining battery costs could bring the price premium down to $5,500—half its current level, in line with DOE's goal for 2012—gas prices as low as $45 per barrel would be enough for most PHEV owners to save money over the lifetime of the car.

The final obvious question is whether PHEVs can achieve environmental benefits in an economically viable way. The emissions associated with PHEVs depend on the mix of power sources feeding into the electric grid, meaning that the ultimate environmental benefit of PHEVs depends on our ability to clean the grid nationwide.

The national electric grid currently depends heavily on coal, particularly for baseload power, which means that most PHEVs would be using a high proportion of coal-fired power when charging overnight. Under current conditions, the average plug-in hybrid on the national grid would emit about 5 percent more CO_2 than a regular HEV (see Table 3).[49] PHEVs still emit almost 30 percent less than conventional vehicles, but at this point most of these gains come from the hybrid technology, not from replacing petroleum with grid electricity. In places like California where the electricity mix is just 15 percent coal, PHEVs can reduce emissions up to 40 percent compared to conventional vehicles and 10 to 20 percent compared to HEVs.[50] This shows that plug-in hybrids do have the potential to create significant reductions in fuel use and CO_2 emissions, but the national grid is a long way from matching the emissions profile of the California grid.

The economic feasibility of cleaning the grid is increasingly promising, but a number of technical and economic hurdles remain. Large-scale wind power is starting to approach grid parity in many areas, and the pending federal cap-and-trade legislation could decrease the price of wind and other renewables relative to fossil fuels. Wind is already cheaper than some traditional sources like nuclear power, and it is cheaper than carbon sequestration technology for coal plants.[51] Yet these optimistic cost estimates include only the cost of wind power capacity itself; they do not include the cost of building new transmission lines or back-up capacity, which is necessary for ensuring power supply when the wind is not blowing. Because the grid must provide a reliable supply of electricity, the intermittency of wind—and some other renewables like solar—will necessarily constrain its penetration in the electric system. Researchers have been working for years on developing electric storage capacity on a scale that will enable greater reliance on wind and solar in the national grid, but they have not yet achieved the necessary technological breakthrough. Until better storage capacity exists, the makeup of the national grid is unlikely to change dramatically, and without a major change in grid composition, PHEVs will provide little environmental benefit.

But even with existing technological limitations, beginning to move toward renewables can lay the groundwork for the greener grid that may be possible in the future. While there will be significant costs and challenges associated with increased wind power penetration, existing technologies may allow wind power to increase its share to 20 percent over the next several decades.[52] Secretary Salazar recognizes this potential and has made renewable energy—particularly offshore wind energy—one of the highlights of DOI's energy plan. Among other measures, the secretary created a new energy and climate task force to investigate possible opportunities for onshore and offshore renewable energy development across the country. This task force would do well to incorporate a wide range of renewables in its investigation, recognizing that even our vast offshore wind resources cannot power the majority of the U.S. grid until better electric storage technology exists.

For a clean grid, and thus for PHEVs, the key lies in creating a broad portfolio of renewables and other sources of relatively clean electricity. Geothermal power, for instance, is a cost competitive and increasingly viable option.[53, 54] While solar power is still significantly more expensive than fossil fuels, the prices of thin-film solar and solar thermal technologies are falling quickly. Moreover, solar power and small-scale renewables can often be installed right where the power is needed, which eliminates transmission costs and thereby reduces the overall cost of power. Natural gas can serve as an important "transition fuel" in the meantime, reducing U.S. emissions during the time it takes to develop the technology that would allow for a greater share of renewables.

With the right mix of clean and cost-competitive options, it may someday be possible to clean the grid to the point where PHEVs nationwide achieve the emissions benefits currently possible in California. At that point, PHEVs will provide not only petroleum savings but also environmental benefits above and beyond the benefits of regular HEVs. Until then, however, the main environmental benefit of a PHEV will continue to come from its efficient hybrid power train rather than its use of grid electricity.

Table 3. Benefits From Plug-In Hybrid-Electric Vehicles on California Grid (50 mpg): Annual Gains Compared to Conventional Vehicles With Current Average Fuel Economy

	CO_2 Abated (metric tons)	Gas Saved	$ Savings (or Cost)* at $40–$130/bbl
Benefits per car	3.7	444 gal	($891)–$60
Total benefits: 2030 projected fleet (4.3 million PHEVs)	15.7 million	45.2 million barrels	($3.8)–$0.3 billion
Total benefits: 50% market share, 2030 (150 million PHEVs)	544 million	1.6 billion barrels	($132)–$8.9 billion
Growth in offshore oil production, 2008–2030		*514 million barrels*	
Total offshore oil production, 2030		*1.1 billion barrels*	

* Amount saved on gas, net of electricity cost and annualized price premium for vehicle

Source: Calculations based on simulation using Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, Version 1.8.b, Argonne National Laboratory.

Cellulosic Ethanol

Ethanol, the subject of long and heated debate, is another petroleum replacement option whose environmental benefits depend heavily on its production source. Ethanol manufactured from corn not only uses our farmland inefficiently but also provides tenuous environmental benefits at best. According to optimistic models, the full lifecycle emissions from corn-grain ethanol are just 7 percent lower than emissions from gasoline,[55] whereas many studies show that the production process is so energy intensive that net emissions may actually be higher than net emissions from gasoline.

On the other hand, cellulosic ethanol produced from the fiber of plants like switchgrass has the potential to reduce emissions 87–94 percent compared to gasoline (see Table 4).[56, 57] Production technology for cellulosic ethanol is expected to be commercially available by 2010, and the EIA baseline scenario predicts that annual production may reach 5.1 to 5.6 billion gallons (133 million barrels) by 2030.[58, 59] This would directly displace an equivalent amount of gasoline, equal to 25 percent of new offshore oil production by 2030. High-production scenarios from the EIA predict nearly twice this quantity, estimating annual cellulosic ethanol production at 10.1 billion gallons (240 million barrels). Cellulosic ethanol production in this scenario would amount to just less than half the new offshore oil production capacity.

Cellulosic ethanol would be cheaper than offshore oil, making it an attractive option even if it is not a silver bullet that can fully eliminate U.S. dependence on oil. Baseline EIA estimates for 2030 show that a gallon of ethanol (E85 blend) would be approximately $1 cheaper than a gallon of conventional gasoline,[60] which could save consumers $5.8–$10.5 billion annually. Cellulosic ethanol could therefore play an important role in reducing the need to expand offshore drilling, while also abating emissions and reducing the price consumers pay at the pump.

Table 4. Benefits From Cellulosic Ethanol: Annual Gains Compared to Gasoline

	CO_2 abated (metric tons)	Gas Saved	$ Savings
Benefits per gallon	87–94%	0.85 gal gasoline per gal of E85	$1/gal
Total benefits: 133 million barrels (2030)	44.8 million	133 million barrels	$5.6 billion
Total benefits: 240 million barrels (2030, high)	80.8 million	240 million barrels	$10.1 billion
Growth in offshore oil production, 2008–2030		*514 million barrels*	
Total offshore oil production, 2030		*1.1 billion barrels*	

Source: Calculations based on M. R. Schmer, K. P. Vogel, R. B. Mitchell, and R. K. Perrin. "Net Energy of Cellulosic Ethanol From Switchgrass." Proceedings of the National Academy of Sciences, vol. 105, no. 2 (2008), pp. 464–469.

Alternative Commuting Patterns

Behavioral shifts, such as alternative commuting schedules, can also reduce the country's reliance on petroleum. Commuter travel currently accounts for 35 percent of total miles traveled,[61] which means that new commuting patterns cannot solve our energy dilemmas singlehandedly, but they can have a positive impact at a very low cost. The workers who would most likely switch to telecommuting or a four-day workweek are those who could do so without significant productivity loss, making these options very cost effective. Moreover, these alternative commuting patterns reduce congestion, which benefits all the drivers on the road. It has been estimated that traffic delays are reduced by 10 percent for every 3 percent of commuters who stay home one day a week, ultimately saving everyone more time, fuel, and money.[62]

Some employers have already begun to implement a four-day workweek, consisting of four ten-hour days rather than five eight-hour days. At essentially no additional cost, this alternative schedule can reduce each driver's commute-related fuel consumption by 20 percent, or about 7 percent of total fuel consumption (including both commute and non-commute travel). While not all workers have the flexibility to switch to a four-day workweek, a basic sectoral breakdown of the American workforce shows that approximately 45 percent of American workers are employed in sectors where a five-day workweek is not inherently necessary.[63] Therefore with increased employer support, particularly likely as this alternative schedule becomes more mainstream, many of these workers could take advantage of an optional four-day workweek.

If even half of eligible workers switched to a four-day workweek, they could collectively save 54 million barrels of oil and abate 31 million metric tons of CO_2 (see Table 5). These petroleum savings are equivalent to just a small fraction of the predicted growth in offshore oil production, but, unlike offshore oil, they come at essentially no cost to American consumers. A shift to four-day workweeks could therefore save $41 to $134 per commuter, or $2 billion to $7 billion nationwide each year (assuming oil prices range from $40 to $130 per barrel).

Telecommuting, also known as telework, has begun to gain popularity in some areas too. For example, surveys of the Washington, D.C. metropolitan region have shown increasing rates of telecommuting over the past decade, with 19 percent of respondents reporting that they telecommuted at least occasionally in 2007, a nearly 50 percent increase from 2004. Furthermore, another 24 percent of respondents said the nature of their job permits telecommuting and they would like to telecommute (on a regular or occasional basis) if their employer offered them the opportunity.[64] While this shift in the D.C. area does not necessarily reflect a national trend, it does indicate that telecommuting is a rising possibility.

The benefits of telecommuting are potentially even greater than the benefits of a four-day workweek, because participants can telecommute more than one day a week and thus save more fuel. If approximately 20 percent of American workers telecommuted three days a week—comparable to the proportion of telecommuters in the D.C. area—they could save 149 million barrels of oil and 84 million metric tons of CO_2 emissions each year (see Table 5). Gas savings could total $6 billion to $19 billion for these telecommuters, not counting the additional gas savings from reduced traffic congestion among other commuters. While not all jobs allow for the possibility of telecommuting, improved technology is making telework an increasingly easy and cost-effective option.

As with four-day workweeks, the petroleum savings from telecommuting are relatively small compared to the quantity of available offshore oil, but here again the low cost makes telecommuting an attractive option for some commuters. Among the many energy options that are cheaper and cleaner than offshore oil, these alternative commuting patterns can form part of a broad portfolio of changes, which could collectively make significant gains in reducing emissions and reducing the need for more offshore drilling.

Table 5. Benefits From Alternative Commuting Patterns: Annual Gains Compared to Conventional Commuting

	CO_2 Abated (metric tons)		Gas Saved		$ Savings (at $40–$130/bbl)	
	4-day workweek	Telework 3 days/wk	4-day workweek	Telework 3 days/wk	4-day workweek	Telework 3 days/wk
Benefits per car	0.6	1.7	43 gal	130 gal	$41–$134	$123–401
Total benefits: 50% of eligible participants*	31 million	42 million	54 million barrels	74 million barrels	$2–$7 billion	$3–$10 billion
Total benefits: all eligible participants*	61 million	84 million	109 million barrels	149 million barrels	$4–$14 billion	$6–$19 billion
Growth in offshore oil production, 2008–2030			*514 million barrels*			
Total offshore oil production, 2030			*1.1 billion barrels*			

* Based on sectoral breakdown of workforce

Source: Calculations based on U.S. Department of Labor, Bureau of Labor Statistics, "News Release: Occupational Employment and Wages, 2007 (reissue)," February, 2009, http://www.bls.gov/oes/.

Table 6. Summary of Annual Benefits From Clean Alternatives

	Total CO_2 Reduction (million metric tons)		Total Petroleum Reduction (million barrels)		Total Savings (or Cost) ($billion)	
	High	Low	High	Low	High	Low
Fuel efficiency*	846	347	1900	806	248	32
HEVs	555	87	1200	200	121	(1.9)
PHEVs	544	8.6	1600	36	79	(145)
Cellulosic ethanol	81	45	240	133	10	5.6
Commuting alternatives	84	31	148	54	19	4
Growth in offshore oil production 2008–2030			*514*			
Total offshore oil production, 2030			*1100*			

* Fuel efficiency scenario represents increased fuel efficiency in conventional passenger vehicles

Note: These figures represent the highest and lowest results of the scenarios presented in the preceding individual analyses.

Conclusion

The United States currently faces a dizzying array of energy options. As shown, some options are clearly better than others, from an environmental and an economic standpoint. Consuming imported oil puts U.S. national security at risk, but replacing foreign oil with domestic offshore oil is not the answer to this problem. Continuing to depend on large volumes of petroleum imperils our climate, with enormous consequences for our society.

Offshore oil in particular bears its own additional set of environmental costs. Learning from past catastrophes and using modern risk analysis methods, it is clear that offshore drilling is environmentally dangerous and costly, not only in the production process but also through downstream emissions. Furthermore, our offshore oil reserves are too small to have a significant effect on world oil prices and would provide little economic benefit to consumers. Offshore drilling, therefore, is not the best solution to our energy dilemma.

Instead, we have an ample number of cheaper, cleaner—better—alternatives. Highly fuel-efficient conventional vehicles and hybrid-electric vehicles provide huge economic and environmental benefits, and they are already commercially available on a large scale. These options are not only cheaper than offshore oil but also have the potential to reduce our dependence on foreign oil by a greater margin. As fuel efficiency and hybrid-electric technologies continue to improve, and as their markets continue to expand, they have the potential to deliver ever greater benefits to consumers and society as a whole. With the right mix of policies and regulations, the government could hasten this process and create even larger gains.

Other technologies, such as plug-in hybrids and cellulosic ethanol production, are not yet commercially available but have the potential to yield large benefits in the future. The government or private investors could consider providing support to push these technologies toward commercial viability, but this must be done with careful attention to the environmental impacts of all steps in the process. The PHEV market should expand only in tandem with an increasingly clean mix of electricity in the national grid—which may take years to be a viable option—and the ethanol market should expand only with the production of cellulosic rather than corn-grain ethanol.

The first step toward weaning our nation off petroleum is to take full advantage of the efficient technologies we already have. We can then supplement these with more advanced technologies to maximize our long-term environmental, economic, and security gains.

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