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THE FORD RIVER ROUGE PLANT— AN ICON OF SUSTAINABLE MANUFACTURING?

The River Rouge Plant in Dearborn, Michigan, is a unique symbol of Henry Ford's pioneering success in mass production technologies, which became the basis for large-scale manufacturing in American history. His legacy of innovation and visionary business acumen were reflected in the technically and architecturally sophisticated industrial complex, the largest in the world at that time. At its peak production, the Rouge plant employed 100,000 workers and spat automobiles feverishly from its linear assembly lines. Along with brand-new Ford vehicles, the factory also generated huge amounts of industrial pollution and toxics from steel operations, glass production and vehicle assembly, which was released into the environment (King and Mayne, 2004). Over the years, the number of jobs and assembly operations dropped as the aging Rouge lagged behind in efficiency, paling in comparison with newer state-of-the-art plants. The adjacent river, a recipient of high quantities of oil from the plant, actually even caught fire in the late 1960s, prompting a rapid efflux of industrial activity, and leaving behind an industrial artifact (McCosh, 2004).

Figure 1. An aerial view of the Ford Rouge complex in Dearborn in 1947 (Baulch and Zacharias)

Despite the company's recent troubles, William Clay Ford, Jr., the current CEO of Ford Motor Company, embarked on a daring $2 billion venture to revitalize this 600-acre historical complex to demonstrate Ford's commitment to the sputtering local economy. His vision was to become an icon of sustainable manufacturing for the 21st century, and

to portray the company's shift towards greener manufacturing practices. This ambitious revival project was designed by environmental architect William McDonough, who is renowned for his green architecture portfolio and his signature style of incorporating natural systems in his designs. The Ford Rouge facility, completed in 2004, proved to be very successful, at least in the perspective of green buildings—it was awarded the LEED gold certification by the U.S. Green Building Council (Figure 2). This paper examines LEED-rated green features that were ingeniously designed in order to meet this formidable challenge of industrial sustainability, and discusses whether it is, indeed, an "icon of sustainable manufacturing" as Willliam Ford envisions, beyond the context of the LEED rating system.

Figure 2. Artist's depiction of the completed Ford Rouge facility. (Sneary)

Sustainable Sites

The site was chosen for its historical legacy and connections to the Dearborn people. At the heart of the project, Ford wanted to revitalize the factory and remediate the brownfield, compensating for the damage that the company's industrial activity had inflicted on the environment and the local community. In its environmental review, the design team found high concentrations of soil contaminants such as leaking fuels, solvents and other manufacturing by-products (King and Mayne, 2004). Instead of conventional chemical treatment, the team opted to create a constructed wetland of native plants to absorb and neutralize polycyclic aromatic hydrocarbons (McDonough Partners). This phytoremediation experiment, hosted in a 1.6 acre garden, leverages on the natural toxic assimilation capacities of plants that only rely on plentiful, clean and inexpensive solar energy (Ford Motor Company). In addition, not only does this method cost much less than excavating and land filling, it also conveniently generates several

other valuable benefits; it contributes to storm-water management, beautifies the landscape, and restores native wildlife habitat. 20,000 honey bees were released into the plant grounds, housed in three hives, to attract birds, insects and small animals back to the area.

The Ford Rouge factory is also heralded for designing an integrated storm water management system, which again relies on the elegance and economy of natural processes. The site has several acres of landscaped swales that work together with the constructed wetlands, a 10.4 acre green roof, retention ponds and porous pavements (Figure 3) to minimize storm water run off (AIA Michigan). The green roof of sedum can absorb up to 4 million gallons of rainwater annually (King and Mayne, 2004). Emulating natural watershed services, the system of landscaped surfaces collects and filters water into rock beds and diverts it into an underground storage basin for reuse in the plant and discharge to the river. The wetlands, swales and green roof area also enhance storm water quality by the naturally cleansing mechanisms of filtration and root zone microbe action (AIA Michigan).

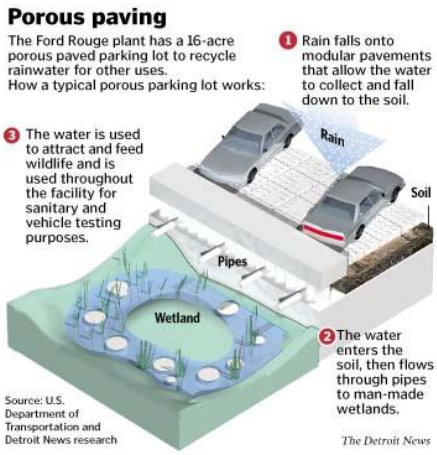

Figure 3. An annotated illustration of integrated storm water management system using porous paving (Ford Motor Company)

Water efficiency

The Ford Rouge Center scored a maximum of 5 possible points in this criterion, achieving no potable use or no irrigation of landscaping, as well as water use reduction of greater than 30%. Rainwater is collected in a 12,500 gallon cistern for irrigation purposes. Excess water from the porous surfaces and landscaped spaces will likewise be channeled to underground storage basins for recycling for various uses in the plant.

Energy and Atmosphere

Although there were a variety of energy efficient features in the plant's design, its performance was relatively mediocre in this criterion (it scored only 4 out of 17), indicating that energy performance can be better optimized. Shading is provided by the 10.4 acre living roof, the largest in the world, and vertical landscaping is added using trellises mounted on over 75% of building façades. These naturally insulate the buildings and reduce heating and cooling demands. The living roof, for example, keeps the interior at least 10 degrees cooler in the summer (King and Mayne, 2004). This green roof, which shelters the Dearborn Truck Final Assembly Building, is one of the most prominent and beautiful parts of the complex. It comprises a drought-resistant perennial ground cover called sedum that is designed into a bed of several layers to reduce design weight, cost, and fulfills a myriad of important functions simultaneously (Figure 4). For example, it restores eco-structure, improves air quality, mitigates the urban heat island effect at the site, treats and retains storm water, insulates plant interior and saves energy. The green roof, which is 25% of its original design weight and expected to last twice as long as a traditional roof, is identified as a best practice for future projects (AIA Michigan; Hammonds, 2004 ; King and Mayne, 2004).

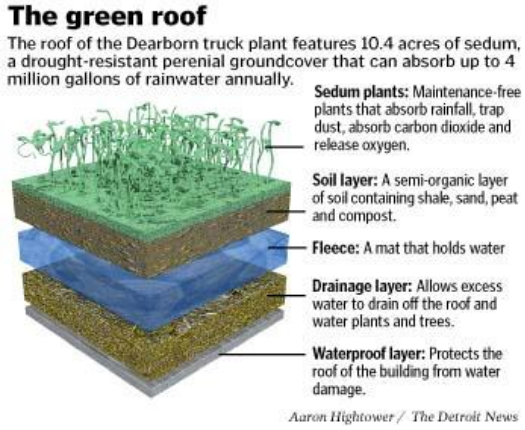

Figure 4. Schematic breakdown of green roof layers (Ford Motor Company).

Besides the green roof, there are various other energy reduction measures such as a combined chiller and chiller water storage, ten giant window boxes and 36 smaller skylights atop the plant that provide natural day lighting (Figure 5), ten large networked HVAC units that heat and cool air efficiently, a photovoltaic array above the Visitor Centre's main entrance, and solar thermal panels for its restrooms (AIA Michigan).

Figure 5. Daylighting window boxes that look out onto the living roof (AIA Michigan).

The Ford Rouge Center is hosts an innovative pilot test that generates 5 KW of electricity from paint fumes, known as the Fumes-to-Fuel System. Paint fumes are concentrated and volatile organic compounds found in them are converted into hydrogen fuel for fuel cells, producing electricity which is distributed to the plant's energy grid (Ford Motor Company). For an industrial facility, the business case for energy efficiency is very strong since these features directly translate to substantial savings in energy costs and pollution control. However, alternative energy sources do not seem to be substantial in this factory, possibly due to its relatively uncompetitive operating and maintenance costs. Despite the photovoltaic array and solar thermal panels, the Ford Rouge Center does not even manage to replace 5% of its conventional energy demands with renewable energy, suggesting that these systems may be superficial "showcase" features, rather than a genuine commitment to transit to cleaner energy technologies. However, if the Fumes to Fuel system, which received a 2003 Clean Air Excellence Award from the U.S. EPA, proves to be replicable at large scale, it is an excellent, cost-effective opportunity for Ford to replace a greater portion of electricity demands with clean energy and be a role model for the industry.

Materials and Resources

During construction, demolition debris were recycled in an on-site concrete crushing operation and used as sub base under the new plant floors (AIA Michigan). In addition, recycled material were sorted and reclaimed. Arcadis-Giffels, the engineering company that led the design team, commented that *"…all project stakeholders were assembled and given clear choices, with the aid of data and samples, regarding use of sustainable vs. conventional material selections. The overriding commitment of the team to implementing sustainable solutions led to a comprehensive selection of environmentally*

responsible materials including linoleum, ceramic tiles, low emission paints and others…" (AIA Michigan). The LEED rating awarded the project two points for using materials with recycled content of more than 50% (USGBC). There was also moderate adaptive reuse of some portions of the old glass facility, which saved construction demolition, disposal costs and expenditures for new materials (AIA Michigan). This was, however, not significant enough to show up in its LEED score sheet.

Indoor Environmental Quality

The interior environment was a paramount issue for the Ford Rouge plant, which houses a large number of workers, processes and public tours. Non-toxic and low-emitting materials for adhesives, sealants, paints and carpets were selected and used. There was some, albeit not terribly significant, introduction of daylighting through monitors, skylights and specially placed windows, and interior climate control systems (AIA Michigan). No LEED credit was awarded for daylight and views, yet many visitors complimented the factory on its pleasant, quiet and clean environment that defied the stereotype of industrial facilities (Kirsner, S. Oct 2004).

Innovation and Design Process

The Ford Rouge Center, embracing its heritage of invention and modernity, implemented a variety of innovative green building strategies that conferred it a maximum of five points in the LEED rating. Those that were formally recognized by the LEED process include sustainability education, as environmentally friendly characteristics are pointed out to visitors of the historic complex, the fumes-to-fuel system which is based on industrial ecology principles, its exemplary storm water management system based on natural systems, and the green screen, which is the vertical landscaping on building façades. The screen is a cost-effective and visually pleasing nylon mesh surface on which indigenous climbing vines grow (USGBC, AIA Michigan). In many ways not reflected in the LEED rating, the center is a pioneer in its design because it marries industrial manufacturing with the environment in a financially sustainable manner. For example, the phytoremediation project has potential to be another best practice to emulate in industrial construction projects, in which brownfields are remediated economically, natural pollutant-assimilating infrastructure is established for the lifetime of the facilities, *and* wildlife habitat and ecological diversity is promoted. It can be replicated in a wide variety of industrial brownfield settings with varieties of species that have pollutant assimilation capabilities that coincide with the contamination in the area.

The LEED rating system

In many ways, an analysis of green building features and an assessment of exactly how "green" a building is, based solely on the LEED rating system, has both benefits and detriments. The nature of a rating is quantitative rather than qualitative in order to maintain an objective standard that ranks how significant a green feature is. I appreciate this characteristic of the system when I observe that the rating effectively filters out features such as the solar photovoltaic array at the entrance of the visitor center, which may appear green, but are really present for aesthetic rather than practical uses. Increasingly, the market is crammed with a plethora of "green" buildings with just one or two environmentally friendly features. The LEED system is a mechanism in which green buildings are credibly certified and information about the building's environmental performance in each area is made available to the public.

However, a checklist of scores based only on quantifiable measures of success also inevitably understates and overlooks small but important improvements. In this case study, the phytoremediation and fume-to-fuel technology were not given due credit. It assumes that because the fume-to-fuel system does not generate a significant amount of electricity, it is not valuable as an alternative energy source. Yet, one can argue that it is an important means of turning polluting waste into energy and should be awarded credit for energy performance. Based on fixed criteria and scores, the LEED becomes absolutely arbitrary rather than context-sensitive. As LEED seeks to become the leading green building certification around the world, it must adapt to different cultures, environmental conditions and government regulations. A building should be judged upon how well it manages and enriches the environment it is situated in. For instance, it is much more sensible to place a greater emphasis on water efficiency, rather than storm water management in a water-scarce area.

In addition, the LEED system also fails to assess the performance of the facility beyond its design, which disconnects the point system from true environmental benefits and financial feasibility. Post-construction, the plant had indeed significantly contributed to the restoration of the ecosystem health of Rouge River. The Ford facility had planted 30,000 indigenous shrubs, bushes and trees on the grounds, constructed wetlands and green roof of the complex, released 20,000 honey bees to remediate the contaminated soil and attract biodiversity back to the area. This has proven to be extremely successful,

with birds, fish, mammals and reptiles returning to the greened landscape and a visible increase of fish populations in the river with rising levels of dissolved oxygen (King and Mayne, 2004). In addition, the storm water management system employing vegetated areas, rock beds and storage basins is effective, and most importantly, much cheaper than a conventional system. These aspects of the project are however beyond the scope of the LEED rating system.

While the LEED rating does not give full credit to long-term environmental benefits, similarly, it fails to alert people to negative environmental impacts stemming from processes and operations. In the case of the Ford Rouge plant, the building has been boasted about repeatedly in Ford Motor Company's websites as a revolutionary, "greenest automotive factory" (Ford Motor Company). It is cited as evidence that the company is transiting to become a more responsible steward of global resources. Environmentalists protest against the irony of this, since the products of the factory remain environmentally damaging, contributing significantly to air and water pollution. According to current EPA reports, Ford's average fuel efficiency is the worst of all automakers in the United States (Lydersen, 2004). Many see this as Ford's "green washing" marketing mechanism to polish its corporate reputation rather than a shift of attitude of the automaker that is notorious for its fuel inefficiency. Some of these comments are excerpted below.

"All of this is welcome and commendable. Still, one should remember that Ford Motor Company's biggest environmental impact is through promotion of their highly profitable SUVs and pick up trucks, and resistance, along with other automakers, to stricter standards on fuel efficiency…"
–Martha Gruelle, member of Southwest Detroit Environmental Vision (Sylvester, 2003).

"Nowhere else has there been a plant that has been built to such high environmental standards. In and of itself, that's not necessarily worth applauding, given that the sod roof obscures both literally and figuratively the tremendous harm being caused by the F-150 trucks being built under it…"
--Russell Long, executive director of the Bluewater Network (national environmental group) (Hammonds, 2004).

Hence, while it is justified to commend and learn from the green design elements of the Rouge plant, it is necessary to view the plant beyond the LEED rating system, in the larger context of its function and impacts.

The Ford Rouge plant is, by all definitions, a very green building. Particularly impressive is the use of innovative cost-effective natural processes to achieve multiple objectives. Constructed wetlands, for example, control storm water quantity, improve its quality, provide green spaces, attract wildlife, remediate toxics, and improve air quality. By integrating industrial and natural systems with biomimicry concepts, this plant sets the platform for sustainable architecture in manufacturing facilities. Yet, to be an “icon of sustainable manufacturing”, the plant has to go beyond LEED certification and to green its products. This highlights a real limitation of the LEED rating system to establish standards for what constitutes a green building. I believe that a building is characterized by not only its physical design, but also its interaction with its occupants, its functions and its long-term impacts. These should be accounted for in determining its sustainability. Will the environment suffer or benefit from the existence and operation of the Ford Rouge Plant over its life span? The Rouge plant is indeed very green and a remarkable architectural accomplishment, but if it does not produce automobiles of good environmental performance, it is of no real consequence to the sustainability movement. The gold LEED certification becomes nothing more than a piece of marketing rhetoric.

References

AIA Michigan website. Retrieved on Oct 12, 2006 from http://www.aiami.com/green/projects/Ford_Rouge_Ctr/rouge_intro.htm

Baulch, V. and Zacharias, P. *The Rouge Plant—the Art of Industry.*The Detroit News. Retrieved on Oct 12, 2006 from http://info.detnews.com/history/story/index.cfm?id=189&category=business

Ford Rouge Visitor Center, LEED Project #0424. June 2003. U.S. Green Building Council.

Ford Motor Company website. *Introducing our Greenest Automotive Factory*. Retrieved on Oct 11. 2006 from http://www.fordvehicles.com/environmental/greenerplant/

Hammonds, D. Nov 2004. *Greener, Literally: Ford's Better Ideas for Newest Plant include Grass-covered roof, pollution eating plants.* Pittsburg Post-Gazette. Retrieved on Oct 11, 2006 from http://www.post-gazette.com/pg/04317/410625.stm

Lydersen, K. July 2004. *Ford gets an 'F' for Fuel Efficiency.* AlterNet. Retrieved on Oct 11, 2006 from http://www.alternet.org/envirohealth/19148/

King, R.J. and Mayne, E. April 2004. *Ford's Rouge Reborn.* The Detroit News. Retrieved on Oct 11, 2006 from http://detnews.com/2004/project/0405/04/d01-137306.htm

Kirsner, S. Oct 2004. *Ford's Theme Park.* CMO Magazine. Retrieved on Oct 12, 2006 from http://www.cmoresource.com/read/100104/ford.html

McCosh, D. April 2004. *Driving; History Bows at a Ford Plant.* The New York Times. Retrieved on Oct 12, 2006 from http://query.nytimes.com/gst/fullpage.html?sec=travel&res=9A00E1DB153BF935A25757C0A9629C8B63

Sneary, D. Artist's depiction of the Ford Rouge Plant. Retrieved on Oct 15, 2006 from http://www.dicksneary.com/pages/watercolors.html

Sylvester, T. 2003. *The Greening of the Rouge: Ford project draws praise and skepticism.* From the Ground Up.

William McDonough and Partners. *Ford Rouge Center Landscape Master Plan. Dearborn, Michigan.* Retrieved on Oct 12, 2006 from http://www.mcdonoughpartners.com/projects/fordrouge/default.asp?projID=fordrouge