

REMARKS PREPARED FOR DELIVERY

“Methanol as a Transportation Fuel”

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Thank you for inviting me to discuss this timely topic.

In recent months, the cost of gasoline has caused hardship for millions of American families. One reason for that hardship is that there are few substitutes for gasoline available to most drivers. Indeed 95% of the energy used to move our cars and trucks in the United States comes from one source – petroleum.

That doesn't seem odd to us – we all grew up in a world in which that's the way it is. So did our parents. So did our grandparents. But it doesn't need to be that way. There are other ways to move our cars and trucks, including with natural gas (now at its lowest price in the U.S. in more than a decade), with electricity and with biofuels.

Change won't necessarily be easy – it rarely is. But ending oil's near-monopoly on the transportation fuels market would pay dividends on many fronts.

Today I'm going to start by describing President Obama's historic leadership on these topics. Then I'm going to summarize the basics on methanol, for those who may not be familiar with them. Then I'll discuss the opportunities and challenges in widespread use of methanol as a transportation fuel. Finally, I'll briefly suggest some next steps.

PRESIDENT OBAMA'S RECORD OF LEADERSHIP

In this year's State of the Union Address, President Obama said: *"We need an all-out, all-of-the-above strategy that develops every available source of American energy"*. As the President has emphasized, there is no silver bullet and no single answer – we need a sustained approach that includes the full range of American energy. Under President Obama, domestic oil production is going up and our foreign oil dependence is going down. We are taking far-reaching steps to improve fuel efficiency and diversify the fuel mix in our vehicle fleet. For example:

In May 2009, President Obama announced national fuel efficiency standards and greenhouse gas standards for cars and light-duty trucks built in 2012-2016 – the first meaningful update to fuel efficiency standards in decades. In July 2011, the President announced the next phase in the Administration's program to improve the fuel efficiency of light-duty cars and trucks, proposing standards under which average fuel efficiency is expected to nearly double, reaching an average performance equivalent of 54.5 miles per gallon by 2025. This will save consumers roughly \$8,200 per vehicle and slash greenhouse gas emissions by 6 billion metric tons over the lifetime of the vehicles covered by these standards. In August 2011, the Administration finalized the first-ever national fuel efficiency and greenhouse gas standards for heavy-duty trucks, vans and buses, spanning model years 2014-2018. The standards for light-duty cars and trucks through 2025 were officially proposed by EPA and DOT in November 2011 and are on track to be finalized this summer.

The Recovery Act, signed by the President in February 2009, included \$2.4 billion for battery and electric drive vehicles. In 2009, the U.S. had only two factories manufacturing batteries that power advanced technology vehicles and produced less than two percent of the world's advanced batteries. But over the next few years, the United States will be able to produce enough batteries and components to support 500,000 plug-in and hybrid vehicles and will have the capacity to produce 40 percent of the world's advanced batteries. In part because of these strategic Recovery Act investments, battery costs are expected to drop by half (2009-

2013). Under the Recovery Act, we are establishing 30 major manufacturing facilities for batteries and components for electric drive vehicles.

To help develop next-generation biofuels, President Obama set a goal of breaking ground on at least four commercial-scale cellulosic or advanced biorefineries by 2013. That goal has been accomplished, one year ahead of schedule. Together, these projects, and associated demonstration and pilot projects will produce a combined total of nearly 100 million gallons per year of advanced biofuels capacity. In addition, EPA's continued implementation of the National Renewable Fuels Standard (RFS) has supported a growing domestic renewable fuels industry. Last year, industry reported production of approximately 14 billion gallons of renewable fuels, about 8% of total U.S. highway vehicle fuel. U.S. biofuel production is at its highest level ever.

Earlier this month, the President announced a new \$1 billion National Community Deployment Challenge to catalyze up to 10 to 15 model communities to invest in the necessary infrastructure, remove the regulatory barriers, and create the local incentives to support deployment of advanced vehicles at critical mass. This 'fuel neutral' approach allows communities to determine if electrification, natural gas, or other alternative fuels would be the best fit. The program would also support the development of up to five regional Liquefied Natural Gas (LNG) corridors where alternative fuel trucks can transport goods without using a drop of oil. Our abundant supplies of low-cost natural gas provide an important opportunity to diversify transportation fuels. The Department of Energy's National Clean Fleets Partners program is helping truck and car fleets use natural gas in addition to other alternative fuels. Manufacturers are developing new heavy duty natural gas engines and more light-duty natural gas vehicles are being produced.

Let me add that, even in this election year, I believe this is a bipartisan topic. I don't know Americans of either party who think we should be more dependent on foreign oil. Republicans including Senator Richard Lugar and Senator Lamar Alexander have shown important leadership on this topic. Working together across the aisle, I believe we can make a difference for the American people.

METHANOL – THE BASICS

Methanol is the simplest form of alcohol (with the chemical symbol CH_3OH) and one of the oldest industrial chemicals. It can be made from a variety of feedstocks. In the 19th century, methanol was made from wood -- and it's still sometimes called "wood alcohol". In the 1920's, a process was developed to make methanol using natural gas or coal. Today, methanol is a widely-used industrial chemical. At the end of 2010, there were over 245 methanol plants worldwide, with production capacity of over 25 billion gallons per year -- equivalent in volume to roughly 1.6 million barrels/day. The global methanol industry generated \$36 billion in economic activity in 2010, creating more than 100,000 direct jobs.

Low natural gas prices in the U.S. create an important opportunity for domestic production of methanol. In recent weeks, natural gas prices in the U.S. have been roughly 15% of natural gas prices in some Asian markets. Not surprisingly, according to reports, several companies are considering scaling up methanol facilities in the U.S.

Many people ask: Are methanol and ethanol closely related? After all, their names are very similar. The answer: Methanol and ethanol are both alcohols, with many of the same physical characteristics such as look and smell. Methanol is primarily used to make industrial chemicals and is very toxic. Ethanol is found in many alcoholic beverages and is safe to consume in moderate amounts. Both methanol and ethanol can be used as fuels and in solvents. Methanol is slightly more corrosive than ethanol. Methanol has about half the energy content of gasoline; ethanol has about two-thirds.

ADVANTAGES OF METHANOL AS A TRANSPORTATION FUEL

So could we use methanol to drive our cars and trucks?

The short answer is yes, but that would require investment and planning. Methanol has many attractive features as a transportation fuel.

First and perhaps most important, methanol is inexpensive to produce. At today's low natural gas and high oil prices, methanol could help reduce fuel costs consumers pay at the

pump. In the U.S., natural gas now costs a small fraction of crude oil on an energy equivalent basis, so finding ways to convert cheap natural gas into liquid fuels could be a promising strategy. Methanol offers one way to do that. At \$4 per million BTU –more than the price of natural gas in the U.S. in recent weeks -- methanol can be produced at well under \$1 per gallon. Even though methanol has roughly half the energy content of gasoline, at such low prices methanol could help bring down costs to drivers.

Second, methanol is a liquid at room temperature. It doesn't need to be compressed or liquefied, as natural gas does when used directly as a transportation fuel. Furthermore, it can be blended with gasoline.

Third, methanol can be made from many feedstocks. As noted just above, methanol can be made from natural gas, offering a potentially promising way to use the United States' cheap and abundant natural gas supplies to power our vehicles. This could help displace petroleum imports, improving U.S. energy security, and put downward pressure on the price of gasoline. Lifecycle greenhouse gas emissions of methanol made from natural gas are slightly less than lifecycle greenhouse gas emissions of gasoline.

Methanol can also be made from biomass and other renewable sources, through a number of different conversion processes. This has the potential to substantially reduce the greenhouse gas footprint of methanol consumption as compared to methanol made from natural gas, depending on the type of biomass feedstock, how it's produced and how it's converted to fuel. However, production of methanol from biomass is not currently economic. Methanol can also be made from coal, although doing so without carbon capture and storage (CCS) results in greenhouse gas emissions substantially greater than conventional gasoline.

Fourth, methanol is a high octane fuel, which means it will produce more power from an engine than gasoline. (That's why methanol has been used in motorsport racing.) If a flex-fuel vehicle capable of taking methanol is optimized for methanol instead of gasoline, its engine could be downsized to take advantage of methanol's ability to provide higher power output per unit of engine displacement. This would in turn provide fuel consumption benefits and increase methanol's potential to displace oil use.

Indeed, for all these reasons, using methanol as a transportation fuel is not a new idea. During the 1970s, in the wake of the Arab oil embargo and Iranian Revolution, methanol was discussed as a possible alternative to gasoline. In the late 1980s, interest in methanol as a transportation fuel peaked, mainly as a way to reduce urban air pollution. Indeed the Clean Air Act Amendments proposed by President George H.W. Bush in 1989 would have established a mandatory alternative fuels program in the Nation's nine most polluted urban areas, with methanol one of the leading candidates to fill this role. As the bill made its way through Congress, however, this proposal underwent significant change. It was replaced with a requirement to provide cleaner "reformulated" gasoline in these nine heavily polluted cities, with 2 percent oxygen by weight. This "oxygenate requirement" led to significant use of methanol in gasoline -- not directly but as a feed stock for methyl tertiary butyl ether, or MTBE, which was the oxygenate most often chosen by refiners. MTBE use peaked in 1999 at about 3% of U.S. gasoline use. About 100,000 barrels per day of methanol -- roughly 1% of U.S. gasoline use -- was required to produce this much MTBE. Growing use of methanol as an MTBE feedstock might have continued, however MTBE started showing up in ground water supplies and several states banned it. The Energy Policy Act of 2005 removed the 2% reformulated gasoline requirement and also implemented the National Renewable Fuel Standard program for all gasoline refiners and blenders. The Renewable Fuels Program was expanded in 2007 and has helped ethanol capture about 10% of today's gasoline market.

CHALLENGES

However a number of important challenges must be addressed before methanol could be used in substantial volumes as a transportation fuel.

First, methanol is more corrosive than gasoline, which means that most cars on the road today could not be driven on it except in very low blends. For a car to be manufactured in order to take fuels with a high percentage of methanol, minor changes would need to be made including a stainless steel fuel system, wear-resistant piston rings and fuel sensor. Estimates of the cost vary, but are generally in the range of a few hundred dollars. For a car to be retrofitted with this equipment would be more. If we are to displace a significant amount of gasoline with

methanol, we will need vehicles that can accommodate the fuel: a methanol flexible fueled vehicle (FFV) – designed by the manufacturers to accommodate high levels of methanol use while meeting all vehicle operating and Clean Air Act requirements.

One implication of the foregoing: It could take a decade or more for half the cars on US roads to take methanol in high concentrations. Last year new cars made up roughly 5% of the vehicles on US roads. Even if every new car sold in the US were methanol-compatible starting tomorrow, it would be at least a decade before roughly 50% of the vehicles on U.S. roads took methanol. New cars are driven more than old cars, so the percentage of miles driven in methanol-compatible vehicles would be somewhat higher, but the point remains: converting to a methanol-compatible vehicle fleet would take time.

Second, methanol has half the energy content of gasoline. Although methanol is cheaper than gasoline on energy-equivalent basis, that means more frequent refueling for drivers using methanol.

Third, Clean Air Act regulations restrict how much alcohol can be used in gasoline for conventional gasoline vehicles and engines. Since ethanol already comprises about 10% of U.S. gasoline, the “room” available for more alcohol, such as methanol, is limited. Furthermore, because methanol has a lower boiling point than ethanol, additional equipment may be needed to ensure that methanol FFVs can operate properly in cold environments. Additionally, methanol blended into gasoline has different distillation characteristics than ethanol gasoline mixtures. Methanol has significantly greater volatility and evaporative hydrocarbon emissions. Additional work may be needed to ensure the evaporative and cold start emissions of methanol FFVs can meet current and future vehicle emission requirements. Previous methanol FFVs had to address issues with corrosion and engine wear. None of these issues are show stoppers, but they present challenges that must be considered and addressed.

A fourth challenge is refueling infrastructure. As with ethanol, methanol cannot currently be transported through petroleum product pipelines, due to its solvent properties and solubility in water. Like ethanol, methanol would need to be transported to terminals closer to retail locations and blended into gasoline during final delivery to retail locations. Additional

methanol tanks would need to be available at terminals and tanker cars available for rail, barge and truck delivery to terminals.

In addition, we will need widespread availability of methanol at service stations. Many service stations have only two tanks for gasoline blends -- one for premium grade octane gasoline and the other for regular grade octane gasoline. Methanol-blended gasoline will not be able to occupy either of these tanks because any residual methanol left in pump lines could cause problems. Fuel retailers may be required to purchase separate tanks or pumps or retrofit existing tanks for FFV refueling only. Furthermore, M85 would need to be priced at a level that attracts consumers with vehicles capable of using it. Initial sales volumes of M85 for retailers will be lower than that for gasoline because of the initial limited demand due to slow fleet turn-over.

There may be room for methanol to fill the low-level blend space, based on current natural gas prices and investment costs. However, if natural gas prices increase substantially and price differentials between methanol and gasoline revert back to historical norms, the economics could be more difficult.

CONCLUSION

So in conclusion, methanol offers a number of important advantages as a transportation fuel, including low cost, the ability to blend it with gasoline and fact it can be made from many feedstocks. However there are important challenges, including the need for changes to the vehicle fleet, emissions issues and investments required in refueling infrastructure. All these issues would benefit from further discussion among experts and stakeholders. As part of our “all-out, all-of-the above” strategy, methanol can play a role.

At DOE, we’re planning additional research in this area. Among the topics: What’s the potential for short-term displacement of petroleum with methanol worldwide, by blending methanol at low levels into liquid fuels or with other strategies? How can some of the challenges identified above best be overcome? We’re eager to work with you and others in exploring these topics. We look forward to the results of your discussions today, which can

help guide our work program. Many thanks to the leaders assembled at your conference and good luck in your discussions. I look forward to a report on the outcomes.

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