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ENVIRONMENTALLY
FRIENDLY, MULTIFUEL-
COMPATIBLE 300TD WAGON

Eco-BENZ PROJECT



Opposite: The route to finding and building this car was as circuitous as famous Lombard Street in San Francisco, but the results are as environmentally pleasing. This page: The solar panel was eventually rewarded with sunlight, as the fog rolled out through the Golden Gate.

Amid instability in the oil markets, who hasn't heard murmurs of running cars on free waste vegetable oil? As this possibility receives increasing play in local and national media, it poses an intriguing idea worthy of a bit of experimentation.

In 2008, the thought of detaching from fuel selling at \$4 a gallon certainly merited attention, but the reduced environmental impact of using recycled food-grade oil to power an automobile proved even more compelling. The hype was clear: Buy a cheap diesel, fill it with oil from the fryer, and liberate yourself from the global turmoil of Big Oil. The reality wasn't so clear, but the arguments were cogent enough for me to warrant exploration of options for providing propulsion in an automobile.

After I decided to experiment with alternative fuels, I had to choose an appropriate vehicle. Enthusiasm for the Mercedes-Benz brand, coupled with the legendary longevity of the W123 diesels, made the choice easy. If the experiment succeeded, I wanted to have a utilitarian car for local trips, so I set out to look for a wagon.

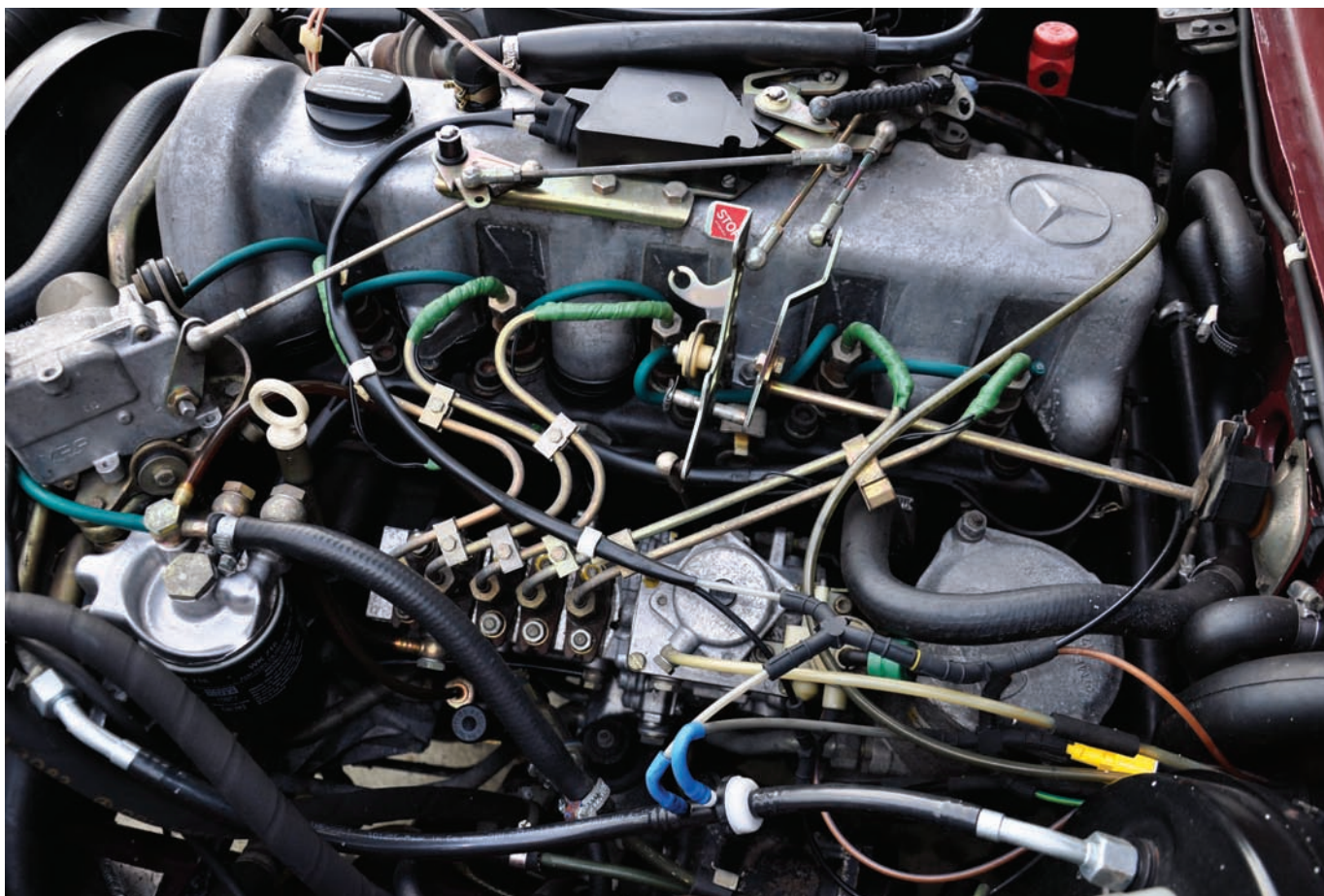
However, finding the right automobile proved a challenge. With the popularity of fuel conversions in Northern California, the price of any decent W123 could be inflated, and the wagons were apparently the Holy Grail, commanding stratospheric prices. After months of searching for the right car (and purchasing and horse-trading a few sedans in the process), I discovered on Craigslist the wagon that would become my "Eco-Benz."

The wagon, a 1983 300TD, registered approximately 240,000 miles on its working odometer. The seller, a Stanford Univer-

sity professor, was the long-term second owner. With faded original paint, a few substantial dents, a cracked windshield, carpets with the patina of a well-worn lifespan, and a price tag of \$700, the car was a perfect "beater" that could be used as the platform for my experiment without breaking the bank.

I took stock of the car as the first step. A thorough cleaning showed that the interior panels, though dirty, were in excellent condition. Power-washing the engine revealed the tag identifying it as a factory-supplied replacement motor. Though no documentation of the replacement existed, diagnostic tests revealed the engine to be in near-mint condition, with no blow-by and perfect compression across the cylinders. Suddenly the cheap beater evolved into something more: a vehicle that could easily be reconditioned to last indefinitely. At this point, the project veered from an opportunity to experiment with veggie oil to a chance to resurrect a solid car with an eye to the environmental sensitivity that drove my initial interest.

From an environmental standpoint, it makes more sense to maintain a well-built automobile than to replace it with even the greenest of current automotive options. I decided a down-and-dirty experiment in alternative fuels would instead become an automotive resurrection that could showcase environmental components and technologies. I revised my goal for the project to build a car that stayed true to the design, engineering, and quality of a Mercedes-Benz while integrating environmentally sensitive upgrades. In addition, I would add a few creature comforts in the process; you never know how much you miss a cup holder until you spend a week in a W123.



The heart of the conversion system is a heating system that heats the oil before the engine reaches operating temperatures through line heaters installed at the tank, in advance of the injection pump, and at each individual injector [green wrapping].

Replacement hoses are made of Viton. A Vormax multi-stage filter, water separator, and heater are shown on page 42. Even with this system, I normally use ASTM-certified biofuel, but it's nice to know that I could run WVO, if necessary.

Designing a Flexible Fuel System

Although my original attraction to the project relied on running the car on free vegetable oil, my research showed this to be a controversial proposition (discussed further in the next article). The potential of running free waste vegetable oil in this excellent engine suddenly seemed fraught with complications. However, the flexibility of running on straight vegetable oil (SVO) or waste vegetable oil (WVO) still appealed, so the design for the fuel system needed to be adaptable. When I finished, I had fitted the Eco-Benz with a hybrid single-tank fuel system that can accept regular petroleum-based diesel, any concentration of ASTM-certified biodiesel, SVO, or WVO.

Running petrodiesel or biodiesel in the car is as easy as filling the tank. The only modification necessary to run an OM617 engine on B100 biodiesel is the replacement of the fuel lines with hoses made of Viton®, which will not degrade with the increased solvent properties of biodiesel. Running the engine on SVO or WVO requires more extensive modifications, including the installation of specialized filters and heaters to condition the oil before delivery to the engine. A Vormax® multi-stage filter provides water separation and particulate filtering to 10 microns, as well as oil heating through the use of a heat exchanger using the engine coolant. Electric line heaters are installed to provide immediate heat to the oil before the engine reaches the temperature required to optimize the

heat exchanger. Electric line heaters are installed at the tank, in advance of the injection pump, and at each individual injector. When running on SVO or WVO, a short fuel return loop is employed to keep heated oil recycling in the engine compartment rather than returning to the tank.

There are arguments for and against the use of unprocessed vegetable oil as a fuel. After experimenting with different combinations, I can report that in the Northern California climate, this car runs beautifully on any mix of petrodiesel, biodiesel, and vegetable oil.

Because of the local interest in anything that helps preserve the environment, the San Francisco Bay Area boasts easily accessible ASTM-certified B100 biodiesel at specialized biodiesel stations, so I typically use it in the Eco-Benz. But when the big quake hits and California slides into the ocean with all its gas pumps shut off, I'll load up with Wesson Oil and see you in Phoenix!

Exterior Restoration

With the design and implementation of the fuel system complete, attention turned to making the car presentable. Selecting a shop to do the work proved easy: European Collision in San Francisco is a Mercedes-Benz Authorized Collision Center known for its impeccable body and paint repair. Ludwik Rutkowski and Dennis Kirkpatrick opened the shop in October



The interior is inspired by environmental concerns. Bamboo veneer has been applied over recycled aluminum, with controls for the biofuel system adapted from M-B components and integrated in the dash. Sisal and hemp carpet is similar to the original pattern. A readout in the luggage area monitors the solar panel output. And it has cupholders and an iPod socket.



2008 with a commitment to preserve Mercedes-Benz vehicles as well as the environment.

Paint selection was straightforward. Although waterborne paint technology is not the norm in the refinishing industry, these paints are more environmentally friendly and have been used in Mercedes-Benz OEM application for years. When Spies Hecker, whose paints are factory-approved by Daimler AG and Mercedes-Benz, learned of the experiment, the company enthusiastically supported the project. The original Orient Red (501) color was not in its waterborne color catalog, so Spies Hecker reps worked closely with European Collision to create a perfect match. It's fun to know that the new color is now permanently listed in the Spies Hecker global database as "Eco-Benz Red."

Interior Restoration and Upgrades

With fuel-system modifications and exterior finishes complete, I tackled the interior of the car. The original MB Tex material lived up to its reputation for longevity, but the dashboard and woodwork showed typical signs of years of exposure to the harsh sun, and the carpeting and headliner definitely needed work. I replaced the carpeting with a sisal and hemp blend carpet from Livos, with a pattern true to the square-weave carpet fit in earlier W123 cars. Using the original carpet as a template, the cutting and installation of the new carpet was a good

weekend project. I also obtained and installed a replacement headliner from GAHH.

I replaced the dashboard with a beautiful original dashboard that had found its way into the OEM parts collection of a local club member. Swapping a complete dash is a pretty extensive job, so it was the ideal time to address a problem plaguing Mercedes-Benzes of this vintage: the servo-controlled climate control. Replacing all of the vacuum diaphragms and installing the solid-state controller from Adsit proved a straightforward solution resulting in a fully adjustable interior climate.

Two other typical glitches in the dash area are the failure of the rheostat controlling the dash illumination and the inevitable failure of the tachometer. The rheostat was repaired and the tach issue corrected with the discovery of a replacement solid-state tach amplifier that uses a RISC processor. Manufactured by Bob Meyers at MBElectronicUpgrades.com, this is an upgrade that every diesel W123 owner should consider.

All the interior woodwork suffered the typical problems: delamination, cracked finishes, and warping of the underlying plywood structure. The solution: new panels artfully created from recycled aluminum by fellow club member Sandy Drobilisch. Cooks Upholstery and Restorations veneered and finished the structural panels with sustainable bamboo. The stunning result deserves attention from Mercedes as it considers interior finishes for the pending hybrid lineup.



The photovoltaic panel produces 160 watts of power, but fits neatly into the original luggage rack. I found Green Diamond "Iceland" all-season tires for the car, which are made of recycled rubber, manufactured using silicon carbide granules for grip. Though some conversion kits even come with insignia saying "Veggie Diesel" in chrome letters, I'll stick to the original, but other Mercedes owners can guess at the meaning of the license plate slogan. The restoration project really got out of hand before I was through, but I'm very proud of the result and enjoy displaying it at alternative fuel shows.



Manufacturing new custom panels provided the opportunity to integrate monitoring and management of the fuel system as well as creature comforts such as cup holders and controls for heated seats.

In keeping with the original look and feel of the car, all switches are factory OEM units internally reworked to control new functions. A converted air recirculation switch controls fuel recirculation when running heated oil, and a repurposed rear window washer/wiper control switch controls the multiple fuel heaters, mounted between period-correct VDO gauges that measure fuel temperature at the tank and the injectors. The controls for the fuel system are located in the original location of the unused ashtray.

Stereo technology has advanced substantially since the original Becker Grand Prix was installed in this car, but rather than buying new, I sent the original Becker to Becker Autosound in New Jersey for a complete upgrade. When the company returned the unit, it had been fitted with an auxiliary input for an iPod, and the original internal amplifier had been bypassed and replaced with two low-level RCA outputs for external amplification provided by multiple Linear amplifiers unearthed in a parts box in my garage. I even found audiophile speakers manufactured from hemp. Now the car boasts the combination of a completely original stereo dash faceplate and the clear, crisp sound of digital music, processed with modern solid-state amplification, broadcast through Hemp Hop speakers.

Other Aspects of the Project

As the project neared completion, one outstanding problem remained: the need for a new set of tires. Although "tires" and "environmental sensitivity" don't often appear in the same sentence, Green Diamond Tire uses recycled rubber, keeping tires out of the landfill. Green Diamond remolds its tires and manufactures them via a sophisticated process that embeds thousands of diamond-hard silicon carbide granules evenly throughout the tire's tread. As the tires wear, the granules become exposed as green flecks in the tread and provide excellent grip characteristics. The tires are available as snow tires or all-season mud and snow models. The Eco-Benz sports the all-season design, and I can report that they are outstanding tires.

As the Eco-Benz became a rolling environmental showcase, a roof-mount solar panel seemed in order. To keep true to the design of the original car, a custom mounting system incorporating the original roof rack was devised. Manufactured from stainless steel, the racking system allows a custom-fabricated solar panel to be adjusted to maximize exposure to the sun.

The panel was fabricated using individual solar cells assembled in a pattern that allows it to fit perfectly between the original rack rails. In

full sun exposure, the photovoltaic panel produces 160 watts of power, processed through a SunForce charge controller custom mounted in the rear interior quarter panel. The charge controller feeds power to a Xanrex 1500 portable power pack for storage and distribution through its built-in inverter. Because the power pack is portable, it can be used inside or outside the vehicle to operate blenders at a tailgate party, 12-volt lights at a campground, or a host of 120-volt appliances and electronics for display use.

Other small upgrades include the use of LED elements in blinkers and taillights and bio-based lubricants. I'm considering the installation of wind turbines in place of the fog lights to generate additional electricity. A little over the top? Perhaps. But compared to the typical conversion of a W123 to run alternative fuel, what part of this car isn't slightly over the top already?

For discussion on the use of alternative fuels, visit the alternative fuels forum on the MBCA website. For detailed information on modifications to the Eco-Benz, visit the project website at www.Eco-Benz.com.

