California
Clean Cars Campaign
Global Warming Solutions for a Healthy California
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Off-the-Shelf Technologies to Reduce Global Warming Pollution

There is no shortage of technologies to cut global warming pollution from today's cars, pickups, minivans and SUVs. Many automakers are already beginning to use these existing technologies in their new vehicles. Motor vehicles emit a number of global warming pollutants, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20) from the tailpipe, and refrigerants from the air conditioning system (HFC-134a also called R-134a). Here are just some of the technical changes or additions that are available *today* to reduce those emissions. This is not an exhaustive list.

ENGINE TECHNOLOGIES TO CUT CO_2 POLLUTION

- **Variable valve timing**. This pollution control technology varies the opening and closing of the engine valves. It lowers CO_2 pollution by allowing the engine to waste less energy by improving the way the engine "breathes" and through better fuel/air mixing. Honda calls its version of this technology VTEC (Variable Valve Timing and Lift Electronic Control), Toyota's version is called VVTi (Variable Valve Timing with intelligence), and BMW calls its version VANOS.

- **Cylinder deactivation.** This technology shuts down one or more cylinders when the extra power is not needed. It is applicable to larger engines, such as V-8s or V-12s bigger than 4.0 liters of displacement. GM announced it would use its version of this technology, called "displacement on demand," on its V-8 Vortec engines for SUVs and pickups in 2004.

- **Engine downsizing combined with turbocharging or supercharging.** A smaller, lighter engine combined with a turbocharger or supercharger can cut engine emissions without reducing performance. A turbocharged 4-cylinder engine can have the same performance as a 6-cylinder engine, while emitting less CO_2 pollution. Turbocharged engines are popular in Europe.

- **Other engine improvements.** Technology exists to cut CO_2 pollution caused by the additional load on the engine from such accessories as air conditioners, power-steering pumps, and lubrication systems. Electric motors powered by a higher voltage electrical system (42V vs. today's 12V) can also reduce pollution through reduced accessory load. Higher manufacturing tolerances and improved oil and transmission fluids that cut engine friction can also help cut CO_2 pollution.

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OTHER TECHNOLOGIES TO CUT CO_2 POLLUTION

- **Better transmissions.** By better matching the engine speed to the transmission gear ratio, CO_2 emissions can be cut by allowing the engine to run closer to its optimal point. One way to do this is by adding another gear or two to a standard 4-speed transmission. Another technology is a **continuously variable transmission (CVT).** CVT allows an infinite number of gears and is usually operated by a belt or chain, similar to bicycle gears. CVTs are gaining popularity in the U.S. and are being currently offered in hybrids and some conventional cars.
- **Slicker aerodynamics.** Racing car drivers already know this, and so do most auto manufacturers. Simply designing a car to reduce drag is an effective way to reduce global warming pollution.
- **Low-rolling-resistance tires.** Lower friction-tread materials and improved tread design can cut global warming pollution by reducing the load on the engine. Michelin and Goodyear sell tires that they advertise as low rolling resistance.
- **Lower carbon fuels.** Fuels such as ethanol, hydrogen, electricity and natural gas, in either dedicated or hybrid vehicles, or in a fuel blend can reduce CO_2 emissions from vehicles.

TECHNOLOGIES TO CUT OTHER POLLUTANTS (CH_4, N_20 AND HFC-134a)

- **Improve catalysts to cut CH_4 and N_20 global warming emissions.** Methane (CH_4) and nitrous oxide (N_20) are potent greenhouse gases. Methane results from incomplete burning of gasoline. Nitrous oxide is formed in the catalytic converter. On a pound-for-pound basis, methane is 21 times more powerful than CO_2 as a greenhouse gas. N_20 is 310 times more powerful. By improving the operation of the engine and catalytic converter, these pollutants can be readily cut.
- **Reduce HFC-134a leakage from air conditioners.** The current air conditioning refrigerant used in cars, hydrofluorocarbons (HFC-134a, sometimes called R-134a), is 1,300 times more powerful than CO_2 as a greenhouse gas. Unfortunately, a lot of refrigerant escapes into the atmosphere due to poor seals, improper servicing of air conditioning units, and when the vehicle is scrapped. Simply by using better materials, such as better seals and improved hose materials, refrigerant leakage can be cut in half. In addition, by better matching the compressor to the air conditioning load (through a variable compressor), an improved air conditioning system can cut CO_2 pollution from the tailpipe by reducing load on the engine.
- **Switch air conditioning refrigerants.** HFCs can be replaced with other gases that have less, or no impact on global warming. Manufacturers are currently developing systems that run on alternative refrigerants such as HFC-152a or even CO_2. HFC-152a is about 10 times less potent a greenhouse gas than the current refrigerant, HFC-134a. CO_2 could be captured from power plants and thereby have no net global warming impact. Toyota uses a CO_2 air conditioning system in its fuel cell vehicle that is currently being tested in California.

Technology	Examples
Variable valve timing	*Honda Civic EX, Accord, CRV and Pilot; Toyota Corolla, Camry, RAV4 and 4Runner, Sienna; BMW 3 series*
Cylinder deactivation	*GM will introduce on V8 Vortec engines for SUVs and pickups in 2004*
Continuously Variable Transmission	*Honda Civic Hybrid, Toyota Prius, Saturn Vue AWD4, Audi A4 and A6*
Lower rolling resistance tires	*Michelin Energy MXV4 and Goodyear Viva 2*
CO_2 based air conditioning system	*Toyota Fuel Cell Vehicle*

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