Executive Summary

Increasing concerns over oil dependence and climate change have prompted renewed U.S. interest in diesel technology for cars and trucks despite a history of poor sales in the American market. Diesel also continues to carry the stigma of being a "dirty" fuel. This image has the potential to change as a result of new technology, but questions remain about how much cleaner diesel vehicles can get.

If emissions challenges can be overcome, diesel cars may be able to incorporate and compete with other fuel-saving technologies, such as more efficient engines, better transmissions, improved aerodynamics, and high-strength materials. Diesel will still carry a higher price tag, however.

Should Americans invest in diesel or gasoline cars and light trucks to reduce oil usage, global warming pollution, and toxic air contaminants—while saving money at the pump? The Union of Concerned Scientists (UCS) explored this question by comparing the cost, fuel economy, and emissions performance of conventional, advanced, and hybrid-electric diesel and gasoline cars (Table ES-1).

This report presents a new analysis of these fuel-saving technologies, applying each to the five major classes of passenger vehicles (small cars, larger "family" cars, sport utility vehicles, minivans, and pickup trucks). Our analysis provides an apples-to-apples comparison of diesel and gasoline by evaluating vehicles with equivalent 0 to 60 mph acceleration performance, assuming both fuels can meet the same air pollution emission levels within the new federal tailpipe standards, and accounting for the difference in energy content between the fuels.

Our major findings are:

1. Diesel is becoming much cleaner, but key questions and challenges remain. Diesel vehicles appear to be on track to meet the weakest, and possibly the average, federal emissions standards for the latter part of this decade. However, concerns about real-world emissions, long-term pollution reduction, and the importance of non-regulated emissions may create public health barriers and cloud diesel's future.

- *Diesel cleanup technologies are rapidly advancing, and more effective systems appear close to realization.* Emission controls for reducing particulate matter, or soot, are already being offered on

Table ES-1 **Comparing Gasoline and Diesel Vehicles at a Glance**[a]

	Diesel	Gasoline
Initial cost	-	o
Net consumer savings	+	+ +
Cost-effectiveness for oil reduction	+	+ +
Cost-effectiveness for global warming benefits	+	+ +
Infrastructure availability	-	+ +
Tested tailpipe pollution	-	+
In-use pollution[b]	- - ?	-
Extreme towing capability	+	o
Range	+	o
Maximum potential oil reduction	+	+
Maximum potential global warming benefits[c]	+ + ?	+

KEY:
"+" This vehicle type excels in this area.
"-" This vehicle type performs poorly in this area.
"o" This vehicle type performs adequately in this area.

NOTES:
a. Multiple marks indicate significantly superior or inferior performance.
b. Assuming diesel emission controls fail at the same rate as gasoline, resulting in higher in-use pollution.
c. If diesel soot proves to be an important heat-trapping gas and is difficult to control, the potential global warming benefits from diesel will be muted.

many European diesel cars. Properly functioning particulate traps can cut these emissions and toxicity to very low levels, but reducing smog-forming nitrogen oxides is proving more challenging. Significant technical, cost, infrastructure, and pollution challenges remain.

- *Cleanup technology must ensure that real-world emissions match tailpipe standards.* Routine deterioration with age, tampering with emission controls, improper maintenance, and poor engineering already lead to more tailpipe emissions from gasoline vehicles. Diesel vehicles, for similar reasons, may suffer from dramatically higher in-use emissions than certification values indicate, particularly when new pollution controls are first implemented.
- *Future diesel vehicles may not be as clean as today's best gasoline cars.* Today's diesel cars and trucks are major polluters, releasing substantially more toxic soot and smog-forming nitrogen oxides from the tailpipe than the average gasoline vehicle. New federal regulations coming into full effect in 2009 will hold diesel engines to the same set of tailpipe standards as gasoline cars and trucks, but the structure of these standards allows some cars to release two times more soot and nearly three times more nitrogen oxides than the average vehicle.

  While some conventional and hybrid-electric gasoline cars are already several times cleaner than the average vehicle under the new tailpipe standards, no diesel vehicles are currently capable of meeting even the average standards. If diesel cars are unable to meet progressively tighter emissions standards, future progress in protecting public health may stall.
- *Non-regulated tailpipe emissions from gasoline and diesel vehicles could pose significant public health threats.* The federal Tier 2 tailpipe emissions standards are based entirely on the mass of pollutants emitted from a vehicle, but particle size, number, and toxicity may also be important indicators of the public health threats posed by diesel and gasoline vehicles.

2. Gasoline vehicles are more cost-effective than diesel for reducing oil use and lowering global warming pollution. As shown in Table ES-1, more efficient gasoline and diesel vehicles could substantially improve fuel economy and save consumers money at the pump. Our modeling, though, suggests that the high up-front cost of diesel engines and emission controls allows improved gasoline vehicles to deliver energy security and global warming benefits at a lower cost.

- *Diesel's oil savings and global warming benefits are often oversold.* Low-sulfur diesel fuel is more oil- and carbon-intensive than reformulated gasoline; each gallon requires 25 percent more petroleum and results in 17 percent more emissions of heat-trapping gases.[1] Thus, the fuel economy improvement afforded by diesel does not provide equivalent reductions in oil use and heat-trapping gases.

  Diesel vehicles can help a car travel 30 to more than 40 percent farther on a gallon of diesel fuel. However, this advantage is only partly due to the higher efficiency of diesel engines, which offer a 15 to 25 percent improvement over gasoline. The remaining increase is due to the fact that diesel fuel contains 13 percent more energy than a gallon of gasoline. We present our fuel efficiency results using the standard analytical measure of miles per gallon of

1 UCS calculation, including fuel production and refining, from Wang, 2003.

gasoline equivalent (mpgge) to account for the different energy content of gasoline and diesel fuels.

- *Consumers can save more money with efficient gasoline vehicles.* The higher costs of efficient diesel and gasoline vehicles are more than offset by reductions in fuel costs, saving consumers between $400 and nearly $2,000 over a vehicle's useful life. However, as a result of their higher up-front costs, diesel vehicles prove less cost-effective than gasoline vehicles, saving consumers as much as $700 less for an equivalent improvement in fuel efficiency. Diesel vehicles do offer superior capabilities in extreme towing situations, which may be desirable for a subset of consumers.
- *Gasoline vehicles provide oil savings at a lower cost.* To achieve a 20 to 30 percent reduction in oil demand, the average diesel passenger vehicle will add 2.5 to greater than 4 times more in up-front costs ($1,700 to $1,800) than an equivalent gasoline vehicle. To achieve a 50 percent reduction in oil demand, the gap for diesel drops only slightly, to about $1,600 (or nearly two times the added cost for an equivalent gasoline vehicle).
- *Gasoline vehicles reduce global warming gases at a lower cost.* To achieve a 30 percent reduction in global warming pollution, the average diesel vehicle will add nearly 2.5 times more in up-front costs ($1,600) than an equivalent gasoline vehicle. To achieve a 50 percent reduction in global warming pollution, the gap for diesel narrows to $1,100 (or approximately 1.7 times the added cost for an equivalent gasoline vehicle).

Our recommendations are:

1. Protect public health. At a minimum, the federal government must refrain from weakening its new Tier 2 tailpipe emissions standards. These standards are expected to prevent as many as 4,300 deaths per year (EPA, 1999) and should not be compromised.

In addition, research is needed on the impact of particle size, number, and toxicity to determine whether Tier 2 standards protect human health sufficiently. Evaluating the adequacy of emissions standards will also require the monitoring of in-use vehicle pollution, especially during the first decade in which the Tier 2 program goes into effect. Finally, inspection and maintenance (I/M) programs, which can help reduce the gap between expected and real-world pollution, should be expanded to include diesel vehicles, particularly if diesel becomes more popular in the light-duty vehicle sector.

2. Promote energy security. To reduce oil use and promote energy security, the average fuel economy of new vehicles must be increased. One method, raising the Corporate Average Fuel Economy (CAFE) standards, will ensure that consumers are offered a wide variety of fuel-efficient vehicle choices, but these standards need to be modified to eliminate inequities in the treatment of gasoline and diesel vehicles. Since CAFE gives credit to vehicles based on fuel economy rather than oil use, and a gallon of low-sulfur diesel fuel requires 25 percent more oil than a gallon of low-sulfur reformulated gasoline, putting more diesel vehicles on the road could actually increase U.S. oil dependence. CAFE standards should, at a minimum, compare gasoline and diesel on an energy-equivalent basis.

3. Avoid unnecessary tradeoffs. Protecting public health and improving vehicle fuel economy can and must be complementary goals. Performance-based incentives that focus on conventional technology can include diesel engines, but must also provide the same benefits to other conventional vehicle technologies and must reward higher fuel economy or lower heat-trapping gas emissions while also requiring lower tailpipe emissions than the average new car. Additional support for hybrid vehicles is merited given their link to a potential clean hydrogen fuel cell vehicle future. In addition, the United States should not follow Europe's lead by giving diesel tax advantages over gasoline or by creating new emissions loopholes.

4. Consumers should compare diesel and gasoline carefully. Today's new vehicle window sticker does not give consumers enough information to evaluate the air quality, global warming, and energy security implications of investing in a diesel or gasoline car. The EPA should require better labeling to help consumers make smarter choices. But if government fails to act, consumers can do their own analysis. At a minimum, consumers should look for a vehicle certified to the federal Tier 2 Bin 5 standard, though cleaner gasoline and hybrid-electric vehicles are available today. When evaluating a diesel vehicle's impact on oil dependence, consumers should adjust the listed fuel economy downward about 20 percent before comparing it with a gasoline vehicle. For heat-trapping gas emissions, a diesel vehicle's fuel economy should be adjusted downward about 15 percent.