Prepared by the Energy-Climate Committee, Sierra Club California

Plug for Plug-Ins
Electric auto would only consume 1% of US electricity by 2030

Burning oil-based fuels, in addition to its political and economic problems, is the single largest contributor to US greenhouse gas emissions. The recent Al Gore film, An Inconvenient Truth, addresses the climate damage from petroleum with the recommendation to increase fuel efficiency of gasoline powered cars. This is a great interim strategy, favored by many environmentalists. Yet, it suffers from one important problem: it relies on a continuing commitment to gasoline. In parallel, we need strategies for getting off fossil fuel. It will take a range of approaches to move our energy system in the right direction. Electric cars provide unique opportunities in this regard as they can be powered by solar, wind or almost any other form of renewable energy.

Ironically, one of the biggest objections to the electric car comes from the environmental movement itself. The concern is that they will add to US electric consumption, which may mean more dirty coal or risky nuclear plants. But such a fear is misplaced. Even with an aggressive program of developing electric vehicles, it would take decades to add even 1% to US electric consumption.

A typical electric auto uses about 12 kWh for traveling 50 miles, more than the average US auto travels per day. This is 12 x 365 = 4380 kilowatt-hours/year for one vehicle, or 65 billion kilowatt-hours for every 15 million plug-in hybrid autos, which is about 10% of all cars on the road.

Achieving this level of market penetration would take decades. Assuming the industry started in 2008 with 40,000 plug-in sales, and the sales rate grew relentlessly at 20% per year, we would get to 15 million plug-ins on the road by around 2030. At that time total US electricity consumption will have grown from today's 4000 billion kilowatt-hours to 6000 billion kilowatt-hours. Simple math shows that 15,000,000 plug-ins would use only about 1 percent of US electricity; an amount that could be saved by having Americans cut the 4 hours/day of television they watch to 3 hours/day and go for a walk instead.

Replacing all 150 million cars on the road with plug-ins would consume about 10 percent of US electricity, less than we use for our light bulbs.

Why would converting the entire US auto fleet add so little to electric consumption? The key is the great efficiency of the electric motor, and the terrible inefficiency of our automobiles. According to Chevron engineers, the current internal combustion car only delivers 13% of the fuel energy from the motor to the wheel. And a recent report by US traffic engineers discovered that 10% of the remaining energy is wasted waiting for traffic lights.

Plug-in hybrids avoid most of these losses, and others besides. A battery stores energy at nearly 90% efficiency, while electric motors are also about 90% efficient. Thus the energy efficiency of an electric vehicle is about 80%. Much superior to the 13% efficiency of the current car, and 30% efficiency of hydrogen fuel cell cars.

Critics point to the inefficiency and pollution from generating electricity. About 30% of coal, gas and

nuclear fuel energy gets to your plug-in, in the form of electricity. But even accounting for this, the total efficiency of an electric auto system is double the gasoline car. The electric car also causes less pollution than the automobile, even when the mix of fuels that power electric generators is included in the calculation. Looking to the future, electric generation will get more efficient, and much more clean, by 2030 and beyond.

The plug-in hybrid is also a far better solution than the hydrogen fuel cell. Experimental fuel cell cars cost about $3,000,000. The expensive platinum-coated cells (platinum is currently over $1000 per ounce), which account for much of the car's cost, must be replaced every few years. So even if the cost of a fuel cell car can be brought down ten-fold through mass production, it would still cost most of a million dollars to own and run the car over its lifespan. In addition, there are serious technical problems with storing the hydrogen that powers the fuel cells. Enough hydrogen must be safely and efficiently contained is a small tank so that cars can travel the long distances that people expect. In hydrogen car circles this is referred to as "The Storage Problem". Current methods require enormous compression of this very thin gas, or chilling the hydrogen to hundreds of degrees below zero. Engineers say that mass produced fuel cell cars are decades off in the future, compared to plug-in hybrids that can be brought on line within a few years.

As if these problems were not enough, the hydrogen is, from an environmentalist's point of view, a potential catastrophe in the making. Nearly all hydrogen today comes from natural gas, a fossil fuel. The Bush administration's plans call for converting coal or natural gas to hydrogen using hundreds of nuclear power plants. Existing natural gas and likely future "nuclear hydrogen" technology strips the hydrogen from the fossil fuel and spits out the carbon into the atmosphere.

The alternative hydrogen technology, electrolysis, splits water into hydrogen and oxygen using electricity. The fuel- to-wheel the recovered energy at each stage is: 30% (electric system) x 80% (electrolysis) x 30% (auto-sized fuel cell) for a grand total of 7.2% efficiency. This is much worse than the internal combustion machine we have today. Hydrogen fuel cells, as sexy as they sound, are potentially a step backwards and a trap for the environmental movement.

By the time electric automobiles become a standard way to drive, the US will need to scale-up renewables and energy efficiency, if we are to reduce fossil fuel dependency and cut carbon emissions. This appears increasingly likely, as most people in the U.S. favor such a move, and political consciousness is growing. Our energy policy should embrace the cleanest and most efficient modes of transportation, of which electric vehicles must become a part if we are not to tie ourselves down to the inefficiency and carbon emissions of the internal combustion engine, or the absurd plans for nuclear hydrogen.

Plug-in hybrids are the most efficient technology we know of that can match the function and performance of the modern car. Building electric cars today should be part of the necessary preparation for a future of increased reliance on energy efficiency and renewables.

Prepared by a research team, Energy-Climate Committee, Sierra Club California, as part of an effort to stimulate discussion about plug-in hybrids and electrification of U.S. transportation within the U.S. and Canadian environmental and sustainability movements. Ed Mainland, Co-Chair, Energy-Climate Committee, Sierra Club California, July 29, 2006.