Union of Concerned Scientists

EXECUTIVE SUMMARY

Fueling a Clean Transportation Future

Smart Fuel Choices for a Warming World

HIGHLIGHTS

U.S. transportation fuels are changing, with oil getting dirtier and cleaner fuels playing a larger role in our fuel mix. But to dramatically reduce emissions, we must make sure that our oil is produced with the lowest possible global warming emissions and that our cleaner fuels deliver on their potential—becoming ever-cleaner and more sustainable. We need biofuels made not from food crops but from wastes and perennial grasses, we need cleaner electricity to power our electric vehicles, and we must hold oil companies accountable to produce gasoline and other fuels using the least-polluting methods and the lowest-emissions sources of oil available.

Cutting oil use dramatically is essential to the comprehensive transformation of our energy system that is required to avoid the worst impacts of climate change. In 2012, the Union of Concerned Scientists (UCS) unveiled a practical plan to cut projected U.S. oil use in half by 2035 through improvements in vehicle efficiency and by accelerating the use of innovative clean fuels. The good news is that we are off to a solid start. After years of stagnation, the efficiency of our passenger cars and trucks has improved by about 20 percent. Americans are driving less, and sales of cleaner fuels and electric vehicles (EVs) are rising.

But there is a largely unrecognized problem undermining these efforts: the oil we use is getting dirtier. The resources broadly described as oil are changing, with major climate implications. The global warming pollution associated with extracting and refining a barrel of oil can vary by a factor of more than five. As oil companies increasingly go after unconventional, hard-to-reach sources such as tar sands and use more intense extraction techniques such as hydraulic fracturing (fracking), dirtier sources of oil have become an increasingly large part of the mix, and wasteful practices are needlessly increasing emissions. Because we use so much oil, even relatively small changes in emissions per barrel add up to very large increases in pollution over time.

It doesn't have to be this way.

This report points the way to a cleaner transportation future by describing key ways we can clean up our transportation fuels. This report builds on the UCS Half the Oil plan by explaining how our major transportation fuels are changing and what we can do to reduce emissions from fuel production. Our clean fuels—

Cutting oil use dramatically is essential to avoiding the worst impacts of climate change, but to achieve a clean transportation future, we must ensure that all of our fuels are as clean as possible.

electricity and biofuels—are already cutting oil use and emissions from transportation, but more work is required to deliver on their potential. Oil is getting steadily more polluting, but by holding oil companies accountable to reduce avoidable emissions and avoid the dirtiest sources, we can check that mounting climate damage and make sure that the oil we continue to use has the lowest global warming emissions possible.

As easily accessed oils dwindle, the oil industry is looking increasingly to ever-riskier sources of oil and more polluting practices in production.

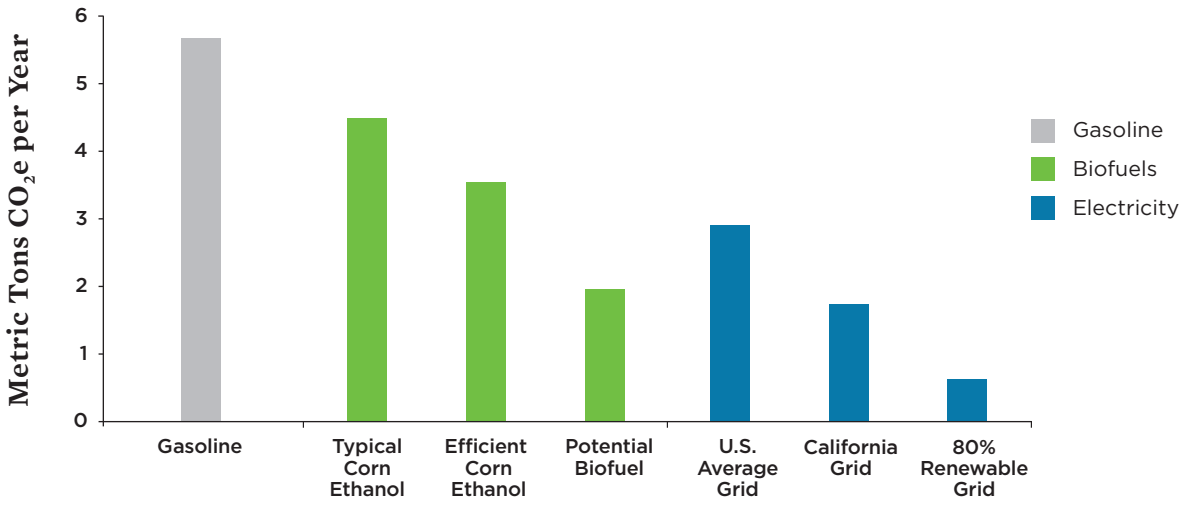
Oil Is Getting Dirtier

Oil is the largest source of U.S. global warming pollution and for more than half a century has been the dominant source of transportation fuel. Hidden behind the pump is a global supply chain for oil that is changing in ways that have important consequences for the climate. As the easily accessed oils that characterized the oil booms of the last century are dwindling, the oil industry is looking increasingly to ever-riskier sources of oil and more polluting practices in production.

The surprising truth is that global warming emissions associated with extracting and refining a barrel of oil vary from less than 50 kilograms to 250 kilograms, depending on where the oil comes from and how it was extracted and refined. Some oil extraction techniques use large amounts of natural gas to generate energy to pump oil and water, and to generate steam. Natural gas that is extracted along with oil is sometimes simply burned in place (flared) because oil operators start extracting oil without providing the infrastructure necessary to bring the gas to market. Emissions are also much higher for unconventional fossil resources like Canadian tar sands, whose emissions can be higher by as much as 100 kilograms per barrel than more conventional crude oil.

Even small increases in the emissions of the oil supply chain add up quickly. Over the course of 2015 to 2035, the addition of just one kilogram of emissions per barrel of oil per year (a rise of less than 1 percent per year) would increase cumulative emissions from oil production and refining by approximately one billion tons—roughly the tailpipe emissions of all of the gasoline-powered vehicles in the United States in 2014.

Compared with Gasoline, Alternatives Are Clean and Getting Cleaner



A typical car produces 6.7 metric tons of global warming pollution each year, once emissions from oil extraction and refining are added to tailpipe emissions. Biofuels and electricity are cleaner, and have the potential for dramatic improvements in the future.

Note: The global warming emissions of gasoline represents the metric tons of CO_2e associated with the production and consumption of fuel required to power a typical car (getting 25 miles per gallon) for a year (driving 12,000 miles). This is compared with the energy equivalent amount of ethanol. For electricity the emissions represent the production of fuel (e.g., coal, natural gas) and consumption by power plants to generate a quantity of electricity needed for a similar vehicle traveling the same distance, adjusted for electric drive efficiency.

SOURCE: CARB 2015A; CARB 2015D; UCS ANALYSIS; NEALER, REICHMUTH, AND ANAIR 2015; HAND ET AL. 2012.

Clean Fuels Are Getting Cleaner

While oil is getting dirtier, other fuels are getting cleaner. The UCS Half the Oil plan highlights the importance of advanced biofuels and EVs in meeting oil-savings targets. But maximizing the benefits of biofuels and EVs depends on both scaling up these solutions and making sure these fuels get cleaner over time. This potential, for both, is real.

Biofuels. The use of biofuels in the United States has expanded dramatically since 2002. This expansion has cut oil use significantly. In 2009, oil's share of transportation energy fell below 95 percent for the first time since 1958, largely because of increased biofuel use. Ethanol now accounts for about 10 percent of every gallon of gas. But the rapid increase in the use of corn for fuel also put pressure on crop prices and highlighted trade-offs and limitations with food-based biofuels in general, and corn ethanol in particular. Fortunately, advanced biofuels made from non-food resources offer a better path to continue to cut oil use and emissions.

The ethanol being blended into gasoline today reduces emissions by about 20 percent compared to gasoline. Ethanol produced in today's most efficient ethanol facilities has emissions reduced by another 15 percent. Advanced biofuels made from wastes—including cellulosic ethanol made from agricultural residues—are coming to market now, and environmentally friendly perennial grasses offer further opportunities to expand biofuel production while complementing food production and enhancing the sustainability of the U.S. agricultural system. The potential scale of biomass resources is vast. Biofuel production can triple while protecting our food system and environment. By seizing these opportunities, global warming emissions from biofuels can be cut by more than 60 percent compared to gasoline on an energy equivalent basis.

Electricity. EVs cut oil use by getting their power from the grid rather than a gasoline pump. How much they cut global warming pollution, therefore, depends on the grid used to charge them. A battery electric vehicle charged on the average U.S. grid produces about 50 percent of the global warming pollution produced by a gasoline-powered vehicle. But in many parts of the country the grid is much cleaner. In California, which has more EVs than any other state, charging the same vehicle produces just 35 percent of the emissions of a conventional vehicle.

As the use of coal to produce electricity falls, the grid gets steadily cleaner. However, to avoid risky overreliance on natural gas, it is important to invest in expanding the use of clean renewable energy from wind and solar power. EVs can facilitate utilities' efforts to integrate more wind and solar resources, leading to a synergy between two crucial elements of a comprehensive approach to reaching the deep emissions reductions required to stabilize the climate.

The Road Ahead

With oil getting dirtier and appealing alternatives getting cleaner, the road ahead for cleaner U.S. transportation is clear. But oil will remain a significant part of our transportation fuel mix for many years to come. A few key steps must be taken immediately to prevent emissions from oil extraction and refining from continuing to climb.

ELIMINATE WASTEFUL PRACTICES

It is incumbent upon responsible energy companies to minimize global warming emissions from their own operations and their supply chains. The first step is to make sure oil companies change wasteful practices. The widely used practice of flaring marketable natural gas is the product of a flawed regulatory system. In addition, the use of energy-intensive practices for oil recovery can be reduced through the use of technologies such as solar-thermal steam generation. And, the higher emissions from some extremely polluting fossil fuels such as tar sands are not cost-effectively mitigated with existing technology, and their use should be curtailed.

REQUIRE DISCLOSURE AND TRACKING

One key step for ensuring that oil companies act responsibly is to require greater disclosure and tracking of emissions from oil production. More is known about the impacts of one gallon of ethanol that makes up 10 percent of our gasoline mix than the impacts of the gasoline that makes up the rest, particularly about extracting and refining the oil.

While government agencies, companies, and trade groups collect and publish a great deal of information about oil markets, comprehensive accounting of emissions from oil extraction and refining is inadequate. Open-source models of oil extraction and refining have been developed, and these are

> ***Maximizing the benefits of biofuels and electric vehicles depends on both scaling up these solutions and making sure these fuels get cleaner over time.***

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The oil we use is getting dirtier, as companies shift toward more polluting sources of oil and more extreme extraction and refining methods.

being used to assess overall U.S. and global oil production as well as incorporated into lifecycle assessment models for transportation fuels. Working with these models, the Carnegie Endowment has developed the Oil Climate Index, which covers 30 major global oil fields and highlights both the wide variability of different sources of oil and the lack of transparent public information required to make accurate assessment of these oil fields.

MAKE OUR CLEAN FUELS CLEANER

While minimizing emissions from the production and use of gasoline is important, a low-carbon transportation system must shift steadily away from oil toward cleaner fuels. To maximize the climate benefits of this transition, we must ensure that these clean fuels get cleaner over time. This means shifting biofuel production toward advanced biofuels produced at appropriate scale and in a sustainable manner, and cleaning up the grid with the increased use of renewable sources of electricity.

These strategies to reduce the emissions associated with all of our transportation fuels complement the UCS Half the Oil plan to cut oil use and together they move us toward a clean transportation future.

A NOTE ON THE FEBRUARY 2017 CORRECTED VERSION

The original release of this report made an incorrect inference based on preliminary research. The error became apparent upon subsequent publication of the final analysis, so we have removed the specific claim and the reference to the preliminary analysis. The revised report reflects the literature available at the beginning of 2016, when this report was originally published. Subsequent analysis will be reflected in future publications.

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FIND THE FULL REPORT ONLINE: www.ucsusa.org/FuelingaCleanFuture

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with citizens across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

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