

# GREEN WAYS

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*Working toward an advanced automotive society*

**DENSO**



### River Cleanup

Matt Matsushita, president and CEO of DENSO's North American headquarters, in Michigan's Rouge River during the Rouge Rescue, an annual volunteer event sponsored by Friends of the Rouge.

Photo: Phillip T. Dattilo

# GREEN WAYS in North America

**DENSO's Green Ways permeate every facet of our global business—from management, initial R&D, product development, manufacturing, distribution and disposal, to our employees and even the communities in which we operate.**

Our green ways are not new. As a young automotive components supplier struggling to get on its feet, DENSO produced an electric car in 1950 – fully 40 years before the first mass-produced electric vehicles hit the roadways in the early 1990s – to demonstrate our technology capabilities.

Today, DENSO supplies advanced automotive technology, systems and components to all the world's major carmakers, employing 106,000 employees in 32 countries.

Automobiles continue to be an essential part of people's daily lives: 800 million are in operation worldwide. But, automobiles do have some negative impact on the environment. DENSO believes helping reduce that impact is one of its most important responsibilities. To do so, DENSO has dedicated its worldwide resources to help create what we call an "advanced automotive society" – a society in which automobiles co-exist in harmony with the environment.

In North America, we're putting into action our second environmental plan, based on DENSO's global EcoVision 2015, our most recent 10-year strategy for DENSO environmental activities throughout the world.

**North American goals for the next five years include:**

#### Eco Products

- Deliver products that are lightweight, energy saving and help improve the environment.
- For all our products, reduce our use of resources; control and reduce environmentally hazardous substances, and integrate environmental planning in the product design stage.

#### Eco Factory

- Reduce the environmental impact of our North American manufacturing facilities (including manufacturing and distribution) through reduced water use, CO<sub>2</sub> emissions, landfill waste and hazardous substance emissions.

#### Eco Management

- Develop environmental action plans at each North American facility and reinforce environmental partnerships with suppliers through activities such as developing green procurement guidelines and promoting the purchase of environmentally friendly products.

#### Eco Friendly

- Contribute to a better society by encouraging and supporting employee environmental activities; proactive information disclosure and communication with stakeholders; environmental education, and environmental and social contributions.

Ultimately, we hope to help prevent global warming, recycle resources and further reduce environmentally hazardous substances in North America.

During our previous five-year North American environmental action plan, all our facilities achieved ISO 14001-certification, a globally recognized and totally voluntary standard of excellence for environmental management.

To truly understand our commitment, please read the following pages.



Photo: Maryville Daily Times

## Lasting Memorial

House of Payne members Mary Jo Beard, Scott Brackett, Eric Brewer, Tina Crisp, Gary Hughes, Jeff Montgomery, Jamie Raby, Steve Ridley, Bruce Slater, Cory Tallent, Will Wilson and team leader Rick Owen reduced hazardous ink waste at DENSO Manufacturing Tennessee by 76 percent in memory of former co-worker Dennis Payne.

*“This land is your land,  
this land is my land...”*

– Folksinger Woody Guthrie



## Remembering Dennis

Dennis Payne was the kind of person who inspired those around him – good-natured, caring and always smiling. When he died in a motorcycle accident in October 2003, his co-workers at DENSO Manufacturing Tennessee in Maryville were determined to make a statement about his life. Most had worked beside him for nearly 10 years in the Instrument Cluster Division’s printing department.

In Payne’s honor, the department’s quality circle became known as House of Payne. As a lasting tribute to his memory, the team’s project would leave a lasting impact – it would help improve the environment.

With the manufacturing facility located in the foothills of Great Smoky Mountains National Park, and overlooking dramatically beautiful terrain, protecting the environment is a priority.

The House of Payne soon began a project to reduce and reuse hazardous waste ink, an ideal project for the printing department’s quality circle – or kaizen circle, as DENSO calls them, for the concept of continuous improvement.

The group’s nine-month project proved hugely successful in reclaiming ink used to print speedometers, tachometers and several other types of dials in finished automotive instrument clusters. The result was a hazardous ink waste reduction totaling 76 percent. A new printing procedure the team developed also reduced annual production net costs by \$156,000.

Key to the transformed printing process was the addition of “wings” to the printing machine’s ink scrapers (scrapers push ink through the screen onto the cluster dials).

These wings direct ink toward the center of the screen, allowing most of it to be used instead of wasted. Team members also added a straining machine to filter foreign matter from used ink, thus making more ink reusable.

The House of Payne’s project earned the 2005 Hazardous Waste Award from the Tennessee Chamber of Commerce and Industry’s Environmental Conference.

Team representatives traveled to Japan – after winning DENSO’s North American President’s Award – to compete with worldwide DENSO kaizen teams, winning the Gold Medal.

Because they improved a process that other DENSO locations could use, House of Payne members not only left a tribute to their co-worker, Dennis Payne, but also ended up sharing their ideas globally with affiliate companies from Japan to the Philippines to Mexico.

That’s quite a memorial.



## Water Watchers

In the Southern California desert, water cannot be taken for granted. At American Industrial Manufacturing Services in Murrieta, no one does. Especially not Recycling Specialist Rigo Licea who keeps an eye on the company's daily water use.

Licea makes certain that he and his 115 co-workers watch every single drop. Literally.

Since 1997, the company has been recycling 100 percent of its manufacturing process water, cleaning water and even air conditioning condensate – or 200 gallons of water daily – with zero discharge to the city's sewer system. All this is on top of the company's primary function of remanufacturing automotive starter motors and alternators.

Remanufacturing itself is an advanced form of recycling that involves the disassembly of products into their component parts. Components then are remanufactured, assembled and tested, emerging as close-to-new products. Most of the materials, energy, labor and capital equipment contributions used to produce the near-new products are retained for reuse.

That includes the water – all the water.

Here is how the water recycling works. During the process of disassembling, cleaning and reassembling used starter motors and alternators, Licea washes the starter and alternator units in hot water and aqueous cleaners. The discharged water then filters through the company's own recycling system, which removes all grease and chemicals. After this cycle, the now-clean water is routed back into the system's main storage tank for reuse.

Licea's co-workers mop the plant floors with the recycled water. After the floors are clean, Licea filters the leftover mop water back through the system, cleaning it again. The recycled water is also used to rinse all soiled work gloves, rags and mop heads before laundering. Soap, grease and dirt from the laundry rinse and wash cycles are filtered out through the recycling system and again routed back as clean water into the system's holding tank.

For this ingenious system of water conservation, the California Water Environment Association named American Industrial Manufacturing Services its Southern California Plant of the Year back in 1997.

Now, the company even uses recycled water for landscape maintenance. During the summer, recycled water from the city's recycling system feeds the company's surrounding grass and shrubs.

But again, every drop counts.

So, a weather-monitoring satellite controls the sprinkling system, telling it when the landscape needs watering and when the watering needs to stop, all depending on current Murrieta conditions.

What next?

"Our water-related goals for 2010 include developing an alternative to water-based painting and a steam collection and condensation system," says Manufacturing Engineer Ben Robledo. "The steam emissions we collect will go back into our system."

Every drop.

### Wash, Rinse, Recycle

In Murietta, Calif., American Industrial Manufacturing Systems recycles 100 percent of its manufacturing process water every day through the company's recycling system (above). After filtering out grease and chemicals, the now-clean water goes back into the main storage tank for reuse.

Photos: Cristina Salvador

*"Nobody can be in good health, if he does not have all the time, fresh air, sunshine and good water."*

– Oglala Sioux Indian Chief Flying Hawk

# Restoration



## Wet, But Undaunted

Howie Mori steers a heavy, water-soaked log toward a crew of more than 100 fellow DENSO volunteers waiting to pull it up out of the Rouge River, near DENSO International America in Southfield, Mich.

Photos: Phillip T. Dattilo

*“Conservation is a state of harmony between men and land.”*

– American ecologist Aldo Leopold



## Take Me to the River

**C**hest-deep in the waters of the Rouge River, Howie Mori maneuvered an enormous log toward the river’s right bank. A thick rope, tied around the log, snaked up the eight-foot-high bank and stretched 75 feet into the deep woods, gripped all the way by volunteers from DENSO International America.

“One, two, three – pull,” shouted the team leader as the group pulled hard on the rope. Mori, a DENSO senior manager, and several DENSO engineers carefully guided the waterlogged tree trunk slowly up the riverbank. On the opposite bank, another DENSO group wielded a second rope hauling up logs from a big jam in the middle of the river.

All were participating in the Rouge Rescue, a multi-community cleanup designed to help keep the river healthy, reduce erosion and provide habitat for fish and wildlife. The annual event, sponsored by the Friends of the Rouge, depends on the sweat equity of local volunteers like Mori to break up logjams and clear trash.

For DENSO, maintaining a healthy Rouge River is personal.

The company’s North American headquarters, DENSO International America, sits near the Rouge River floodplain in Southfield, Mich. That’s one reason DENSO has been involved in its restoration for the past nine years.

More than just a local river, the Rouge centers an entire ecosystem right in the middle of Michigan’s most densely

populated, urbanized land area. Running 126 miles through southeastern Michigan before emptying into the Detroit River, the Rouge connects to Lake St. Clair, which then connects to Lake Erie, one of the five Great Lakes.

For the last couple years, more than 100 DENSO volunteers from 14 local communities turned out to help – the largest corporate volunteer group in the event’s history.

DENSO also aids the Rouge ecosystem in other ways. The company has contributed nearly \$100,000 in money and in-kind gifts to the Friends of the Rouge since 1997.

Most of the monetary contributions go to support the organization’s Rouge Education Project, a nationally recognized water quality monitoring and watershed education project. DENSO volunteers work with students at Detroit’s Logan Elementary School, Southfield’s Thompson Middle School and Southfield High School.

Through the project’s hands-on, real-world science activities, such as monitoring the river’s water quality, volunteers and students alike increase their awareness of the Rouge River watershed, how they impact it and how it impacts them. In turn, they can apply the knowledge they gain to address environmental issues throughout their lives.

For future generations – that’s why Howie Mori and more than 100 DENSO co-workers took to the river in the first place.



## Reclamation Fever

Out on DENSO Manufacturing Michigan's plant floor in Battle Creek, large furnaces tower among the assembly lines. These furnaces hum along nearly 24-hours a day, working their magic on partially assembled products, joining metals with their 1,000-plus-degree temperatures.

Greg Sundalius, Facilities section leader, steps close to one of these furnaces and places the palm of his hand in front of a grate. The grate is like a window, and through the crisscrossing bars you can see the assembly line passing through the system and feel the heat that radiates within the belly of the furnace.

"These things generate a lot of wasted heat," he says. "That's where our project comes in."

Above the furnaces, he points to huge silver and beige ducts that travel along the ceiling. Their presence is unremarkable to the average eye, blending with ceiling supports and myriad fixtures high above the plant floor. However, these ducts perform a significant function: they take wasted heat from the furnaces, carry it upwards, circulate it with fresh air from the outside and transport it out to cooler areas of the plant. This process is called heat reclamation, and it is used to keep the plant warm during the frigid Michigan winters.

In the first year after DENSO Manufacturing Michigan's heat reclamation project began, associates monitored the plant conditions daily. As part of the company's original heating system, 37 burners throughout the facility were on standby, ready to fire up and heat the building as conditions demanded.

Yet after the heat reclamation equipment was installed and operational, on average only two or three burners were ever in use on chilly days, and only 17 percent of their capacity was needed. Even on zero degree days, only five or so burners fired up and only at 5-10 percent capacity.

The reclaimed heat was doing the job of heating the facility nearly on its own.

The end result? The Battle Creek facility reduced its consumption of natural gas by more than 33 million cubic feet and its CO<sub>2</sub> emissions by 3.9 million pounds – exceeding even DENSO's ambitious global goals for CO<sub>2</sub> reduction.

"When we started out, a big aim for our team was to reduce utility costs," says Sundalius, who manages the project. "But as we evaluated the impact it would have, we realized it would have a big effect on CO<sub>2</sub> emissions as well. At the end of the day, you feel like you're trying to do your part – not just from a company standpoint, but also from a personal standpoint – by not adding to the greenhouse effect."

The wheels of progress have long turned with power generated from fossil fuels. But as supplies decline and concern about greenhouse gases increases, industry will define progress not just by the products DENSO produces, but by the by-products it doesn't produce and the resources it conserves and protects. DENSO takes that challenge seriously.

The heat is on...and DENSO Manufacturing Michigan stands ready to reclaim it.

### The Heat is On

Ceiling ducts draw wasted heat emitted from the furnaces at DENSO Manufacturing Michigan in Battle Creek, transporting it to cooler areas of the plant. This heat reclamation system reduced natural gas consumption by more than 33 million cubic feet, and CO<sub>2</sub> emissions by 3.9 million pounds.

Photos: Phillip T. Dattilo

*"Society cannot continue to live on oil and gas. Those fossil fuels represent nature's savings accounts which took billions of years to form."*

– Futurist R. Buckminster Fuller

# Renewal



## Crawl Space

Nearly 150,000 California Redworms convert cafeteria waste into highly rich fertilizer for the surrounding area at DENSO Mexico's worm farm in Apodaca, N.L. Tended by Advanced Team Leader Cristabel Meza (left) and Manager Jorge Haros, the worms can eat their own weight in organic garbage daily.

Photos: Fausto Tovar

*“Waste not, want not  
is a law of nature.”*

– British engineer John Platt

## As the Worm Turns

Sitting alone under the Mexican sun having lunch, the temperate air soothing his thoughts, Jorge Haros came upon an idea almost the same way the *Cerro de la Silla* mountains come into view along the eastern foothills of the *Sierra Madres* – as an inspiration.

A pioneering use for the heaps of food scraps tossed out daily from the cafeteria at DENSO Mexico's Apodaca plant, thought the manager of Safety, Health and Environment, would lessen the burden on the growing number of landfills in the Monterrey region – Mexico's second most important industrial area.

While researching solutions, Haros came across a fellow DENSO employee in India, S. M. Aggarwal, who was experimenting with an organic recycling method known as vermicomposting. Haros went to DENSO India to study with him.

What he brought back to Apodaca is a can of worms.

This is a can like no other – a farm, in fact, crawling with some 150,000 California Redworms, which daily consume their own weight in garbage, the organic variety, of course.

Besides the cafeteria's hundreds of discarded chicken bones and other food refuse, DENSO Mexico's sewage sludge, garden waste and sanitary paper – all previously designated for a landfill – are converted into a highly rich fertilizer as a result of the worms' work, or vermicomposting.

The worms, scientifically referred to as *eisenia foetida*, collectively polish off about 3 ½ tons of junk food a week, saving DENSO Mexico more than \$33,000 in annual disposal costs.

While the global target for DENSO companies is to reduce landfill waste from manufacturing operations by 75 percent, DENSO Mexico's target is zero emissions.

“Our goal is to waste nothing,” says Haros. His thinking: “We'll have to get to zero eventually, so why not start now?”

At one time such an ambitious goal might have been called a whole lot of trash talk, since a company would have to find a reuse for just about everything, including organic refuse.

For years, communities have been able to recycle such items as plastics, metals, paper and batteries, while even printing inks, chemicals and oils can be processed into supplementary fuels.

But organic waste has always been sort of a recycling quagmire for environmentalists because there are few items that organic materials can be converted into that offer any real value.

Now, the worm farm changes matters, says Haros. Besides producing a useful fertilizer, vermicomposting gives Apodaca plenty of wiggle room to meet its stringent zero-emissions standards.

Apodaca's organic waste recycling yields about 18 tons of fertilizer a year. Some goes to DENSO employees for home garden use and the remainder is distributed to local municipalities for tree planting.

Cristabel Meza, who oversees vermicomposting at Apodaca and holds on-site workshops for employees, students and environmental groups, says, “We want to turn others into pioneers, building their own worm farms at home, at school and places of business.”

## Preserving Clean Air

### Monolithic Carrier

The monolithic carrier acts to reduce or oxidize harmful emissions such as hydrocarbons, carbon monoxide and nitrogen oxides.



### Air Flow Meter

This air flow meter measures the flow rate of air into the intake manifold, resulting in the correct air-fuel ratio for efficient combustion.



## Promoting Recycling



### HVAC Unit

The plastic case on this HVAC (heating, ventilation and air conditioning) unit is molded with 20 percent in-house recycled material. A titanium-based process provides corrosion resistance for the evaporator rather than hexavalent chromium, an environmentally hazardous substance. Lead solder was eliminated from processing operations by a raw material switch from copper to aluminum.

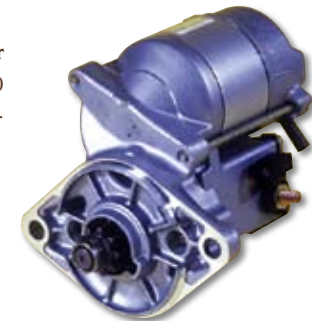


### Alternator

A redesigned segment conductor produces a smaller, lighter alternator with higher efficiency and lower noise.

### Starter

The die cast process reuses 90 percent of internal scrap aluminum.



## Reducing Hazardous Substances

The instrument cluster and air conditioning panel are manufactured without the anti-corrosive hexavalent chromium, an environmentally hazardous substance that can leak into the underground water table if a product containing the metal is not disposed properly.

### Instrument Cluster



### Air Conditioning Panel



### Cooling Fan Motors

The fan motor is manufactured with lead-free electrical brushes.



### Windshield Wiper System

The wiper motor is manufactured with lead-free electrical brushes.



## Helping Prevent Global Warming

### Fuel Injector

This fuel injector's atomizing capability dispenses fuel in precise quantities and allows for better mixing with air, increasing fuel efficiency.



### Spark Plug

Tough metal alloys applied to the tip of the plug assure proper ignition even during idling, with less fuel consumption and less noise.



# North American Environmental Awards

DENSO CORPORATION	
2004	U.S. Environmental Protection Agency (EPA) Climate Protection Award for developing an electrical inverter air conditioning system that provides cooling when engine is not running
2002	EPA Climate Protection Award Developed the world's first mass-produced CO <sub>2</sub> refrigerant heat-pump water heater for households
2001	Innovest Strategic Value Advisors Environmental Rating Survey. Top marks (AAA score)
1993	EPA Stratospheric Ozone Protection Award Developed methods to convert air conditioning systems to HFC-134a, which replaced the ozone-depleting refrigerant CFC-12
DENSO INTERNATIONAL AMERICA	
2002	Southfield Community Foundation Commitment to Community Award for improving the community through support of Rouge River Rescue
2002	Ford Motor Company Recognition of Achievement World Excellence Award for environmental leadership and honor as one of its top suppliers in the world
2001	Best Friend of the Rouge Award for volunteer and financial contributions in support of the Rouge River Cleanup Project and the Rouge Education Program
2001	Ford Motor Company Recognition of Achievement World Excellence Award for innovation in reducing the environmental impact of Ford products and ISO 14001-certification at majority of plants
2001	Greening of Detroit Gold Trowel Award for improving the environment through volunteer and financial support of Greening of Detroit's Moses Field Project
DENSO MANUFACTURING CANADA	
2005	Honda ISO14001 Recognition Award for excellence in environmental management through ISO 14001 certification

DENSO MANUFACTURING MICHIGAN	
2005	EPA Smartway Partnership, a voluntary collaboration between U.S. Environmental Protection Agency (EPA) and the freight industry
2000 to 2005	U.S. EPA National Environmental Performance Track, Charter Member, a voluntary partnership recognizing top environmental performance among participating U.S. facilities
1998 to 2005	Michigan Clean Corporate Citizen (C3) for environmental stewardship; also received the Longevity Award
1992	Michigan Chamber of Commerce Environmental Quality Award for environmental stewardship
1990, 2001	Michigan Water Environment Association Award for being chosen industrial wastewater operator of the year
DENSO MANUFACTURING TENNESSEE	
2004	Kentucky-Tennessee Water Environment Federation Wastewater Award for excellence in wastewater pre-treatment operations (10 consecutive years)
2004	Tennessee Chamber of Commerce Environmental Excellence Award for best overall past performance and reductions in discharge of environmentally hazardous substances
2003	Tennessee Pollution Prevention Partnership (TP3) for achieving Performer status (top level)
2003	Little River Watershed Association Award for industrial environmental protection
2001, 2002	Tennessee Association of Business Environmental Awards for outstanding achievement in water quality; and certificate level in solid waste management
2002	Tennessee Department of Environment and Conservation Industrial Pollution Award for overall environmental effort

DENSO MANUFACTURING ATHENS TENNESSEE	
2004	Kentucky Tennessee Water Environment Federation Wastewater Award for excellence in operation and management of industrial pretreatment facilities
2004	Tennessee Chamber of Commerce & Industry Certificate of Achievement in Solid Waste Management for reducing landfill waste by more than 2,400 tons per year through reuse of ceramic waste
2003	Tennessee Pollution Prevention Partnership (TP3) for achieving Performer status (top level)
2002	Tennessee Association of Business Environmental Awards for hazardous waste management (replaced a petroleum distillate-based cleaner with non-hazardous alternative)
DENSO MEXICO	
2005	Certificaciòn de Industria Limpia "Clean Industry" Certification, recognition from Mexico Federal Environment Authority for environmental legal compliance
AMERICAN INDUSTRIAL MANUFACTURING	
1996	California Water Environment Association's Southern California Plant of the Year for outstanding professional achievement within wastewater field
ASSOCIATED FUEL PUMP SYSTEMS CORP.	
2005	South Carolina Environmental Excellence Program for demonstrating superior environmental performance through pollution prevention, energy and resource conservation, and the use of an environmental management system
2005	U.S. EPA Environmental Performance Track, Charter Member, a voluntary partnership recognizing top environmental performance among participating U.S. facilities
2001	South Carolina Wildlife Federation Industrial Conservation Award for outstanding achievement in the conservation of South Carolina's natural resources

GAC CORPORATION DE MEXICO	
2005	Certificaciòn de Industria Limpia "Clean Industry" Certification recognition by Mexico Federal Environment Authority for environmental legal compliance
ASMO NORTH CAROLINA	
2005	Environmental Business of the Year by Iredell County Recycling & Keep Iredell Clean for reducing solid waste and increasing items to be recycled
2004	North Carolina Environmental Steward for demonstrating a mature environmental management system and setting aggressive environmental performance goals
2002	EPA National Environmental Performance Track, a voluntary partnership that recognizes top environmental performance among participating U.S. facilities
2000	The National Strategic Goals Program, a cooperative effort between the EPA and the metal finishing industry
1994	City of Statesville PACE Award for Environmental Excellence for reducing pollutants in industrial discharge
ASMO MANUFACTURING	
2001	Honda Green Supplier Award for efforts in pollution prevention, energy reduction and conservation of natural resources





### Green Thinking

With water pressure providing energy, Samantha, the Garden Robot Worm simultaneously aerates and irrigates soil as she moves. Brothers Mike Ely (left) and Eric Ely, of DENSO Manufacturing Michigan in Battle Creek, won third place in DENSO's global idea contest for this creative concept robot. The global contest promotes innovative thinking among employees.

Photo: Phillip T. Dattilo

## North American DENSO Environmental Policy

It is the policy of DENSO in North America to conduct its business in a manner that is consistent with environmental preservation and harmony with society.

To implement this policy, DENSO commits to the following principles:

- DENSO will operate as an environmentally responsible corporate citizen;
- DENSO will seek to prevent pollution and to ensure that its operations comply with relevant environmental laws and regulations and other related environmental obligations;
- DENSO will implement an environmental management system which includes objectives and targets, periodic review and a commitment to continuous improvement, and
- DENSO will communicate this policy to all DENSO in North America associates and make it available to others upon request.