2004-2005 MARIN COUNTY GRAND JURY

TITLE OF REPORT: *What's the Alternative? A Review of Marin County Department of Public Works Garage Vehicle Acquisition Policy*

Date of Report: January 12, 2005

What's the Alternative? A Review of Marin County Department of Public Works Garage Vehicle Acquisition Policy

SUMMARY

To reduce its operating costs and adverse impact on the environment, the Marin County Department of Public Works (DPW) has begun replacing some of its conventional gasoline-driven vehicles with hybrid gas/electric vehicles and experimenting with use of biodiesel fuel in County diesel vehicles. The Grand Jury sought to test the cost-effectiveness and impact of this environmentally-conscious vehicle initiative.

Charged with protecting taxpayers' interests, the Grand Jury was principally concerned with preventing exorbitant financial burdens on Marin County, ensuring that taxpayers' dollars are spent wisely and preserving Marin County's natural assets. The Grand Jury therefore scrutinized the DPW's practices with regard to its vehicles, operating costs, and the rationale for alternative-fuel vehicles (discussed further in Appendix D).

Ultimately, the Grand Jury found that the DPW's initiative is well-planned and effective: The hybrid vehicle and biodiesel fuel innovations have a negligible impact on DPW's annual operating costs and, therefore, reduce DPW's adverse impact on the environment at no cost to taxpayers.

This report explores the details and costs of DPW's environmentally-conscious practices and makes some recommendations to further those practices.

BACKGROUND

The following fact led to this investigation:

> One of the 2004-2005 goals of the DPW Garage's approved 2004-2005 budget is to "replace aging vehicles with hybrid vehicles when possible." The County has increased the fleet of hybrid vehicles to a total of 12 to date out of a total fleet of 406. (A summary breakdown of the Marin County vehicle fleet inventory is provided in Appendix A.)

As a consequence, the Grand Jury decided it was timely to ensure that DPW and the County Garage program goals and objectives are the most economical for Marin County taxpayers.

METHODOLOGY

The Grand Jury divided the investigation into five parts:

1. Understand the sources and rationale for the current policy to replace aging vehicles with hybrid vehicles when possible
2. Understand the operating economics of alternative vehicles
3. Understand the impact of the vehicle replacement policy on the DPW's operations budget
4. Examine the policies, experiences, and plans of comparable organizations
5. Examine the feasibility of the DPW Garage making its own fuel

The Grand Jury collected data and information through:

- Interviews with County and State agencies
- Review of vehicle cost records provided by the DPW Garage
- Review of publicly available literature on hybrid, flex-fuel (capability to use more than one kind of fuel, typically gasoline and/or ethanol), and bio-diesel vehicles
- Information provided by other organizations utilizing alternative vehicle/fuels

DISCUSSION

1 DPW Vehicle Acquisition Policy

The objective of the DPW's vehicle acquisition policy is to improve the efficiency of the DPW. The DPW includes public works, garage, and environmental departments. The DPW is dedicated to saving energy and fuel, as well as protecting the environment and complying with the County's policies expressed in Appendix B. The DPW's vehicle acquisition policy is as follows:

VEHICLE REPLACEMENT ACQUISITION PURCHASE POLICY

When vehicles are to be replaced as part of the Vehicle Acquisition Program, the following criteria apply:

1. Replacing a non-SUV with an SUV requires an explanation of the nature of the need and approval by the County Administrator
2. Replacing an SUV requires a review of the original purpose of the SUV and determination if it is still valid
3. All new vehicles purchased for the purpose of the Motor Pool must be hybrid unless specifically exempted by the Public Works Director for a specific reason
4. All non-emergency sedans that are programmed to be replaced will be replaced with hybrid vehicles unless the Public Works Director makes an exception
5. Currently we are experimenting with six bio-diesel (B-20) vehicles. The intention is that, as we continue to be successful, we will continue to expand the number of fleet vehicles using bio-diesel and the percentage of bio-diesel

The DPW came to their policy by experimentation:

- They experimented with dual-fueled vehicles (natural gas/gasoline), but this proved impractical because when drivers ran out of one fuel, they didn't refill since there was only one natural gas station available (at a PG&E depot located some distance from the DPW garage). The DPW found the construction of their own natural gas station to be prohibitively expensive (over $500,000), and plans were abandoned

- They experimented with electric sedans but found they were not suited for DPW needs, as distances in the county and limited recharging stations made them impractical

- Experiments with hybrids began in 2002 and have been successful as indicated by their popularity in the DPW Motor Pool. The DPW estimates that 10-15% of its fleet could be hybrids based on current hybrid technology, and could replace 50-75 conventional vehicles

The DPW does not actively participate in trade associations with other operators of similar vehicle fleets.

2 Operating Economics of Alternative Vehicles

To assess the relative operating costs of hybrid vehicles and biodiesel vehicles vs. comparable conventional vehicles, the DPW's actual experience has been used where available. Where DPW data was not available, published data believed to be reliable, based on the source, has been provided.

The life-cycle operating costs of hybrid vehicles vs. conventional vehicles:

The Department of Public Works purchased 17 passenger vehicles (sedans) for model years 2002-2004 (excluding the Sheriff's Crown Victorias specially equipped for police work). Twelve of these were hybrids:

- The purchase prices for the conventional sedans averaged $20,248 each, and the cost of hybrids averaged $21,827 each. (A $2,000 grant for each vehicle from the Bay Area Air Quality Board reduced the actual purchase price to $19,827.)
- Based on the DPW's fuel and repair cost data on a lifetime-to-date basis, hybrids averaged $0.0779 per mile and conventional sedans averaged $0.1119 per mile, a 30% operating cost advantage for the hybrids.
- Real world mileage testing by "Motor Trend" magazine for their May 2004 issue showed combined city and highway mileage at 53.0 mpg for the 2004 Toyota Prius, 51.7 mpg for the 2003 Prius, and 45.9 mpg for the 2004 Honda Civic hybrid. This is significant when compared to the Pontiac Grand Prix at 30 mpg, Honda Accord at 34 mpg, Ford Crown Victoria at 25 mpg, or the Ford Taurus at 27 mpg.
- While battery life and battery replacement costs are a potential problem, data are not yet available in the U.S. Toyota has a 100,000-mile warranty for their traction battery, and, based on laboratory bench testing, its expected life is 150,000 miles.

The environmental offsets between the two are significant – the Prius scoring a 10 (best) on the U.S. Environmental Protection Agency (EPA) scale of 1-10 in air pollution and greenhouse house gases while the Ford Crown Victoria scored 8 in air pollution and 4 in greenhouse gas emissions (see Appendix C for an explanation of EPA scoring).

The life-cycle operating costs of biodiesel fueled vehicles vs. conventional diesel fueled vehicles:

Biodiesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is safe, biodegradable, and reduces serious air pollutants such as particulates, carbon monoxide, hydrocarbons, and other air-born toxins. Blends of 20% biodiesel with 80% petroleum diesel (B-20) can generally be used in unmodified diesel engines. Biodiesel can also be used in its pure form (B-100), but it may require certain engine modifications to avoid maintenance and performance problems.

The DPW has diesel vehicles ranging from pickups, street sweepers, graders, light trucks, dump trucks to emergency vehicles (fire trucks and ambulances) costing $450,000-$500,000 each.

The DPW has six diesel vehicles in its biodiesel fuel test program. (At this time emergency vehicles are not included in the fuel test program.) Since biodiesel (B-20) does not require any engine modification, the only life-cycle cost comparison is the amount of fuel used and the cost of fuel.

- Since no vehicles were purchased exclusively to run on B-20 biodiesel fuel, vehicle costs were determined to be irrelevant.
- The data collected indicates that the fuel consumption (mpg) of biodiesel-fueled vehicles is comparable to that of diesel-fueled vehicles.
- The DPW's test program is using B-20 biodiesel fuel, which currently costs 18 cents more per gallon than conventional diesel fuel.

The primary objective for the DPW's test program is to establish a "user comfort level" with biodiesel fuel.

The DPW also wants to know what problems they might encounter in fuel storage. For example, the biological component of biodiesel tends to support mold growth if there is any water in the system (including vehicle fuel tanks). The DPW also is collecting data on maintenance. Information from other users indicates that adding higher percentages of the biological component to the petroleum-derived component causes deterioration of rubber seals in the fuel system. The DPW wants to determine if this will also occur using the lower percentage (B-20) in their vehicles. Performance data from other users indicates this is not a problem; however, DPW wants to move slowly on this test program, gradually adding their diesel engine vehicles to the program.

Additional background on the general economics of alternative vehicles is provided in Appendix D.

3 Impact of the Vehicle Replacement Policy on the DPW's Operations Budget

The DPW's budgeting process for the purchase of vehicles (as with other equipment) is through an "escrow account." Funds are drawn from the requesting department's budget to satisfy the escrow account, and purchases are not made until sufficient moneys are in the escrow account to make the purchase. Therefore, and because the number of vehicles involved is small, no significant impacts to the DPW budget were identified.

The as-yet immeasurable factors that could affect the Garage budget in the long run are:

- The life-cycle costs of hybrid vehicles. As mentioned in Section 2, there are some untested concerns about a potentially higher cost of maintenance and battery replacement over the life of the vehicle. Hybrid car technology has not been around long enough to know whether these are valid.
- Future operating cost of conventional gasoline-driven vehicles and comparative advantages of hybrids. (E.g., in 2008, the cost of operating a gasoline-driven vehicle may be substantially more than the 11 cents per mile compared earlier to the hybrid's present average cost of 7.8 cents per mile.)
- The operating costs of biodiesel vehicles. The biodiesel test program is currently using 500 gallons of B-20 bio-diesel fuel/week at a cost increase/week of approximately $90.00. If the program proves successful, DPW plans to fuel the majority of its diesel vehicles with B-20 diesel fuel, replacing the current usage of 67,000 gallons/year at an estimated diesel fuel annual cost increase of $12,060.

Thus, there is no immediate impact on the DPW's operating budget. Future impact on DPW's budget is not predictable; there is a possibility that hybrid vehicles and bio-diesel may cost more than traditional gasoline-driven vehicles over the life of the vehicle, while there is also the probability that they may cost less.

4 Policies, Experiences, and Plans of Comparable Organizations

The Grand Jury reviewed two comparable vehicle fleets. These fleets included alternate fuel vehicles, electric vehicles, and hybrids.

The smallest fleet reviewed was that of the Arcata California Department of Public Works. The City of Arcata is in the process of converting 25% of their city vehicles to alternative fuels by the year 2010. Arcata is experimenting with electric vehicles, compressed natural gas (CNG) vehicles, and hybrids. Road paving equipment and two buses use B-20 bio-diesel. So far there have been no major problems. The CNG test vehicles are pick-up trucks. These have two drawbacks: Their CNG fueling system requires all night to refuel, and converting a vehicle to CNG costs approximately $5,000.00. All of their hybrids are sedans. They found that the traction battery has a shorter life span if the vehicle is not used daily.

The largest fleet reviewed is that of the City of Berkeley. They have converted all of their diesel vehicles to run on biodiesel. Nearly 200 city trucks and buses use biodiesel made from vegetable oils. The only Berkeley diesels not yet converted to biodiesel belong to their Fire Department. Conversion of those trucks will take place when accommodations for delivering and storing biodiesel at the fire stations are made. Berkeley started using biodiesel three years ago. In their first year, they used a B-20 mixture. After one year, the results were so positive that city officials mandated they use B-100. This resulted in the following problems: fuel hoses decayed, lift pumps malfunctioned, vehicles required more maintenance, and the B-100 cost more than B-20. Even though it is more expensive, B-100 burns cleaner than B-20, thus causing less atmospheric pollution. Berkeley purchases its biodiesel from an outside company.

5 The Possibility of the Marin County DPW Garage Making Its Own Fuel

The DPW has a very limited need for fuels they could produce for the following reasons:

- They rejected a flex-fuel (natural gas/gasoline fuel) program because of lack of support from the drivers. (There are two vehicles in the fleet still capable of being used as dual fuel vehicles.)
- Alcohol-fueled vehicles are not being tested.
- The current vehicle of choice being tested is the electric hybrid, which uses conventional gasoline.
- The DPW is currently in the test stages of biodiesel vehicles; if the test program is successful, the DPW will move to use biodiesel in most of their diesel engines. The DPW estimates the volume of biodiesel to be used in this year's test program to be 26,000 gallons. The current usage of diesel is 67,000 gallons/year. A conservative estimate of the volume of biodiesel required to make the manufacture of biodiesel economically feasible is at a minimum 1,000,000 gallons/year. Obviously the amount of biodiesel fuel required to meet the County's needs is insufficient to warrant manufacture of its own biofuel. Additionally, the regulatory compliance measures for the manufacture and storage of fuel are too expensive to be justified for this small a volume.

ANALYSIS

As stated in the opening paragraphs, in conducting this investigation the Grand Jury was principally concerned with promoting environmentally-beneficial practices, while ensuring that taxpayers' dollars are spent wisely, and preventing exorbitant financial burdens on Marin County. On principle, we salute any organization's efforts to reduce the environmental impact of its activities, especially when its activities have as broad a reach as that of the Department of Public Works. We wanted to be certain, however, that in addition to being well-intentioned, the hybrid vehicle and biodiesel innovations are also well-planned, impactful, and do not carry with them an exorbitant cost.

It is the Grand Jury's ultimate finding that the DPW's initiative is well-planned and effective: The hybrid vehicle and biodiesel fuel innovations have a negligible impact on DPW's annual operating costs and, therefore, reduce DPW's adverse impact on the environment at no cost to taxpayers.

FINDINGS

F1. The DPW has an ongoing program of testing alternative fueled vehicles and fuels. The DPW has instituted an effective initiative that reduces operating costs and environmental impact of the County's vehicle use.

F2. The production of alternative fuels would not be economical for the DPW.

F3. The DPW tends to operate independently without significant participation in trade associations with operators of comparable vehicle fleets.

RECOMMENDATIONS

The Grand Jury recommends that the DPW:

R1. Continue its vehicle acquisition policy and program.

R2. Develop documentation of life-cycle cost studies that measures the anticipated benefits of any new vehicle in order to determine whether investing in experimentation is justified. Measurements should be used during experimentation and afterwards to determine whether anticipated benefits have been realized. This capability would also facilitate explaining the cost/benefit trade-offs of alternative fuel vehicles to the Board of Supervisors and the public.

R3. Not undertake production of its own alternative fuels.

R4. Consider active participation in trade associations, such as the American Public Works Association (APWA), the Public Fleet Supervisors Association (PFSA), and the National Association of Fleet Administrators. Participation in other organizations with similar fleet management challenges should be beneficial, particularly during a period of technological change. With regard to these trade associations, the DPW should not only consider what it might gain by participating but what it might *contribute* as a leader in innovation.

R5. Publicize its vehicle management program through its Website, local newspapers, public presentations, etc., so the Marin County public can appreciate their program and its accomplishments.

REQUEST FOR RESPONSES

Pursuant to Penal code section 933.05, the Grand Jury requests responses as follows:

- Marin County Department of Public Works

APPENDICES

Appendix A Marin County Vehicle Fleet Inventory

Appendix B Goals of the Countywide Plan

Appendix C U.S. Environmental Protection Agency Green Vehicle Guide

Appendix D Operating Economics of Alternative Vehicles
    Attachment 1 to Appendix D Green Vehicle Guide
    Attachment 2 to Appendix D Hybrids - A Marriage of Convenience - *Consumer Reports*

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<u>U. S. Clean Air Act.</u> U. S. Environmental Protection Agency.

APPENDIX A

MARIN COUNTY VEHICLE FLEET INVENTORY

Type of Vehicle	Number
Sheriff, patrol & undercover vehicles	109
Fire SUVs	7
Motor pool (most likely to be replaced by hybrids)	79
21-25 passenger buses	1
Pickups – 1 ton	106
Service trucks	3
Vans	12
Street sweepers	2
Ambulances	5
Medium use vehicles	15
Heavy use vehicles	34
Heavy use rescue vehicles	4
Fire Trucks	20
Other fire vehicles	2
Trailers	5
Gradalls	2
Total	**406**

APPENDIX B

Goals of the Countywide Plan

"The County of Marin has been famous as a beautiful piece of the planet, forest and farm and headland, and for the extraordinary things done here, against all odds, toward keeping that beauty whole." It took spirit and fight to "keep the beauty whole"--not only in rural West Marin, but also in urban East Marin with its irreplaceable bayfront wetlands. That spirit is still alive and is reflected in this plan.

The 1973 Countywide Plan included three goals which expressed community consensus about Marin's future. The goals were:

- Discourage rapid or disruptive population growth, but encourage social and economic diversity within communities and in the County as a whole.
- Achieve greater economic balance for Marin, by increasing the number of jobs and the supply of housing for people who hold them.
- Achieve high quality in the natural and built environments, through a balanced system of transportation, land use, and open space.

These three goals were carried over to the 1982 Countywide Plan along with a fourth one which reflected the emphasis on energy conservation in the 1982 update. The energy conservation goal stated:

> Achieve a sustainable energy future for Marin County by reducing total energy demand; and by replacing substantial dependence on nonrenewable, imported energy resources with greater reliance on local, renewable energy resources.

The Marin County Board of Supervisors adopted the following updated goals for the Countywide Plan. These goals restate some of the earlier goals in more direct language and express the desires expressed in the public participation process on the plan.

- To preserve and enhance agricultural, recreational, and open space resources and the natural environment.
- To strive for high quality in the built environment.
- To preserve and enhance Marin's small-town community character and architectural heritage by encouraging appropriate building design and adaptive use of historical buildings.
- To create housing and varying job opportunities for Marin's economically and socially diverse population by encouraging affordable housing development and retention of clean business and industry.
- To coordinate transportation and land use planning and to provide effective public transit service which reduces dependence on automobiles, thereby reducing traffic congestion and emission of air pollutants.
- To achieve resource conservation by reducing consumption, and recycling and reusing products and resources.
- To encourage inter-jurisdictional planning in Marin to guide development which has adequate public services and maintains a high quality of life within communities and in the County as a whole.
- To recognize Marin's role as part of the Bay Area and to encourage working relationships with neighboring counties in dealing with regional concerns about planning and capital improvement projects.

APPENDIX C

U.S. Environmental Protection Agency

Green Vehicle Guide - Note Set Print to Landscape

How to Use This Guide
Look up a Vehicle
About the Ratings
Q's and A's
What You Can Do
Download Vehicle Lists
Links to Related Sites
Get E-mail Updates

About the Ratings

- This guide uses emission levels and fuel economy values to determine environmental scores for cars and trucks.
- Every vehicle listed in this guide meets federal emission and fuel economy requirements. Some larger vehicles may be exempt from fuel economy requirements.
- Three pieces of information about a vehicle's environmental performance are presented: the Air Pollution Score, the Greenhouse Gas Score, and the Fuel Economy estimates. Together, they give a complete picture of the relative environmental performance a vehicle is expected to achieve.
- The scores range from 0 to 10, where 10 is best (and "best" means the lowest emissions). The scores can be used to compare all vehicles and all model years against one another.
- The fuel economy estimates are the same "City" and "Highway" values that are posted on the window stickers of new vehicles. The estimates can be used to compare the fuel economy of different vehicles. Of course, your actual mileage may vary depending on driving conditions.

Air Pollution Score

The Air Pollution Score is based on the level of pollution that produces smog and causes health problems. The score allows you to compare the expected pollution levels of different vehicles. The scoring is from 0 to 10, where 10 is cleanest.

The levels of pollution for each vehicle are determined by the official EPA or California exhaust emission standards for the major pollutants in vehicle exhaust. These include nitrogen oxides (NOx) and non-methane organic gases (NMOG), which combine in the presence of sunlight to create smog. They also include the health-affecting pollutants particulate matter (PM), a lung irritant, and carbon monoxide (CO), a poisonous gas. For more information on EPA's vehicle emission standards program, click here.

The average Air Pollution Score for model year 2004 is 5. This average will increase in the next few years as EPA's new stringent "Tier 2" emission program requires cleaner cars and trucks to be sold. In the fall of 2004, we'll be revising the scale of the Air Pollution Score to take these cleaner vehicles into account.

APPENDIX C

A higher score means a vehicle is designed to emit less pollution. This chart shows the emissions standards and the expected amounts of air pollution for each Air Pollution Score. This Air Pollution Score will be updated in the fall of 2004 to reflect the new, tighter emission standards.

Fuel Economy

The fuel economy estimates provide the EPA miles-per-gallon City and Highway values for each car and light truck. These estimates are the same as those seen on the window stickers of new vehicles and in the Fuel Economy Guide published annually by EPA and DOE (available at auto dealers, public libraries, and online at www.fueleconomy.gov). These estimates are meant to be used to compare the fuel economy of one vehicle to another. Of course, your actual mileage may vary depending on driving conditions.

Vehicles with higher fuel economy save natural resources and create less carbon dioxide–a greenhouse gas–than vehicles with lower fuel economy. Every gallon of gasoline burned puts 20 pounds of carbon dioxide into the atmosphere.

Greenhouse Gas Score

The Greenhouse Gas Score allows you to compare the expected amount of greenhouse gas emissions for different vehicles. The scoring is from 0 to 10, where 10 represents the lowest amount of greenhouse gases.

The Greenhouse Gas Score reflects the exhaust emissions of carbon dioxide (CO_2), a greenhouse gas, and one of the biggest by-products of engine combustion.

The Greenhouse Gas Score is determined by the vehicle's estimated fuel economy and its fuel type. The lower the fuel economy, the more carbon dioxide is emitted as a by-product of combustion. The amount of carbon dioxide emitted per gallon of fuel burned varies by fuel type, since each type of fuel contains a different amount of carbon per gallon.

The average Greenhouse Gas Score for model year 2004 is 5.

A higher score means a vehicle is expected to emit less carbon dioxide. The chart below shows the combined mpg for each fuel type at each score. It also shows the expected amount of carbon dioxide emissions per mile for each score. Combined mpg is calculated from the City mpg and Highway mpg on the window sticker and in this guide, as follows:

$$\text{Combined mpg} = \frac{1}{\dfrac{0.45}{\text{City mpg}} + \dfrac{0.55}{\text{Highway mpg}}}$$

Fuel Economy: Combined mpg

APPENDIX C

Greenhouse Gas Score	Pounds CO2 per mile	Gasoline	Diesel	E85	LPG	CNG
10	Less than 0.45	44 and higher	50 and higher	31 and higher	28 and higher	33 and higher
9	0.45 to 0.54	36 to 43	41 to 49	26 to 30	23 to 27	27 to 32
8	0.55 to 0.64	30 to 35	35 to 40	22 to 25	20 to 22	23 to 26
7	0.65 to 0.74	26 to 29	30 to 34	19 to 21	17 to 19	20 to 22
6	0.75 to 0.84	23 to 25	27 to 29	17 to 18	15 to 16	18 to 19
5	0.85 to 0.94	21 to 22	24 to 26	15 to 16	14	16 to 17
4	0.95 to 1.04	19 to 20	22 to 23	14	13	14 to 15
3	1.05 to 1.14	17 to 18	20 to 21	13	12	13
2	1.15 to 1.24	16	18 to 19	12	11	12
1	1.25 to 1.34	15	17	11	10	11
0	1.35 and up	14 and lower	16 and lower	10 and lower	9 and lower	10 and lower

More information on this important environmental topic can be found at www.epa.gov/globalwarming.

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Last updated on Monday, June 21st, 2004
URL: http://www.epa.gov/greenvehicles/about.htm

APPENDIX D

OPERATING ECONOMICS OF ALTERNATIVE VEHICLES

Marin County residents made over 750,000 daily trips in 1998. [1] There are significant impacts resulting from this many vehicles on the road which include congestion, diminished air quality, road repairs, highway redesign, petroleum used, etc. Estimating a 20-mile average per trip (arbitrary average) equates to an estimated 15,000,000 and using an average of 18 miles per gallon of gasoline, an estimated 833,333 gallons of gasoline were burned.

Only about 15% of the energy in the fuel put into a gas tank gets used to move a car down the road or run useful accessories like air conditioning or power steering. The rest of the energy is lost.

Just over 18% of the energy in gasoline makes it to the transmission. Losses in the drive train to friction and slippage claim more than 5%, leaving a bit less than 13% to actually move the vehicle down the road. The laws of physics will not permit all of these losses to be entirely eliminated.

The 12.6% of original fuel energy that makes it to the wheels must provide acceleration (5.8 %) and overcome aerodynamic drag (2.6%) and rolling resistance. In stop and go city driving it is not surprising that acceleration is the biggest need, rolling is next, followed by aerodynamic drag. On the highway the order is reversed: aerodynamic drag, which increases at an increasing rate with speed requires the most energy (about 10.9%). Each of these final uses of energy also represents an opportunity to improve fuel economy. Substitutions of high strength lightweight materials can reduce vehicle mass and thus the energy required for acceleration.[2]

The exhaust from internal combustion engines contains chemicals including carbon dioxide, (1 gallon of gasoline is responsible for producing 20 pounds of carbon dioxide[3]) nitrogen oxides, hydrocarbons, and sulfur dioxide. All this chemical soup makes smog.

Diesel engines produce more power per gallon of fuel than a gasoline engine, and therefore obtain more miles per gallon but their exhaust is much ‘dirtier’. The exhaust from newer turbocharged diesel engines is not as ‘dirty’ as the exhaust from the older engines which you may have observed ‘smoking’ on hard acceleration or hills.

An alternative fuel vehicle (AFV) is a vehicle that can operate on a fuel other than gasoline or petroleum based diesel, such as biologically produced diesel (biodiesel) electricity, ethanol, hydrogen, methanol, natural gas, or propane. AFV’s range in function and size from small passenger cars to large 18-wheeler trucks or transit buses. Off-road products such as forklifts, and agricultural and construction equipment are also available with alternative fuel systems. Fuel cell and hydrogen powered vehicles are many years away from production and even then the primary fuel for conversion will be natural gas. The bonus from these however, is that they exhaust only water vapor.

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[1] Marin County 25 Year Transportation Vision
[2] U.S. EPA see also www.fueleconomy.gov
[3] U.S. EPA

PERKS AND CONVENIENCES

Using alternative fuels helps reduce the nation's dependence on imported oil. Alternative Fuels can be derived from renewable biological feedstock or are a by-product of petroleum production. For example ethanol can be fermented from corn or wood waste, while natural gas or propane is produced in conjunction with crude oil production. Some alternative fuels can also reduce vehicle maintenance requirements. For example, spark plugs from a propane-fueled vehicle last from 80,000 to 100,000 miles and engines can last 2 to 3 times longer than gasoline- or diesel-fueled engines.

CHARGING/FUELING

Depending on the fuel, a vehicle may be configured with either dedicated or dual-fuel systems. Vehicles with dedicated systems are designed to run exclusively on a particular alt fuel while dual-fuel vehicles have two separate fueling systems that can operate on either the alternative or conventional fuel. Different alternative fuels are dominant in different regions of the country. Propane is the most widely available, with stations in every state, while ethanol blends are concentrated in the Midwest and plains states. Generally refueling times are comparable with those needed for gasoline or diesel refueling.

TECHNOLOGY

Alternative fuel vehicle availability varies by fuel type. Currently light duty vehicles capable of using compressed natural gas (CNG), ethanol, and blended biodiesel are in production. Various heavy-duty vehicles using CNG, liquefied natural gas, propane, or biodiesel are available. Alternative fuel conversion kits are available for propane. The majority of propane-fueled vehicles are the result of aftermarket conversion.

SAFETY

Alternative fuel vehicles (AFVs)) meet federal motor vehicle safety requirements. The pressurized containers of fuels such as liquefied propane and compressed natural gas go through rigorous safety testing.

ENVIRONMENTAL BENEFITS

AFVs produce fewer emissions than those powered by gasoline or diesel fuel. Emission reductions of up to 80 percent for pollutants such as carbon monoxide, carbon dioxide, non-methane organic gas, oxides of nitrogen, or particulate matter can be achieved. The amount of emission reductions varies by alt fuel type and pollutant.

ENVIRONMENTAL IMPACTS

Air pollution can stunt lung growth in children, according to the recent conducted on children's exposure to air pollution. The research found that the lung damage is serious enough to lead to a lifetime of health problems and, in some cases, premature death.

Scientists have long known that smog aggravates respiratory conditions such as asthma. But until recently, they were uncertain whether the dirty air caused the problems or simply made pre-existing medical conditions worse.[4]

The use of alternative fuels[5] and vehicles[6] can reduce these conditions and have also helped reduce U.S. petroleum consumption. Note that the vehicle rated number 1 on fuel economy is the Honda Insight at 57 miles per gallon (mpg) in the city and 56 mpg on the highway.[7] The number 10 vehicle is the Mazda 3 gasoline powered 2L 4 cylinder 2 WD vehicle achieving 26 mpg in the city and 34 mpg on the highway.

The 157,000 alternative fuel vehicles the Clean Cities program stakeholders added displaced approximately 133 million gallons of petroleum.[8]

Reducing gasoline and/or diesel consumption not only spares the air and reduces fuel costs for the vehicle owner but also reduces the U.S. dependence on foreign oil.

(Some of the information in this report is derived from data acquired from the Department of Energy)

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[4] The study, to be published in the New England Journal of Medicine, provides the most definitive evidence yet that routine exposure to dirty air during childhood actually harms lung development, leading to a permanently reduced ability to breathe. Underpowered lungs are known to cause a wide range of health problems. (*Excerpted from article by Miguel Bustillo, Times Staff Writer and published in Marin Independent Journal 09/25/04*)

[5] Alternative fuels, as defined by the Energy Policy Act of 1992 (EPAct), include ethanol, natural gas, propane, hydrogen, biodiesel, electricity, methanol, and p-series fuels.

[6] Attachment 1 to APPENDIX D The US EPA 'Green Vehicles Guide" ranks the air pollution, fuel economy and greenhouse gas emissions of 33 vehicles manufactured in 2004. To view all the vehicles please go to www.epa.gov/greenvehicles see also www.fueleconomy.gov for side-by-side comparisons of all vehicles.

[7] Attachment 2 to APPENDIX D Consumer Reports October 2004

[8] See http://www.eere.energy.gov/cleancities/ for information on the Clean Cities program.

Attachment 1 to APPENDIX D

U.S. Environmental Protection Agency

Green Vehicle Guide

All Vehicles Sorted by Rating for Model Year 2004

Note set print to landscape

Model	Vehicle Specs	Sales Area	Air Pollution Score	Fuel Economy	Greenhouse Gas Score
HONDA Insight	1L (3 cyl) Auto-AV 2WD Gasoline 4HNXV01.0NCE		10	CITY mpg 57 HWY mpg 56	10
TOYOTA Prius	1.5L (4 cyl) Auto-AV 2WD Gasoline 4TYXV01.5MC1		10	CITY mpg 60 HWY mpg 51	10
HONDA Civic Hybrid	1.3L (4 cyl) Auto-AV 2WD Gasoline 4HNXV01.37CP		10	CITY mpg 47 HWY mpg 48	10
HONDA Civic Hybrid	1.3L (4 cyl) Man-5 2WD Gasoline 4HNXV01.37CP		10	CITY mpg 45 HWY mpg 51	10
HONDA Civic	1.7L (4 cyl) Auto-AV 2WD CNG 4HNXV01.74W3		10	CITY mpg 30 HWY mpg 34	9
NISSAN Sentra	1.8L (4 cyl) Auto-L4 2WD Gasoline		10	CITY mpg 28 HWY mpg 35	8

Attachment 1 to APPENDIX D

NISSAN Sentra	1.8L (4 cyl) Man-5 2WD Gasoline 4NSXV01.883A		10	CITY mpg HWY mpg 28 35	8
MAZDA Mazda 3	2L (4 cyl) Man-5 2WD Gasoline 4TKXV02.0FJ1		10	CITY mpg HWY mpg 28 35	8
MAZDA Mazda 3	2L (4 cyl) Auto-S4 2WD Gasoline 4TKXV02.0FJ1		10	CITY mpg HWY mpg 26 34	7
KIA Spectra	2L (4 cyl) Auto-L4 2WD Gasoline 4KMXV02.0J01		10	CITY mpg HWY mpg 24 34	7
FORD Focus	2.3L (4 cyl) Man-5 2WD Gasoline 4FMXV02.3VLC		10	CITY mpg HWY mpg 25 33	7
FORD Focus Station Wagon	2.3L (4 cyl) Man-5 2WD Gasoline 4FMXV02.3VLC		10	CITY mpg HWY mpg 25 33	7
HONDA Accord	2.4L (4 cyl) Auto-L5 2WD Gasoline 4HNXV02.4KCV		10	CITY mpg HWY mpg 24 34	7
HYUNDAI Elantra	2L (4 cyl) Auto-L4 2WD Gasoline 4HYXV02.0XPC		10	CITY mpg HWY mpg 24 32	7
VOLKSWAGEN Jetta	2L (4 cyl) Man-5 2WD Gasoline 4VWXV02.0227		10	CITY mpg HWY mpg 24 31	7
VOLKSWAGEN Jetta	2L (4 cyl) Auto-L4 2WD Gasoline 4VWXV02.0227		10	CITY mpg HWY mpg 24 30	7
FORD Focus	2.3L (4 cyl) Auto-L4 2WD Gasoline 4FMXV02.3VLC		10	CITY mpg HWY mpg 24 30	7
FORD Focus Station	2.3L (4 cyl) Auto-L4 2WD			CITY mpg HWY mpg	

Attachment 1 to APPENDIX D

Wagon	Gasoline 4FMXV02.3VLC		10	24 30	7
TOYOTA Camry	2.4L (4 cyl) Auto-L4 2WD Gasoline 4TYXV02.4MXA		10	CITY mpg HWY mpg 23 32	7
MITSUBISHI Galant	2.4L (4 cyl) Auto-L4 2WD Gasoline 4DSXV02.4G6G		10	CITY mpg HWY mpg 23 30	7
NISSAN Altima	2.5L (4 cyl) Man-5 2WD Gasoline 4NSXV02.585A		10	CITY mpg HWY mpg 23 30	6
NISSAN Altima	2.5L (4 cyl) Auto-L4 2WD Gasoline 4NSXV02.585A		10	CITY mpg HWY mpg 23 29	6
VOLVO S60	2.4L (5 cyl) Auto-L5 2WD Gasoline 4VVXV2.43S2N		10	CITY mpg HWY mpg 22 31	6
CHRYSLER Sebring Sedan	2.4L (4 cyl) Auto-L4 2WD Gasoline 4CRXV0148VX0		10	CITY mpg HWY mpg 22 30	6
DODGE Stratus Sedan	2.4L (4 cyl) Auto-L4 2WD Gasoline 4CRXV0148VX0		10	CITY mpg HWY mpg 22 30	6
VOLVO V70	2.4L (5 cyl) Auto-L5 2WD Gasoline 4VVXV2.43S2N		10	CITY mpg HWY mpg 22 30	6
SUBARU Legacy Wagon	2.5L (4 cyl) Auto-L4 4WD Gasoline 4FJXV02.5NKR		10	CITY mpg HWY mpg 22 28	6
SUBARU Outback Wagon	2.5L (4 cyl) Auto-L4 4WD Gasoline 4FJXV02.5NKR		10	CITY mpg HWY mpg 22 28	6
SUBARU Legacy	2.5L (4 cyl) Auto-L4 4WD Gasoline 4FJXV02.5NKR		10	CITY mpg HWY mpg 22 27	6

Attachment 2 to APPENDIX D

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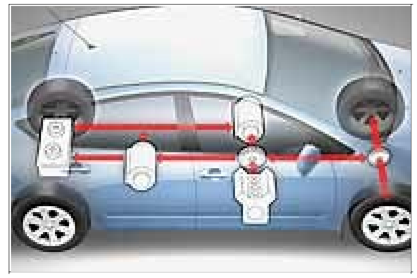
x Close

Hybrids: A marriage of convenience

Pros Good fuel economy, low emissions.
Cons Higher vehicle prices, questions about long-term durability, weight.

Gas-electric hybrid vehicles are an evolution of the intensive push for all-electric vehicles (EVs) that peaked in the '90s. Because of a zero-emission mandate by the California Air Resources Board, billions of dollars have been poured into EVs since the early '90s. Automakers released EV models, including the GM EV-1, Honda EV+, Toyota RAV4 EV, and Ford Ranger EV, but all have been discontinued. Because no car battery can yet provide the power density of a tank of gas, EVs have limited range and hours-long recharge times, which have prevented them from gaining widespread consumer acceptance.



A PRACTICAL COMPROMISE Hybrids couple a gasoline engine with an electric motor to boost fuel economy and cut emissions. The battery is recharged as you drive, so, unlike all-electric vehicles, there's no need to plug in a hybrid.

EV research, however, did yield an important offshoot: the gas-electric hybrid powertrain. This hybrid cuts emissions and improves fuel economy by coupling a conventional gasoline engine with an electric motor. The electric motor runs off a battery pack, which is recharged by the gas engine as you drive, so hybrids never need to be "plugged in." Additional charging can come from "regenerative braking," where the momentum of the braking car turns the electric motor into a generator.

Until recently, only three hybrid models were available, Honda's Civic Hybrid and two-seat Insight and Toyota's Prius, now in its second generation. That's changing. By the end of 2004, there should be several more (See Upcoming hybrid and diesel vehicles.)

Besides saving fuel, hybrids may catch on because they also have the potential to boost performance. For example, Honda says the Accord Hybrid will deliver quicker acceleration than a regular Accord V6, while achieving the fuel economy of a Civic (which we measured at 29 mpg overall). Likewise, Toyota says the Highlander Hybrid and Lexus RX400h SUVs will be quicker and more economical than their nonhybrid counterparts.

There are two basic hybrid powertrain designs, "full" and "mild." With full hybrids, the electric motor provides a significant portion of the power and the vehicle can run on either the gas engine, the electric motor, or both, depending on driving conditions. With mild hybrids, a small electric motor supplements the gasoline engine when necessary, but it cannot power the vehicle by itself. The upcoming Chevrolet Silverado and GMC Sierra hybrid pickups are even "milder;" their systems save fuel simply by using a combination starter-alternator to temporarily turn off the engine while the truck is stopped, restarting instantly when the accelerator is depressed. All hybrids share this feature.

In our tests of the three current hybrids, all provided very good fuel economy compared with similar-sized conventional cars. The 2004 Prius got 44 mpg overall, while the Honda Civic and two-seat Insight got 36 and 51 mpg overall, respectively. However, our mileage calculations were considerably lower than the Environmental Protection Agency figures printed on window stickers and commonly used by automakers: about 40 to 45 percent lower in city driving and about 20 to 23 percent overall.

Some hybrid owners have complained about the discrepancy. The EPA is studying ways to make its fuel-economy numbers more realistic and has recently informed automakers that they can publish lower fuel-economy numbers if they feel such figures are more in line with real-world driving conditions.

Large hybrids are said to get better fuel economy than their nonhybrid counterparts, but they likely won't get the numbers of the smaller hybrids we tested. Still, Tom Stevens, GM's powertrain chief, says, "If you raise fuel economy 10 percent on a 12-mpg vehicle, you save a lot more gallons in a year than if you raise fuel economy 20 percent on a small 30-mpg car." You also burn more than twice as much fuel overall.

While hybrid owners can save money at the pump, hybrids typically cost more than conventional vehicles. A Honda Civic or Accord Hybrid costs about $2,000 more than their nonhybrid versions. A Ford Escape Hybrid is about $3,000 more than a V6 Escape. Tax breaks offered for hybrids by federal and state governments, including a one-time IRS deduction, can help reduce these price differences. For details, go to *www.fueleconomy.gov*.

Without considering tax savings, it can take years for a hybrid to earn back its higher initial cost. For example, if gas costs $2 a gallon, the 44-mpg Prius driven 15,000 miles a year would save about $500 annually compared with a similar nonhybrid sedan that gets 25 mpg, or 19 mpg less. If a hybrid costs $2,000 more, then the break-even point would be about four years. However, if the fuel economy advantage is only 7 mpg, as it is between the Honda Civic Hybrid's 36 mpg overall and the 29 mpg of the conventional Civic EX we tested, it would take almost 10 years to pay back the initial $2,000 price difference.

Attachment 2 to APPENDIX D

Our reliability surveys have shown that the Honda and Toyota hybrids are very reliable so far, but questions remain about the long-term durability of the battery pack. The batteries and hybrid components are warranted for 80,000 to 100,000 miles (150,000 in states with California emissions rules). Toyota maintains that its Prius battery should last the life of the car. A representative told us that since the first Prius was sold in Japan in 1997, no batteries on the cars have worn out. That's good, since replacing a Prius battery pack would cost about $3,000 if not covered by a warranty. When disposal is necessary, the hybrid's nickel-metal-hydride battery is fully recyclable and not nearly as toxic as a lead-acid car battery.

Not everyone thinks the future of hybrid technology is bright. Brett Smith, a senior industry analyst for the University of Michigan's Center for Automotive Research, says that fuel prices would have to go up to about $3.00 per gallon for hybrids to be viable. For now, he says, "I can't see a market beyond the 10 to 15 percent of drivers who really care a lot about fuel economy."