American Council for an Energy-Efficient Economy
529 14th Street, N. W., Suite 600 Washington, D.C. 20045 202.507.4000 202.429.2248 www.aceee.org

Oil Savings Literature Review

Introduction

With the tabling of climate legislation and increased discomfort with oil dependence in recent months, lawmakers' interest in energy legislation, and petroleum legislation in particular, is high once again. Recently, analysts, advocates, and policymakers have made estimates of how much oil consumption could be reduced in the next two decades, and bills have been introduced (e.g., Senator Merkley's *Oil Independence Act of 2010*) that reflect those estimates.

This paper reviews those recent oil savings analyses. It contains a summary of what they do and do not contain, and why they may arrive at different conclusions.

Review of Recent Oil Savings Studies

This literature review focuses on oil savings studies or advocacy materials from:

- major environmental groups—Natural Resources Defense Council (NRDC), Pew Center for Global Climate Change, and Union of Concerned Scientists (UCS) (both the *Blueprint 2030* report and the "National Oil Savings Plan" fact sheet
- energy independence groups—Securing America's Future Energy (SAFE)
- energy policy groups—Resources for the Future/National Energy Policy Institute (RFF/NEPI), Center for American Progress (CAP)
- federal agency reviews—Environmental Protection Agency (EPA) and Department of Transportation (DOT)
- the most recent National Petroleum Council study (NPC)
- a study on overall energy efficiency potential from the National Academy of Sciences (NAS);
- legislative plans from Senator Merkley (D-OR) and Senator Lugar (R-IN)
- a 2006 ACEEE study (E061) and a 2004 RMI study

The survey also included interviews with the leads on a number of these studies to get their sense of the landscape of petroleum efficiency research and advocacy. We limited the temporal scope to 2006–2010. This review focused on work done since ACEEE's E061 study of non-light-duty oil reduction strategies in January 2006. We chose 2030 as the year of comparison, as it is far enough in the future to show the effects of major policy shifts, but near enough to allow plausible projections of oil consumption and savings.

To assess these studies, we catalogued which sectors and sub-sectors the studies addressed, and which major policy options the studies addressed. A "comprehensive" study of oil savings opportunities might be defined as one which:

- addressed all major sectors of petroleum use, and all major policy options/measures;
- contained cost estimates; and
- included assessments based upon political feasibility.

By these measures, there was no one "comprehensive" study. The UCS "National Oil Savings Plan" fact sheet came closest to addressing all sectors and providing estimates by sector. However, it was not a robust study, but a brief, albeit informative, fact sheet. RFF/NEPI provided the best assessments of the costs of policy proposals, but they were focused on comparing policies to each other, not on an overall goal of reducing oil use. Similarly, ACEEE's E061 contained good cost estimates for the sectors it addressed but it is an older study, and in particular predates the CAFE provisions of EISA. RMI was more comprehensive than most of the other studies, and contained both technical recommendations and cost-effectiveness assessments, but is an older study. The Merkley plan, CAP proposals, and Lugar plan addressed all sectors (except the Merkley plan did not address the industrial sector), but these were essentially legislative proposals, not analyses. They did not contain cost estimates, although they did address political feasibility in some sense, as they were designed as policy documents. The NPC study focused on the technical potential in each sector, and recommended some policies, but did not contain estimates of cost-effectiveness, and in general was less ambitious in scope than other studies. The NAS study and SAFE study each had some oil savings estimates, but not on a consistent baseline, and the SAFE study had a focus on oil independence rather than oil use reduction. The EPA, DOT, and Pew Center on Global Climate Change studies were focused only on the transportation sector, and on specific policies to drive greenhouse gas (GHG) reductions.

Sectors

The major sectors considered in the studies reviewed include the Transportation sector (including light-duty, heavy-duty, air, rail, off-road, and marine transport), the Residential/Commercial sectors, and the Industrial sector (including manufacturing, construction, agriculture, and mining). "Including" or "addressing" a sector ranged in scope from specific proposals regarding energy efficiency, to policy recommendations, to basic descriptions of the sector's oil use. These differences in the depth of analysis reflect differences in the scope and type of documents reviewed. Figure 1 below catalogues which studies covered a given sector.

Figure 1. Sectoral Analysis of Oil Savings Studies

Sector	Pew, 2011	Lugar Plan - 06/10	Merkley Plan - 06/10	CAP, 06/10 (a,b)	RFF/ NEPI, 06/10	NAS - 2010	DOT - 04/10	EPA - 03/10	NRDC , 01/09	UCS - 05/09	UCS - 08/10	NPC, 2007	SAFE, 09/08	ACEEE E061, 2006
Transportation	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Light-Duty Vehicles	y	y	y	y	n	y	y	y	y	y	y	y	y	y
Heavy-Duty Vehicles/Freight	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Air/ Marine Transport/Off-Road	y	n	y	y	n	y	y	y	y	y	y	y	y	y
Residential/Commercial	n	y	y	y	y	n	n	n	y	n	y	y	n	y
Industrial	n	y	n	n	n	n	n	n	n	n	y	y	n	y
Manufacturing	n	y	n	n	n	n	n	n	n	n	y	n	n	y
Construction	n	n	n	n	n	n	n	n	n	n	y	n	n	y
Mining	n	n	n	n	n	n	n	n	n	n	y	n	n	y
Agriculture	n	n	n	n	n	n	n	n	n	n	y	n	n	y

All of the studies reviewed addressed at least a portion of the Transportation sector. All included light-duty vehicles and heavy-duty vehicles in some way, and all but two studies addressed the air, marine, and rail subsectors. Only three studies (ACEEE's E061, the NAS report and the National Petroleum Council report) and the UCS fact sheet addressed the Industrial sector. The Residential/Commercial buildings sector was addressed by eight of the thirteen studies.

Estimates of Oil Use

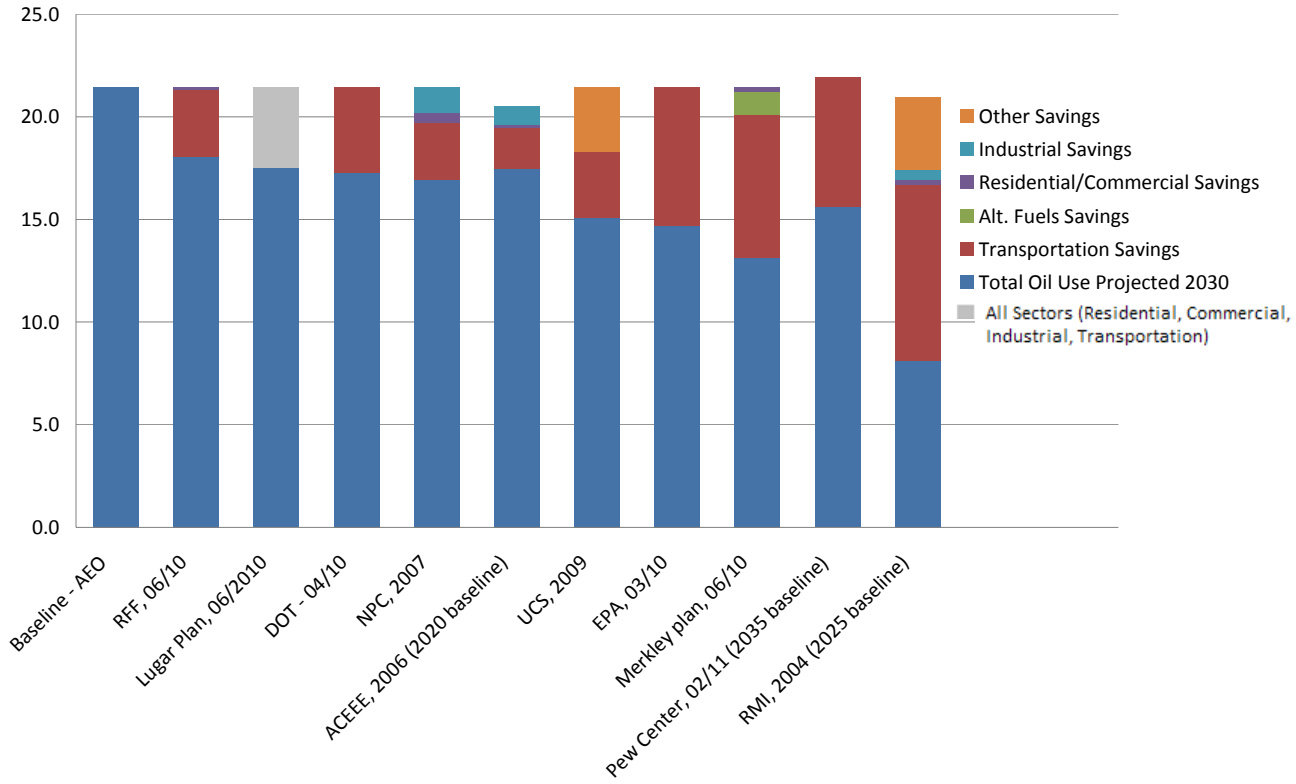
Although all of these studies addressed petroleum savings directly or indirectly, they did not all provide savings estimates in barrels per day (mbd) or a similar metric. The UCS *Blueprint 2030* study emphasized

climate change and greenhouse gas reductions rather than oil use reduction. In these studies, it can be difficult to extract petroleum savings estimates, because assumptions about the fuel mix and penetration of electrification and other technologies often are not explicit.

A number of the pieces reviewed were advocacy pieces, and so did not contain analysis of petroleum savings potential. These included the Lugar and Merkley plans, the NRDC proposals, and the CAP proposals. These works tend to reference EPA (2010), DOT (2010), a report by the Electrification Coalition (2010), and each other's advocacy work.

The combination of different policies considered and differences in the sectors addressed led to a wide variety in the amount of petroleum the studies calculated that the U.S. would be using in 2030. To establish a consistent reference case given the different years and scopes of the studies, we present "total petroleum use" and "total petroleum savings" in the same diagram. These figures are based upon the petroleum use Reference Case projections in EIA's *Annual Energy Outlook* (EIA 2010). There are no comparable estimates of petroleum savings from SAFE (2008) or NAS (2010), so these are not included in the figure below. The study by SAFE was focused on oil independence, rather than overall oil use reduction, and did not include overall savings estimates. The NAS study assessed the potential for some specific oil reduction technologies, but it did not use a common base year for analysis, so its results are not included in the chart below.

Figure 2. Petroleum Use and Savings Estimates in 2030 (in Million Barrels per Day)

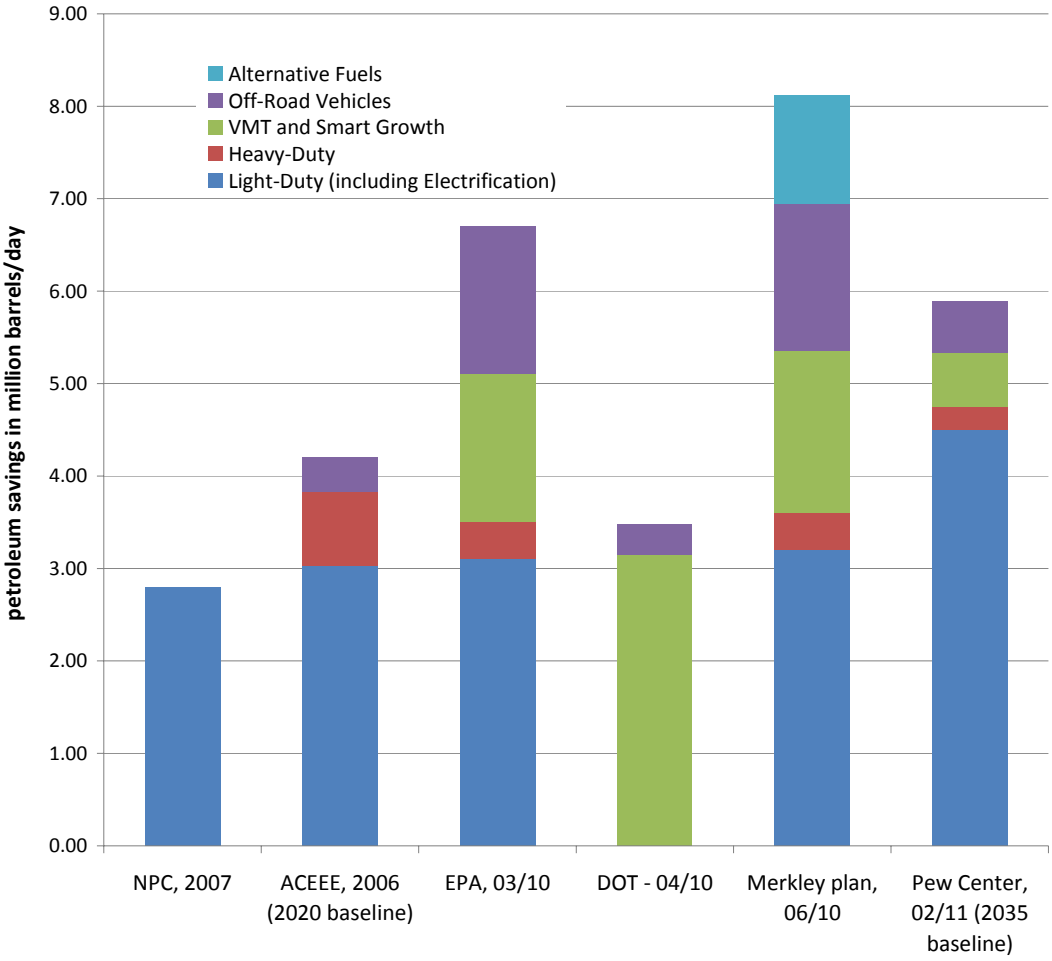


Notes:
1. UCS (2009) figure based on reduction of 6 mbd from 2005, based on *Annual Energy* Review petroleum use figures in 2005.
2. RMI (2004) has a baseline of 2025, and ACEEE (2006) has a baseline of 2020.
3. The NAS and SAFE studies mentioned below are not included in this graph because they did not contain comparable estimates. CAP (2009), NRDC (2009), and UCS (2009) are not included because these do not represent original research with documentation or legislative proposals.
4. NPC (2007), ACEEE (2006), and RMI (2004) include CAFÉ improvements from the May 2009 fuel economy rule in their estimates, so those savings have been subtracted from overall savings to create a consistent treatment of this issue.
5. The Pew Center figure is based on its "High Mitigation Case," which assumes rapid technological progress and aggressive emissions standards.

The estimates of petroleum use in 2030 range from the most ambitious, the UCS's *National Oil Savings Plan* (2009), with oil use at 9.7 mbd in 2030, to the Lugar Plan (2010), with oil use at 17.5 mbd in 2030. However, because the UCS "National Oil Savings Plan" is not a study but a fact sheet with limited documentation, the estimates of oil use surveyed in this review range from the Merkley Plan (13.1 mbd) to the Lugar Plan (17.5 mbd).

For all the studies, the majority of the savings identified were in the transportation sector. This finding results from two factors: the comparatively large percentage of oil use in the transportation sector compared with other sectors; and that the scope of many of these studies were purposefully limited to just the transportation sector. To understand where the studies anticipate savings within the transportation sector, we divided their estimates into four major policy/sub-sector categories: car and light truck fuel efficiency, medium- and heavy-duty trucks, VMT (vehicle miles traveled) reduction and smart growth strategies, and "other" transportation, including airplanes, marine shipping, and off-road vehicles.

Figure 3. Transportation Petroleum Use and Savings Estimates in 2030 and 2035 (in Million Barrels per Day), by Subsector



Although estimates of total savings and estimates within sectors diverge widely, most of this difference in savings is attributable to the scope of the studies rather than to significant differences in the ways they estimate savings or the assumptions used in those savings estimates. Estimates of light-duty and alternative fuel potential are consistent across most estimates. One exception is in the heavy-duty sector, where ACEEE (2006) and UCS (2010) found almost double the potential of EPA (2010)—and consequently, Merkley (2010).

All the other estimates diverge mostly as a result of either the scope of study or the time period in which the study was conducted. VMT and smart growth estimates were relatively consistent, with the exception of DOT (2010), whose scope included both policies to "improve transportation system efficiency on road" and to "reduce carbon intensive travel activity." Off-Road Vehicles estimates were much larger in EPA (2010) and Merkley (2010) than in ACEEE (2006), UCS (2010), and DOT (2010), which were mostly comparable to each other. These differences arose because UCS's fact sheet only addressed fuel economy and did not include operational improvements, and because the DOT study was more focused on operational and system changes to non-road vehicles.

Oil Efficiency Policies

A variety of different policy options to promote energy efficiency and reduce petroleum use were considered in the studies. Each major group of policies options represented in one or more of the studies is briefly described below.

Overall Oil Savings Goal or Mandate
This policy would create an economy-wide or transportation-sector goal for reducing petroleum use by a set date and amount.

Fuel Economy for Cars/Light-Duty Trucks
Establishing improved fuel economy for cars and light-duty trucks through CAFÉ standards is a key tool in moving the market towards more efficient vehicles. Some studies cite an overall "light-duty savings" number, and others specifically note the CAFÉ levels they modeled or recommended.

Fuel Economy for Medium- and Heavy-Duty Trucks
In October 2010, the Obama administration proposed the first greenhouse gas emissions standards for medium- and heavy-duty trucks, so most of the studies reviewed here mention setting CAFÉ-like standards on those vehicles as a first step toward savings in the sector.

Fuel-Efficient Vehicle Feebate
A feebate program provides incentives (in the form of rebates) for buyers of cars that are more fuel efficient than the average vehicle, which is paid for through a fee on vehicles below the average fuel economy.

Electric Cars and Light Trucks
One strategy for reducing oil usage is to transition a portion of the vehicle fleet to electric or hybrid electric vehicles. This policy would include incentives for vehicle purchase and infrastructure installation in deployment communities in phases, support for government and industry research and development (R&D), and the establishment of vehicle electrification goals/rules by DOT/EPA.

Aircraft
Policies to encourage fuel economy through engine technologies/aerodynamics, and to improve operational efficiency, include a goal of improving fuel consumption per revenue mile for air travel by a certain percent per year, action by the Federal Aviation Administration (FAA) to implement and fund improvements to commercial air-traffic routing, and R&D to encourage these improvements.

Marine Shipping
Petroleum use by the marine shipping sector can be reduced through technology retrofits on existing ships, improved designs for new ships, and operational improvements for all ships.

Operational and System Efficiency
A variety of policies to improve the efficiency of the transportation system are mentioned in these studies, including smart growth policies that encourage mixed development, policies that tie federal highway funding to more efficient systems, and pay-as-you-drive-insurance and other per-mile user fees. Examples include:

- investment in high speed rail, bus rapid transit, and other public transportation
    - create a public transportation goal (in terms of ridership)
- community planning and development to reduce vehicle miles traveled
    - policies to encourage mixed development, and pedestrian and bicycle improvements
    - tie federal highway funding to more efficient transportation systems
- transportation pricing strategies, such as a fee per VMT, an increase in the motor fuel tax or pay-as-you-drive insurance, parking taxes
- lowering speed limits on national highways
- reduce on-road VMT by reducing the need for travel, increasing vehicle occupancies
- idle reduction, strategies to improve driver performance, higher capacity trucks, better loading/packaging/routing, intermodal shifts

Building Efficiency
Residential and commercial buildings primarily use oil for heating and strategies like better insulation and duct sealing, replacements of burners and heating systems, and new windows can reduce or eliminate the need for oil in these buildings. There are a number of policies designed to address this, like building codes for new construction, retrofit incentives programs for oil buildings and appliances, and polices to encourage fuel switching (which may or may not reduce total energy use).

Industrial Energy Efficiency
Petroleum use in the industrial sector is varied, and most is used for non-fuel purposes. There are a number of strategies and policies to reduce petroleum use in this sector, including alternative feedstocks, recycling to displace feedstocks, recycling asphalt paving/addition of crumb rubber, improving the efficiency of off-highway equipment, and reducing "passes through field" in agriculture.

Recent Reports and Policy Briefs (since May 2009 Fuel Economy Standards)

Pew Center on Global Climate Change
This February 2011 study, *Reducing Greenhouse Gas Emissions from Transportation*, created scenarios of technology, public policy, and public attitudes. The study addresses all transportation sectors, separating potential estimates into the categories of light-duty vehicles, commercial light trucks, freight trucks and rail, domestic and international shipping, and air transportation. The oil savings estimates focus on years 2035 and 2050 and range from 900 to 2,300 million barrels/year in 2035 and 1,700 to 3,700 million barrels/year in 2050. This translates to 2.5 to 6.3 mbd of savings in 2035 and 4.6 to 10.1 mbd in 2050.

Environmental Protection Agency (EPA)
This March 2010 study, *EPA Analysis of the Transportation Sector: Greenhouse Gas and Oil Reduction Strategies*, completed in the context of Senator Kerry's request for more information on "additional reductions that could potentially be achieved with additional, complementary transportation policies," focuses on oil reduction scenarios given different policies. It focuses exclusively on the transportation sector, and is widely cited throughout advocacy and legislative documents. Costs for the transportation sector scenarios were not considered in this analysis. It included vehicle technology improvements, existing fleet upgrades, transportation system efficiency, and electrification. It did not consider the policy or market choices necessary to generate the GHG outcomes cited (although it mentioned key policy options), instead focusing on the GHG reduction potential assuming that those effective drivers were in place. Savings estimates ranged from 4.2 to 6.7 mbd of savings in 2030.

Department of Transportation (DOT)
This report, *Transportation's Role in Reducing Greenhouse Gas Emissions*, was submitted in response to EISA 2007 requirements. It is primarily an assessment of GHG levels from these policies, but also examines the impact on petroleum savings for carbon pricing, transportation efficiency (for on-road and marine/rail/air), and reducing carbon-intensive travel activity. It addresses potential GHG reductions per vehicle for vehicle efficiency measures, and absolute GHG reductions for low-carbon fuels, but does not address petroleum savings for these measures because of ongoing rulemakings. As a result, this does not

represent total potential savings from the transportation sector. Savings estimates ranged from 1.6 to 4.1 mbd in 2030.

Center for American Progress (CAP)
The Center for American Progress has put together a number of documents that address issues of oil independence (*Securing America's Future*, CAP 2009), oil-reduction measures in response to the BP spill (*Powering an Oil Reform Agenda*, CAP 2010a), and a list of the "best" measures for oil use reduction (*Senate Oil Savings' Greatest Hits,* CAP 2010b). The oil independence piece does not contain potential savings numbers, and is focused on transitioning to natural gas use for heavy trucks, urban fleets, and bus rapid transit, and in electricity production. The policy brief in response to the BP oil spill includes an overall oil use reduction target of 7 mbd by 2030, with interim targets in 2015 and 2020, based on a proposal made by Senator Landrieu (D-LA) in 2003. CAP is supportive of the larger 8 mbd target in Senator Merkley's proposal, but cite the 7 mbd number when representing its own position. These pieces address transportation and buildings use, but not industrial use.

Resources for the Future (RFF)/National Energy Policy Institute (NEPI)
The *Toward a New National Energy Policy* study, completed in September 2010, assessed 35 different U.S. energy and climate reduction policies using ability to reduce GHG reductions and oil consumption as the primary metric. It compares the cost-effectiveness of different policies, and focuses on the "specific government policy instruments that will drive changes in private markets." It included the light-duty vehicle transportation sector and some policies to encourage energy efficiency in buildings, but the study addressed the heavy-duty vehicle sector only through the policy of expansion of liquefied natural gas (LNG).

This study does not attempt to assess total potential oil or energy savings, but does provide estimates of savings from some key individual polices, including Pavley CAFÉ standards (0.7 mbd); a phased oil (1.5 mbd), oil (1.4 mbd), or gasoline (0.8 mbd) tax; and a feebate (0.7 to 0.9 mbd). These estimates also include assessments of combinations of policies—with Pavley CAFÉ and a gas tax, CAP estimates 1.4 mbd of savings, and 2.0 mbd of savings with a phased oil tax, feebate, and a hybrid subsidy. The largest savings estimated came from an aggressive scenario mandating penetration of heavy-duty trucks fueled by LNG into the U.S. fleet, with a 2.2 mbd reduction in 2030. In addition, RFF/NEPI modeled a "Blended Scenario," including a phased oil tax, high feebate, hybrid subsidy, buildings codes, geothermal heat pump subsidy, 'clean' portfolio standard, and an LNG policy, which had savings of 3.4 mbd in 2030.

National Academy of Sciences (NAS)
The National Academy of Sciences' 2010 report, *Real Prospects for Energy Efficiency in the United States*, catalogues the potential to reduce energy demand through improving efficiency. It evaluates present and prospective technologies based on times to commercial deployment, and includes analysis of costs, barriers, and research needs. It is not specifically petroleum-focused, but has estimates of potential oil savings from light-duty improvements in the transportation sector, although these are focused on 2035 (66 to 86 billion gallons/year in 2035). There are estimates of potential savings from the buildings sectors, but these are focused on electricity and natural gas. Industrial sector assessments did not separate by fuel, and did not focus on or particularly mention petroleum efficiency.

Natural Resources Defense Council (NRDC)
The Natural Resources Defense Council fact sheet, *Clean Energy: The Solution to Volatile Gas Prices*, from January 2009, mentions a goal of 9.7 mbd savings by 2030 and describes policy options, but does not provide assessments of energy savings or cost potential for different policies. The 9.7 mbd is in comparison to a baseline in which vehicle fuel economy did not improve from today's levels and vehicle miles traveled increased according to an *Annual Energy Outlook* forecast.

Legislative Plans

Senator Merkley's America Over a Barrel Plan
This plan was created in 2010 by the Senator's office as a document to influence Congress towards enacting oil reduction legislation. It draws heavily from studies by the EPA, RFF, and Electrification

Coalition. It does not include reductions from the industrial sector, but touches on all other major sectors. Most of the major policy options in the transportation and buildings sectors were discussed, with the exception of feebates and an oil tax. A particular goal of the plan was to get a binding overall target on oil use and a governmental structure for directing the reductions in the form of a National Energy Security Council based at the White House.

670,000 barrels/day in 2030, or 8%, of the total reductions, are expected from tax credits and other incentives to encourage natural gas trucks. The overall target for reduction in use is set at 8 mbd in 2030, and his plan estimates overall savings of 8.32 mbd in 2030.

Senator Lugar's Practical Energy Plan
Senator Lugar's office produced "Practical Energy and Climate Plan" in June 2010 as an alternative to cap and trade legislation. It includes a number of oil-use related goals, including reducing foreign oil dependency, improving industrial competitiveness, diversifying energy choices, and better using domestic fossil fuel resources. ClimateWorks (2010) performed an analysis of the provision that estimates a reduction of 1.3 billion barrels by 2030, or (according to CAP analysis) a 3.9 mbd reduction from "business as usual" in 2030. His proposal addresses all major sectors, but includes nothing on VMT reductions, off-road/air/marine vehicles, or electrification of cars and trucks.

Reports/Policy Briefs from 2006–May 2009

ACEEE's E061
This 2006 report, *Reducing Oil Use Through Energy Efficiency: Opportunities Beyond Cars and Light Trucks*, focuses on opportunities other than light-duty vehicles for reductions in oil use, especially savings from heavy-duty vehicles, industrial sector oil use, and buildings heating oil use. It uses a 2020 base year for its estimates, and although it focuses on those sectors specifically, it also contains estimates of total potential including light-duty efficiency. The study found 1.52 to 3.15 mbd of savings potential in 2015 and 2.67 to 5.30 mbd of savings potential in 2030, including light-duty vehicles, for which estimates were drawn from other studies.

National Petroleum Council (NPC)
The 2007 (updated in 2008) report *Facing the Hard Truths about Energy* was designed to be a comprehensive study looking at "the future of oil and natural gas to 2030 in the context of the global energy system." It discusses oil used in all sectors, but does not contain estimates of transportation system efficiency potential. The study focuses on the technical potential in each sector, and recommends policies like standards, RD&D, and biomass development, but does not consider the role of electric vehicles or increased use of natural gas. It cites a total potential reduction of 5.6 to 9.1 mbd by 2030, which includes the recent fuel economy standards put in place by EISA.

Securing America's Future Energy (SAFE)
A National Strategy for Energy Security: Recommendations to the Nation on Reducing U.S. Oil Dependence, which SAFE released in September 2008, contains a section on reducing demand for oil by improving efficiency. Nonetheless, the study includes suggestions on how to expand domestic supply, so the focus is on oil independence, rather than overall reductions. The study suggests a few major areas of potential within the transportation sector: aggressive implementation of fuel economy standards for light-duty vehicles and heavy-duty trucks, system efficiency improvements for air travel, reforms to the biofuels program, and investments in energy R&D. The paper is structured as a set of policy recommendations and does not have consistent estimates of oil savings potential for each of the recommendations. It does not address the buildings or industrial sectors.

Union of Concerned Scientists (UCS)
The Union of Concerned Scientists' May 2009 *Climate 2030 Plan* analyzed the technical and economic feasibility of meeting a cap at 56 percent of 2005 emissions by 2030. It includes a cap-and-trade program and a set of complementary policies, many of which are designed to reduce petroleum use. The policies recommended by the blueprint specifically address oil use through the transportation sector, but also touch

on general energy efficiency policies for building and industry that would likely create some reduction in oil use. For the industrial and buildings sector estimates, the study references ACEEE E061 and other ACEEE work.

On the whole, these "Blueprint Policies" would cut the use of petroleum products by 6 million barrels per day compared with 2005 usage. The study disaggregates energy savings by sector, but not by fuel.

In addition, UCS has a "National Oil Savings Plan" from August 2010, which breaks down savings by sector, and which would cut America's oil consumption by half in 2030. It includes potential savings in the industrial and residential/commercial sectors, and breaks savings for the transportation sector down by light, medium/heavy duty, and "other" modes of transportation, and includes smart growth and expanded public transit estimates. It cites an overall savings number and describes policies for reducing use in the transportation sector. This document does not address pricing policies, feebates, or other incentives for reducing petroleum use.

Outside of Scope of Literature Review

Rocky Mountain Institute
Rocky Mountain Institute's 2004 book *Winning the Oil End Game* contains an entire chapter dedicated to petroleum energy efficiency. Although this book was not in the temporal scope of the study, it includes all of the major petroleum-using sectors, including transportation, as well as the industrial, buildings, and electric power sectors, which are neglected by most of the other studies. The piece contains technical recommendations for reducing use in each sector, and assessments of the cost-effectiveness of those recommendations. It also includes the military sector separately, which no other analysis considered, but which is a large oil user and a potential laboratory for new technologies. The total potential for savings from "state of the art" technologies was estimated at 15 mbd in 2025. RMI has not completed an effort to update this book in the years since 2004, but it is useful to note the much higher estimate in its study compared with other studies.

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