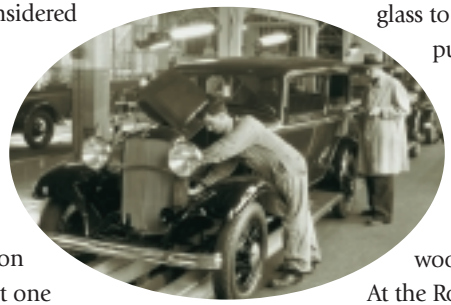
FORD ROUGE CENTER

New Thinking for a New Generation


learn from nature

THE ROUGE RETURNS TO ITS ROOTS AS A MODEL OF INNOVATION

To fully appreciate the legacy of innovation handed down from Henry Ford at the Rouge, picture America in the early 1900s when horses ruled the roads. It was during this era that Henry purchased more than a thousand acres of Michigan marsh land considered unsuitable for farming.



With a prodigy's talent for visualizing solutions to mechanical problems, he envisioned building on this land a colossal "machine" that would be fed tons of iron ore, rubber, sand and coal at one end—while hundreds of shiny new cars emerged at the other end, every day.

Henry Ford began transforming this vision into the River Rouge plant in 1917. And the result was groundbreaking. Known simply as "the Rouge," people traveled from across America and around the world to marvel at mass production on a scale never seen before.

Ford's vision also included changing the way people worked. Teaming with architect Albert Kahn, Henry used concrete, steel and glass to build the Rouge. And he put almost everything on one level. This pioneering design made the Rouge brighter, more efficient and safer than the cramped, multi-storied, wooden factories of the day.

At the Rouge, Henry also put to good use things he learned as a young farmer. Biological processes—especially how little waste they produced—fascinated him.

Today, the revitalized Ford Rouge Center models itself on the legacy handed down from Henry Ford…

Lead through innovation

Learn from nature

Eliminate waste

Improve the way we live and work

A BROWNFIELD BECOMES AN ECO-EFFECTIVE WORKPLACE

The revitalization of the 600-acre Rouge site, shown above in 1952, is the largest brownfield redevelopment in American history.

When Henry Ford built the Rouge, he created a factory that dramatically improved workplace quality and efficiency. He did so during an era when the notion that America was blessed with an infinite supply of natural resources was part of the culture.

But all that changed. Over the years, the once mighty Rouge could not escape the ravages of time. And today, there is universal concern about the depletion of natural resources.

Instead of abandoning the aging brownfield site, Ford Motor Company is revitalizing the Rouge in ways that are good for business and the environment, proving that environmentally sound manufacturing processes can be profitable.

Ford's approach is often referred to as "sustainable design." But it could also be called high-performance design. A high-performance building will:

- Lower annual energy costs
- Lower long-term maintenance costs
- Use non-toxic, easily recycled materials
- Create healthier work environments
- Improve employee productivity
- Attract talented recruits
- Improve market image
- Help protect the environment.

By combining emerging technologies with timeless understandings, Ford is cleaning storm water using natural processes, bringing daylight and fresh air back into the factory, converting paint fumes into fuel, and more.

The Rouge is not only being rebuilt, it's being reimagined as a 21st Century sustainable workplace, a model of lean and flexible manufacturing whose advanced processes both inside and outside the factory are inspiring a new paradigm for economic growth.

Roof specialists top the Dearborn Truck Plant with a living roof that reduces storm water runoff and has the potential to save millions of dollars in roof maintenance costs.

BUILDING THE WORLD'S LARGEST LIVING ROOF

Nature is returning to the Rouge. These killdeer eggs are evidence that the birds have already found a home, up on the living roof.

Of all the innovations at the Ford Rouge Center, nothing has attracted more interest than the 10.4-acre living roof on top of the Dearborn Truck Plant final assembly building.

Large enough to hold eight football fields, it is recognized by Guinness World Records™ as the largest vegetated roof in the world.

Planted with a drought-resistant groundcover called sedum, the living roof offers many advantages over conventional tar and metal roofs.

Sedum on the living roof absorbs rain and melting snow as it uses the water to grow. This reduces the amount of storm water running off the factory.

Sedum also protects the roof from solar radiation, storms, and thermal shock. Thermal shock is the expansion and contraction of a roof due to extremes in daily temperature. As a result of this extra protection, the living roof is expected to last at least twice as long as a tar roof, potentially saving millions of dollars.

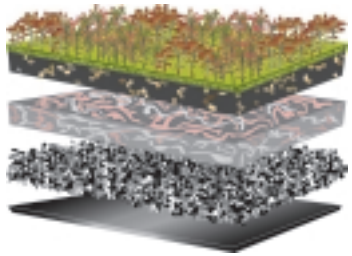
And while tar and metal roofs soak up heat from the sun, the living roof acts as insulation to cool the factory in the summer and warm it in the winter.

Sedum—which is also known as stonecrop—traps dust and consumes carbon dioxide, reducing the "greenhouse effect" that can impact air quality.

Ford's living roof grows in a lightweight, four-layer mat called *Xero flor™*. Heavy, loose soil is not part of the design.

- On top, sedum plants grow in a thin, blanket of shale, sand, peat, compost and dolomite.
- Under the sedum, a layer of fleece made of recycled materials retains water to nourish the plants.
- Excess water seeps down to a drainage layer that channels rainwater off the roof and into natural treatment wetlands.
- Beneath the drainage layer, a special membrane protects the building.

The living roof is nearly maintenance-free because the sedum plants grow less than six inches tall and spread horizontally, crowding out weeds and stray seeds.



On the living roof, sedum plants grow in a four-layer, vegetated mat, rather than in loose soil. As the seasons change, the sedum changes color. During the summer, it flowers.

CREATING NATURAL STORM WATER MANAGEMENT

Rain falling on this porous pavement lot trickles down through tiny holes in the asphalt, through a yard of gravel, and into rock storage basins where particles in the water settle. This process cleans the water before it enters the Rouge River watershed.

In cities across America, rainwater and snowmelt flows into drains and sewers. The sudden rush of water scours dust and dirt from hard surfaces, sending dirty water into nearby rivers and lakes.

By contrast, rain and snow at the Ford Rouge Center falls on acres of soft surfaces like the living roof, where storm water is absorbed and cleansed. The system cleans runoff before returning it to the watershed, using natural processes not chemicals. It also guards against flooding.

The large natural storm water system surrounding the Dearborn Truck Plant includes the living roof, natural treatment wetlands, vegetated ditches called swales, hundreds of newly planted trees, and the world's largest porous pavement lot, located northwest of the Dearborn Truck Plant.

When rain falls on the living roof, it is absorbed or filtered by sedum plants. Any excess water then drains off the roof into stone storage basins located under the porous parking lot nearby.

From the storage basins, water flows into swales and treatment wetlands where plants act as "nature's filters" to prevent dirt from migrating into rivers and lakes.

This natural system has the potential to save millions of dollars by eliminating the need to build and operate a traditional storm water treatment plant.

In the treatment wetlands, the thick roots of plants act as filters, sifting dust and dirt out of storm water runoff.

Henry Ford built the Rouge over a marsh with poorly draining clay soil. Over the years, floods have caused production delays at the facility.


Ford

BRINGING IN NATURAL LIGHT AND FRESH AIR

Each huge roof monitor on the living roof is 115 feet long, 25 feet wide and up to 22 feet high. Back in Henry Ford's day, the Rouge had more than 345 acres of glass windows.

Natural processes are revitalizing the environment outside the Ford Rouge Center. They also are being used *inside* the Dearborn Truck Plant to make it a more desirable place to work.

The building's design considers the needs of people — as well as machinery — a legacy handed down from Henry Ford and architect Albert Kahn.

Compared to the old assembly plant, the change is dramatic.

Ten huge skylights called "monitors" and 60 smaller skylights fill the building with natural light. Energy-efficient glass reduces glare and heat from the sun.

On sunny days, the skylights reduce electrical energy usage by enabling up to half the building's lights to be turned off.

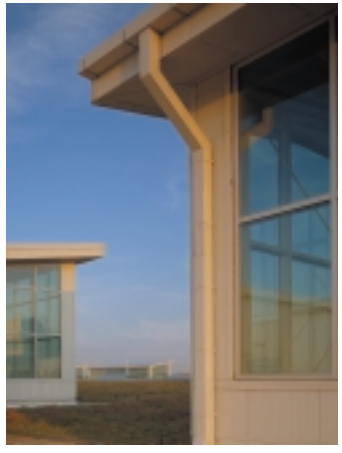
The natural light also improves color perception, reduces eyestrain, and improves mood. According to researchers, people who work in natural light are more productive.

And, since poorly ventilated buildings can induce fatigue, the plant is heated and cooled by an innovative "big foot" air tempering system that replaces air in the building with fresh air every 30 minutes.

This ductless system mixes warm air near the ceiling with cool air near the floor to create a more pleasant temperature at work level. The building acts as one giant air duct, creating a slightly positive air pressure to keep out drafts when loading dock doors open.

The "big foot" system includes a one-million-gallon thermal water storage tank. During the summer, chilled water in the tank cools the building more efficiently and cost-effectively than using oversized air-conditioning equipment.

Employees see and feel better in this more natural working environment.



By reducing the need for artificial light, 60 skylights and ten huge roof monitors reduce electrical energy usage and costs at the Dearborn Truck Plant.

USING PLANTS TO RESTORE HEALTHY SOIL

Many years ago, large furnaces called coke ovens were used in the steel-making process at the Rouge.

Today, Ford is experimenting with a biological process called phytoremediation (fī′-tō-ri-mē-dē-ā′-shen) to remove PAH compounds from soil near the old Rouge coke ovens. PAH compounds are poly-aromatic hydrocarbons, a by-product of decades of steel manufacturing.

Phytoremediation uses plants, and the microbes attracted to their roots, to break down contaminants into harmless organic compounds that are absorbed into the roots. This process helps rid the soil of PAH compounds.

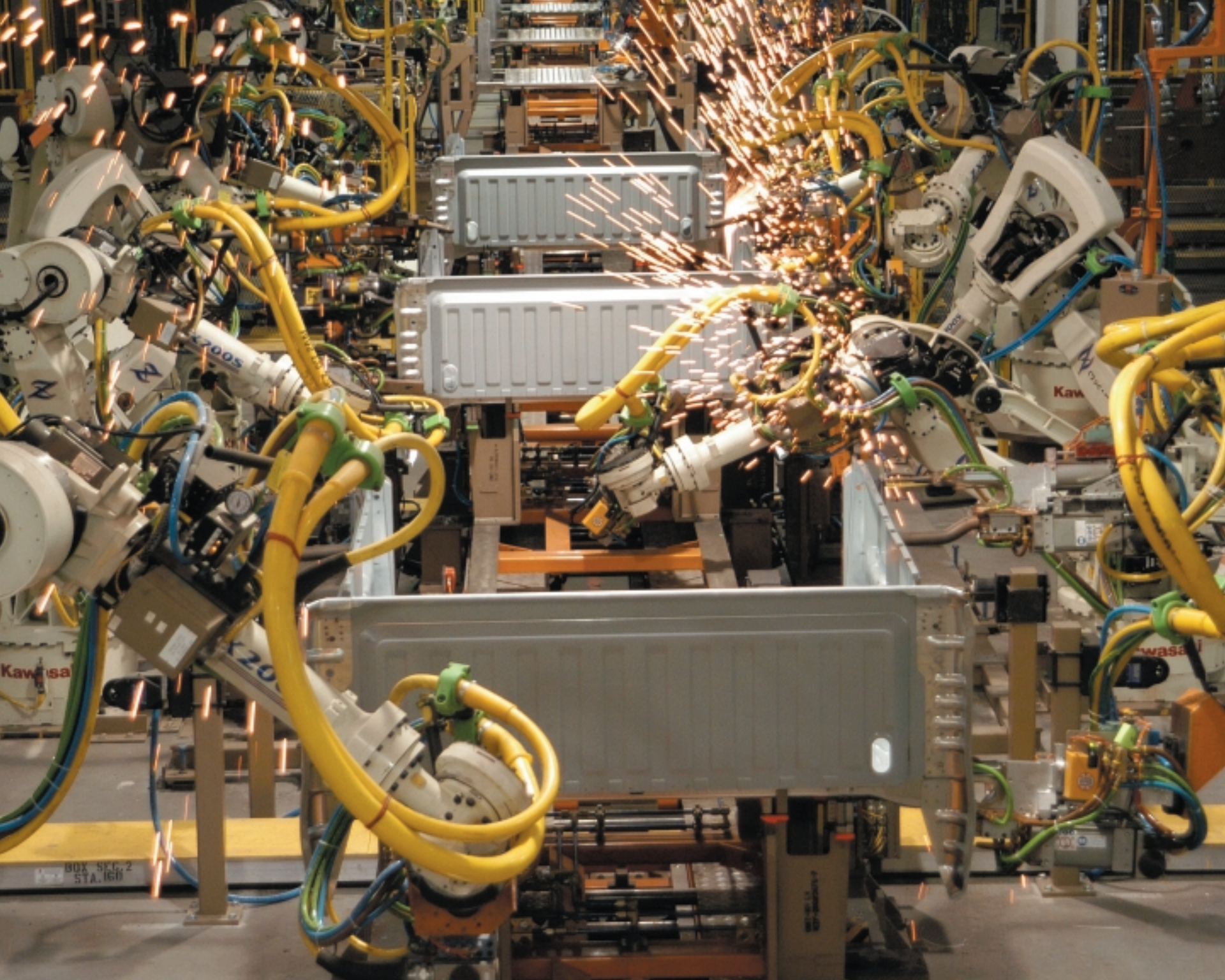
It also filters storm water runoff, regenerates wildlife habitat, and beautifies the landscape.

The phytoremediation test site at the Rouge represents one of the world's most ambitious studies of this process.

Compared to conventional cleanup methods, phytoremediation:

- Is more environmentally beneficial than removing impacted soil and hauling it to a landfill, which merely moves the problem from one site to another.
- Can cost less than excavating and landfilling.
- Is driven by solar energy.
- Adds beauty to the landscape through use of native plants including prairie dock, cardinal flower, New England aster and other perennials that clean soil.
- Restores wildlife habitats.

Working with scientists from Michigan State University and the University of Michigan–Dearborn, Ford planted thousands of special perennials in a first-of-its-kind program to test their effectiveness in cleaning the soil.



BECOMING LEAN AND FLEXIBLE

In the Body Shop, robots can be reprogrammed quickly so it's easy to produce "the right vehicle at the right time" to meet customer demand.

At its peak, Henry Ford's Rouge Plant epitomized mass production. Millions of vehicles were produced based on relatively few makes and models.

But today's marketplace is vastly different. New models are introduced year-round. Customers want more choices. To compete in this new era of mass customization, Ford is moving to a world-class level of flexible production, and the Dearborn Truck Plant is leading the way.

In the Body Shop, the 280 robotic welders can be quickly retooled and reprogrammed to build new models in a matter of days, not months. The Dearborn Truck Plant can produce up to nine different vehicles from three basic platforms.

Vehicle bodies are carried on "smart" pallets equipped with transponders that tell robotic welders what to fabricate. Robots can perform up to 99 different welding procedures.

In Final Assembly, people are the key to operational flexibility. Workgroups are trained and empowered to respond quickly to changes in customer demand.

Ford also has taken the principles of lean manufacturing pioneered by Henry Ford and refined them for a new century. Lean processes, such as just-in-time and vehicle-sequencing, eliminate wasted time and effort, and support the continuous improvement of quality.

Lean manufacturing also means that vehicles are built in a precise order. Truck bodies are matched to parts, and everything reaches the line operator at exactly the right time for assembly. This reduces waste and the need for extra storage space, and significantly increases efficiency.

No more than two hours of parts are stacked along assembly lines, and just 12 hours of total inventory are on site.

EMPOWERING ASSEMBLY LINE WORKERS

Vehicles move on adjustable platforms called skillets. Line operators can raise or lower the skillets to minimize stretching and bending.

The Dearborn Truck Plant is designed from the ground up to be a new kind of factory environment. The spacious interior is bright and well ventilated. Mezzanines and overhead walkways reduce foot traffic on the plant floor. Extra-wide aisles and the absence of towering stacks of parts give employees more room to work.

Work stations are designed around input from line operators. The result is a workspace that is much more people-friendly than a traditional assembly line.

Skillet conveyors carrying vehicles quickly adjust to different heights, so that operators don't have to work with their hands above their heads, or stoop to do a job below their knees. Everyone uses DC electric tools, which are quieter and more precise than pneumatic tools, and place less stress and strain on the operator.

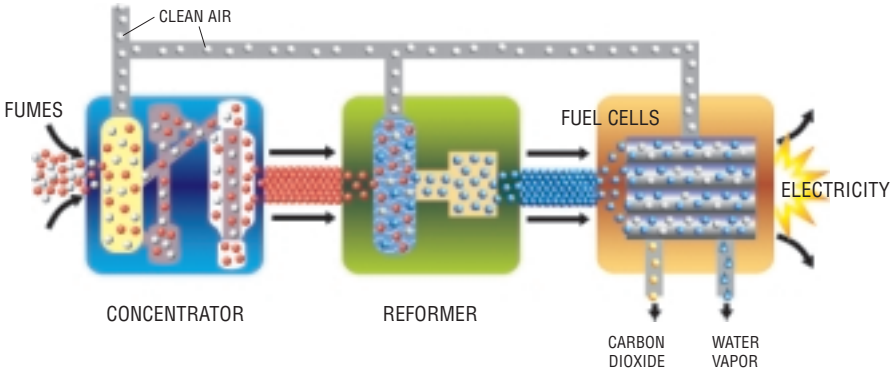
A lean manufacturing environment revolves around in-station process control. Assembly line operators are responsible for the quality of the product coming to and going from their work stations, so they are empowered to identify and resolve quality issues on the spot.

The philosophy toward waste and defects is clear: Don't make it. Don't take it. Don't pass it on.

In addition to being smaller, lighter and more precise, DC electric tools are quieter and use less energy than air-powered tools.

The doors-off process makes it easier for line operators to work inside each vehicle. Cab doors are reattached near the end of the assembly line.

CONVERTING PAINT FUMES INTO FUEL



The Fumes-to-Fuel System captures and concentrates paint fumes, reforms them into a hydrogen-rich gas, and then feeds the gas into fuel cells that generate clean electricity. The only emissions are water vapor and a tiny amount of carbon dioxide.

Inside the Ford Rouge Center paint shop, high-tech spray booths apply world-class finishes to vehicles. The process emits paint fumes that are captured and destroyed in gas-fired burners to keep them from entering the atmosphere.

As paint fumes entered the burners, engineers from the Ford Environmental Quality Office and Detroit Edison noticed that the units used less energy to operate, proving there was energy in the fumes. Could it be converted into an inexhaustible source of clean electricity?

The engineers tested their theory at the Ford Scientific Research Laboratories. They devised a three-stage process that more efficiently captures the fumes, then uses them to create energy. In effect, they were turning waste into wattage.

Calling their invention the *Ford Fumes-to-Fuel System*, a pilot system was installed at the Dearborn Truck Plant. It captures the volatile organic compounds found in paint solvents, converts them into a hydrogen-rich gas, and feeds the gas into a stack of solid oxide fuel cells. Inside each fuel cell, a chemical reaction between hydrogen and oxygen creates electricity, water vapor, and an insignificant amount of carbon dioxide.

The new system also cleans the air more efficiently than gas-fired burners, costs less to operate, reduces carbon dioxide emissions seven-fold, and reduces the Paint Shop's consumption of natural gas.

While still in its pilot stage, a full-size *Fumes-to-Fuel System* would produce 55,000 watts of electricity, enough to power a small residential neighborhood.

This innovative system can run fuel cells, a Stirling engine, or a small electrical generator. Ford is studying which will work best to make its paint shops more energy-efficient and environmentally friendly.

The Ford Fumes-to-Fuel System received a Clean Air Excellence Award from the U.S. Environmental Protection Agency.


FORD ROUGE CENTER

PRESERVING A RICH HERITAGE

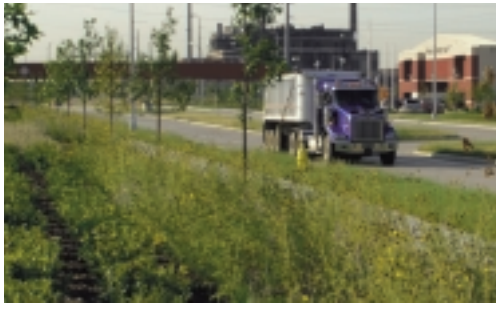
Site of the "Battle of the Overpass" in 1937, the foot bridge at Gate 4 is recognized by the U.S. National Park Service as one of the ten most significant sites in labor history.

For more than 80 years, the Rouge has been a part of the lives of thousands of people, employing multiple generations of families.

And so it's fitting that the transformation of the Rouge includes revitalizing its main gateway along Miller Road.

A replica of the historic pedestrian overpass at Gate 4, with 1920s-style lamp posts and a vintage red oxide finish, now spans Miller Road. It leads to an entry building designed to recall the original architecture of the Rouge, and a bricked plaza with photographic-style insets that honor milestones in the history of the Rouge, its people, and its products.

From Rotunda to Dix, Miller Road was transformed from a gritty, timeworn street into an attractive, environmentally impressive thoroughfare. The new four-lane boulevard has wider traffic lanes and a median designed to clean storm water runoff and provide flood control.



New landscaping on both sides of Miller Road beautifies more than 22 acres, traps airborne dust, and creates wildlife habitat. Plantings include 20,000 shrubs, 85,000 flowering perennials, and hundreds of new trees, including hawthorne, one of Henry Ford's favorites.

The commemorative plaza at Gate 4 honors four generations of men and women who made the Rouge an industrial icon of the 20th Century.

INSPIRING A NEW DAY IN MANUFACTURING

Photovoltaic panels on the roof and over the main entrance convert sunlight into electricity to supplement the Visitor Center's power supply.

For much of the 20th Century, the Rouge was an international tourist attraction. Millions of people came to marvel at its size and manufacturing might.

When the tours were discontinued in 1980, it marked the end of an era. With the revitalization of the Ford Rouge Center, the Rouge tours have returned, transformed into a 21st Century multi-sensory experience.

Presented in association with The Henry Ford, the Ford Rouge Factory Tour begins at the Rouge Visitor Center, a model of environmentally sensitive design.

All of the Visitor Center's hot water, and some of its heat, comes from rotating solar panels on the ground that follow the arc of the sun. Rooftop photovoltaic panels supplement the building's power supply.

Rain falling and snow melting on the roof is collected in a large cistern that feeds into the building's plumbing system.

Green space surrounding the Visitor Center features natural storm water treatment wetlands, and restored habitat for insects, birds, bees, and small animals.

Inside the Visitor Center, an 80-foot-high observation deck offers a panoramic view of the world's largest living roof, where plants capture and clean storm water naturally.

The Ford Rouge Factory Tour also includes two theater presentations and an exciting look at a lean and flexible assembly line in action.

Ford volunteers installed three beehives and 20,000 honeybees in a grove of trees near the Visitor Center. Each hive will weigh over 300 pounds once the bees mature and are producing honey and beeswax.

Solar panels provide hot water to the Visitor Center, which received a Gold LEED Award from the U.S. Green Building Council for its energy efficiency.

CREATING A NEW MANUFACTURING MODEL

New business models and groundbreaking industrial processes are not perfected overnight. They evolve.

Just as the original River Rouge complex tested and proved Henry Ford's theories about mass production and vertical integration, the revitalized Ford Rouge Center is becoming a living laboratory of advanced technical and environmental concepts developed to meet the demands of the 21st Century.

Our lean and flexible production systems demonstrate that advanced manufacturing processes not only make sense from a business perspective, they also create a much more desirable work environment.

The living roof, natural storm water management, phytoremediation, natural lighting, and air-tempering show how new ideas can solve old problems in ways that benefit our company, as well as help protect the natural environment for future generations — a business model we call organic integration.

Our goal is to demonstrate what can be accomplished when engineers, scientists, architects, executives, employees, and members of the community work together to achieve a higher level of performance.

The guiding principle behind this journey of exploration is leadership, not ownership. We look forward to sharing what we learn at the Ford Rouge Center with forward-thinking companies and communities around the world.

learn from nature

These websites offer more information about the Ford Rouge Center:

Ford Motor Company
www.ford.com

The Henry Ford:
America's Greatest History Attraction
www.thehenryford.com

ROUGE COMMUNICATIONS TEAM
Preserving the past, Serving the future

Printed on recycled paper 4.04