GENERAL MOTORS

The Business Case for Zero Waste

GM blueprint summarizes waste-reduction strategies and global landfill-free program

DETROIT – Industrial facilities in the United States generate and manage 7.6 billion tons of nonhazardous industrial waste in land disposal units annually, according the U.S. Environmental Protection Agency. General Motors, however, recycles 85 percent of its worldwide manufacturing waste and has 131 landfill-free facilities with a goal of 150 globally by 2020.

The landfill-free program allows GM to reduce its waste footprint, while creating greater environmental awareness among employees and communities where it makes and sells cars and trucks. The GM workforce is consistently encouraged to find new ways to operate leaner and more efficiently.

The following summarizes GM's blueprint for attaining landfill-free leadership. It is intended to help companies of all sizes and industries reduce waste and create efficiencies.

GM Program Overview

During 2011, GM set a goal to achieve 100 landfill-free manufacturing sites and 25 non-manufacturing sites by 2020. The company has achieved landfill-free status at 90 manufacturing sites and 41 non-manufacturing sites globally to date, and recently increased its non-manufacturing landfill-free target to 50 sites. This progress inspired a new aspirational goal to become the first automaker with all manufacturing sites sending zero waste to landfill. GM has more landfill-free facilities and recycles more waste from its worldwide facilities than any other automaker.

GM uses a number of strategies to achieve corporate sustainability goals, but the underlying philosophy is thinking of waste as a resource out of place. The company's zero-landfill facilities demonstrate this.

Waste reduction also often enhances productivity, quality, efficiency and throughput. This is why GM merged its environmental efforts with its manufacturing sustainability goals. The result is a more sustainable company poised to provide products to global customers well into the future.

GM integrates its waste-reduction goals into business plans at the facility level as well, driving the engagement of the facility workforce and its suppliers and service providers. All GM plants monitor, measure and centrally report their performance on a monthly basis where it is evaluated against company-wide waste-reduction goals. This data helps identify project opportunities and enables the communication of successes globally.

Waste data collection remains a key element in any landfill-free program. It was through this system, in viewing the downward trend in the company's waste generation over the years that sparked the idea for its first landfill-free commitment in 2005.

GM has received increased internal support for the program since it began approaching waste reduction from a sustainable financial perspective, tying revenue to waste streams and managing all byproducts within one system. Senior leadership approved the establishment of a

landfill-free goal, with Global Manufacturing leading the effort and Global Purchasing and Supply Chain supporting the process.

With more than half of its manufacturing operations now designated landfill-free, GM continues to manage byproducts in one electronic tracking system with a goal of recovering all resources to their highest value. All byproducts are regarded as useful and marketable. Contractors and suppliers play integral roles in making this vision a reality.

Implementing a landfill-free program requires investment and a long-term view. Minimal upfront costs generally decrease in time, with revenue generated from recycling helping to offset the initial investment. When GM started its landfill-free journey in the United States, it invested about $10 for every 1 ton of waste reduced. Over time, it reduced program costs by 92 percent and total waste by 62 percent.

Every company may have a different corporate hurdle rate, whether it is engineering expenses or other financial approvals. Companies should continue to persevere for the long-term benefits.

At times, GM has reduced its waste by making it a resource for recycled-content products. If a project is not cost-neutral or revenue generating, a company should rethink it. It could be a simple material substitution or the addition of another party to help solve the challenge.

To improve a business case, a company may re-evaluate the project using other suppliers, substitute a different material, or seek out energy options, logistic changes, geographical options, or other processing technologies.

GM generated $2.5 billion in revenue between 2007 and 2010 through various recycling activities. The number has increased, generating up to $1 billion in revenue in recent years, made possible through using a holistic GM byproducts management system combining environmental and financial benefits of all plant materials. One example seen at Pontiac Metal Center in Michigan resulted in the generation of $7.5 million in recycling revenue, including metals, in 2011 alone.

The corporation's total elimination of waste is having an immediate impact on carbon dioxide emissions as well. During 2014, more than 10 million metric tons of CO_2-equivalent emissions were prevented from entering the atmosphere as a result of its reuse and recycling programs.

The Process: Steps to Achieving Landfill-Free Status

GM follows several key steps to achieving landfill-free status. They are applicable to any size company or facility.

1. Track Waste Data

Data is the backbone of any companywide zero-waste initiative. An organization cannot manage what it does not measure. GM uses a single resource data management system, allowing it to best manage its waste streams with the byproducts yielding valuable commodities.

Waste data tracking allows a company to comprehend all materials generated, reused and recycled. Doing so reveals opportunities to improve and climb the waste-reduction hierarchy. Data can be repurposed to create specific plant goals and metrics.

Tracking data across all operations, where recycling infrastructures may not be developed, also enables the sharing of lessons learned.

2. Define Zero Waste

Although work is being done by various groups to standardize the term "zero waste," definitions can vary across companies. According to the Zero Waste International Alliance, businesses and communities that achieve more than 90 percent diversion of waste from landfills and incinerators are considered acceptable in achieving zero waste.

GM goes further.

Maintaining a common and consistent landfill-free definition with steps and procedures goes a long way. The following requirements define success for GM's landfill-free program:

- All waste generated from ongoing, day-to-day operations, including episodic/periodic events such as pit cleanouts.
- Byproducts dispositioned by any method except placement in a landfill.

- Byproduct materials sent to an off-site recycling or processing center and subsequently landfilled must not exceed 1 percent, by weight, of the facility's total annual waste production. Ash generated from waste-to-energy recovery systems is exempt.

Although it is desirable and recommended to recycle and reuse byproducts of non-manufacturing event waste such as construction, demolition and remediation materials whenever feasible, these one-off event materials do not count as part of daily operations.

Though construction, demolition and remediation waste is exempt from consideration when determining a landfill-free designation, all future GM North American construction sites will adhere to a process that helps reduce waste and increase energy efficiency throughout construction. The "GM Green Construction" program in North America aims to reduce the weight of construction debris per project by 90 percent through recycling and sending less to landfill.

3. Prioritize Waste-Reduction Activities

Following are prioritized byproduct projects that enable facility landfill-free designations.

1. Eliminating or reducing the amount of byproduct materials
2. Reusing materials onsite
3. Reusing materials externally
4. Recycling materials onsite
5. Recycling materials offsite
6. Composting either on or off site
7. Recovering the energy from materials (incineration with energy recovery) either onsite or offsite
8. Incineration without energy recovery.

Reused waste is put to use in its original form with minimal or no processing while recycled waste is re-processed for a different use, such as wood pallets that are shredded and used for wood chips or plastics melted down and used to make other plastic parts.

GM's 90 andfill-free manufacturing sites reuse or recycle, on average, more than 97 percent of their waste from daily operations and convert less than 3 percent to energy. The goal is to eliminate, reuse and recycle, with expensive energy conversion being a last resort for challenging materials.

4. Engage Employees and Build a Sustainability Culture

A key element of any waste-reduction program is the ability for employees to envision other uses for material. While some employees are comfortable challenging conventional operations, leaders can create rewards for new waste-reduction ideas and encourage employees to develop job functions with the environment in mind.

Finding uses for difficult-to-manage materials such as grinding swarf, process pit sludge cleanout and debris, filtration media, and certain scrap vehicle components can be a challenge, but solutions can be found when thinking creatively.

GM addressed these materials by finding or developing global practices from subject matter experts, peer reviews and lessons learned. The GM staff experts view data on a regular basis and target certain byproduct streams for innovative waste-reduction projects. It communicates the solutions and formalizes them within a web-based best practice system. It then tracks these best practices to conformance and evaluates plant management teams based on their facility's performance to the total waste reduction and zero-landfill goal.

Wherever possible, GM continues to make material substitutions and process changes to improve recyclability and design out inefficiencies. A small corporate team oversees, coordinates and supports the waste program to ensure both a holistic approach and the sharing of best practices across sites.

Here are a few innovative uses for some of GM's byproducts:

1. Converting 227 miles of oil-soaked booms off the Alabama and Louisiana coasts from the Gulf of Mexico oil spill into two production year's worth of air deflectors in the Chevrolet Volt.
2. Recycling cardboard packaging into Buick Verano and Lacrosse headliners to provide acoustic padding that reduces noise in the passenger compartment.
3. Donating scrap vehicle sound-absorption material to insulate waterproof coats that transform into sleeping bags for the homeless—a project entitled The Empowerment Plan led by a Detroit humanitarian.
4. Mixing plastic caps that protect vehicle parts during shipment with other post-consumer plastics like bottle caps to make air deflectors for Chevrolet Silverado and GMC Sierra pickup trucks.
5. Recycling test tires into the manufacturing of air and water baffles for a variety of GM vehicles.
6. Reworking pallets to form wood beams for the homebuilding industry.
7. Capturing solvents used between paint color changes and reformulating them into a paint cured and hardened with ultraviolet light and applied to plant floors.
8. Converting scrap Chevrolet Volt battery covers into wood duck, screech owl and bat nesting boxes.
9. Reusing 1,600 shipping crates as raised garden beds in a once-abandoned parking lot for a community garden and an urban farming initiative supporting soup kitchens.
10. Composting food scraps from various facilities to form nutrient-rich organic humus used as natural fertilizer in gardens.

5. Strengthen Supplier Partnerships

As a result of its landfill-free program, GM has built a strong network of suppliers committed to keeping materials in their use phase. It looks for ways to recycle plant waste into vehicle parts or plant supplies. This type of "closed-loop" effort offers the highest form of recycling.

GM plants hire resource managers – experts in waste elimination and reduction – to assist. Resource management is a strategic alternative to contemporary waste management. GM finds it helps improve resource efficiency through enhanced source reduction, recycling and recovery. The contractors' activities align with the company's strategic goals and objectives, and all manufacturing byproducts are included in the program's scope of services.

6. Resolve Regulatory Challenges

Sometimes various government regulations require disposal of certain commodities, but solutions may exist to avoid landfilling. In some instances, GM works with regulatory agencies to help them understand potential options for challenging waste streams and discuss ways to best manage them using sound scientific principles. Smaller companies may partner with bigger companies to do this or join a business association to help address challenges and generate solutions together.

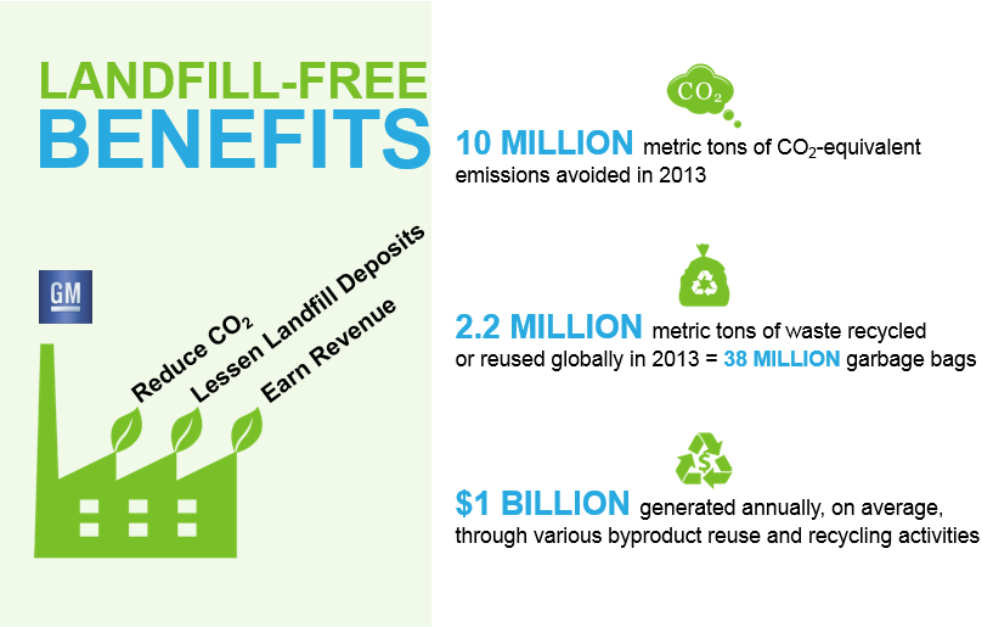
Other challenges vary globally. In some areas of the world, such as certain regions in South America, parts of Asia and Africa, the infrastructure to support recycling is not yet well developed. In North America and Europe where infrastructure is strong and growing, challenges relate to unique or hard-to-treat waste streams.

7. Achieve Landfill-Free

To achieve landfill-free, a facility typically implements waste elimination and recycling projects over time. Once a significant amount of the facility's byproducts are managed without landfilling, the following procedure can be used:

- Inventory all byproducts at the facility and create a spreadsheet showing:
  - Byproduct streams and amount in weight
  - How the material was managed prior to landfill-free
  - How the material will be managed upon landfill-free implementation
  - Byproduct supplier (management company) and destination for each stream
- Route the completed information to the corporate landfill-free subject matter expert to assist in the validation/verification. This enables sharing methods and best practices with others.
- Once a landfill-free program is approved, the plant environmental engineers deploy the projects to eliminate all remaining byproducts from landfill.
- Request landfill-free designation approval from the corporate landfill-free subject matter expert, communicate the landfill-free status to the plant and corporate teams.
- Implement continuous improvement projects, monitor the program to ensure landfill-free conformance and solicit assistance from subject matter experts when needed.

Smaller companies that may not have a corporate landfill-free expert may create a green task force. Much can be accomplished with an enthusiastic team with facility, energy and environmental experience. Thinking creatively goes a long way in absence of dedicated resources. Companies should also consider joining external environmental groups that are dedicated to waste elimination and materials efficiency to share ideas and engage in cooperative projects.



8. Improve Efforts

Zero waste to landfill is a benchmark and strong driver in GM's overall waste-reduction efforts. However, once an operation becomes landfill-free, it still strives to improve the waste performance to reduce environmental footprint and costs, and generate additional revenue. In addition to GM's landfill-free initiative, the company committed to a 40 percent reduction in total waste by 2020, from a base year of 2010. Total waste includes all manufacturing waste, including scrap metals and foundry sands. It excludes event waste such as remediation,

demolition and construction debris and materials reused with minimal or no re-processing (e.g., wood pallets reused as wood pallets).

Companies should continuously improve their waste-reduction efforts even after becoming landfill-free, seeking ways to design out waste versus reusing or recycling. Goal setting fosters improvements and helps encourage employees to maintain momentum.

9. Share Best Practices

To reduce industrial waste going to landfill, companies must continue to openly discuss best practices and work together to brainstorm uses for challenging byproducts. Many deal with the same waste streams, from packaging to paper and metals. GM believes mentoring other companies from all manufacturing sectors is an important aspect to its landfill-free program.

GM plant environmental engineers provide other companies with tours of their facilities and processes to offer ideas about how they can cut their landfill deposits. Facility employees also engage the community through programs such as litter clean-ups and household waste recycling.

Organizations should participate in formal and informal external networking opportunities to identify and drive new opportunities for themselves and the waste community at large. Helping others helps the environment as a whole, and ensures the robust infrastructure of effective partners necessary for all to succeed. GM participates in supplier partnership programs and looks for ways to mentor others in waste reduction and recycling efforts. It links and encourages companies to collaborate. When working together, they have the ability to manage particularly challenging streams in a way that may not be otherwise possible.

Some resources include:

- Suppliers Partnership for the Environment – a partnership between car manufacturers, their suppliers and the EPA that works toward environmental protection.
- Reuse Opportunity Collaboratory-Detroit – an initiative designed to develop a robust reuse network enabling one company's trash to become another organization's raw material.
- U.S. Business Council for Sustainable Development – a nonprofit providing opportunities for industry, government and business to work together on sustainability projects, such as byproduct synergies.
- Waste Wise – a voluntary EPA program through which organizations eliminate costly municipal solid waste and select industrial wastes, benefiting their bottom line and the environment.
- Corporate Eco Forum – an organization for large companies that demonstrate commitment to environment as a business strategy issue. Download paper, "Valuing Natural Capital".

Summary & Future Outlook on Zero Waste

Best Practices

A few elements were key to making the GM landfill-free initiative successful:

- Hiring onsite resource managers with compliance and waste-minimization expertise.
- Setting goals and metrics for each facility.
- Engaging employees as stakeholders in the initiative.
- Strengthening supplier relationships and collaborating to turn ideas into reality.

- Rethinking product design to avoid scrap.
- Setting up a reporting system that allows the global sharing of lessons learned by:
    - Hosting quarterly and web-based global conference calls with experts from each region.
    - Hosting commodity-specific and regular resource management calls with suppliers.
    - Sharing best practices on specific processes and technologies.
- Managing the system through a single corporate entity to enable a consistent, common program with subject matter expertise.

Trends

Sustainability and environmental performance often reflect a solid business model for any company, regardless of what it builds or what services it provides. More companies now understand the bottom-line effects of reducing waste. The trend is to generate less waste from the beginning so that inbound costs are more aligned with total cost, enabling a total-system business case.

Engineers are also applying green chemistry principles so that if a company generates materials, they can be recycled and reused. Going forward, more processing technologies may be used to generate green energy in many forms, and that development is increasing. Both of these concepts complement the landfill-free program.

Through collaboration, companies are learning various technology options and developing robust networks. GM often goes to multiple sources, and at times, it must facilitate the collaboration among various companies to manage a particular waste stream. It's about connecting the green dots that improve company efficiency. This networking and sharing serves to build an infrastructure and strengthen those companies – many of which didn't exist in the past – that are working with one another.

Future Outlook on Zero Waste

There will soon be more opportunities to create "byproduct synergies". One company's output can be another company's treasure, or input. There will be more work to provide linkages between companies, and it will be done collaboratively.

Industries should work together to share best practices, and work with academia to create guides and definitions to bring more structure to zero waste initiatives and help make the future path smoother for companies.

GM believes that transparent, accurate reporting that follows accepted published guidelines and standards, such as the Global Reporting Initiative, is an important step to ensuring the public receives reliable information. GM is beginning to engage third parties in review of its data. It is promoting the use of a common definition for landfill-free as it believes consistency throughout industry will result in improved conditions for the global community.

Whether a company is large or small, a landfill-free journey involves a long-term view, bottom-line focus, innovative thinking and ongoing collaboration.

General Motors Co. (NYSE:GM, TSX: GMM) and its partners produce vehicles in 30 countries, and the company has leadership positions in the world's largest and fastest-growing automotive markets. GM, its subsidiaries and joint venture entities sell vehicles under the Chevrolet, Cadillac, Baojun, Buick, GMC, Holden, Jiefang, Opel, Vauxhall and Wuling brands. More information on the company and its subsidiaries, including OnStar, a global leader in vehicle safety, security and information services, can be found at http://www.gm.com

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APPENDIX: GM FACTS

Landfill-Free

- GM has 131 landfill-free facilities worldwide that reuse, recycle, or convert to energy all waste from daily operations. No other automaker has as many facilities contributing zero waste to landfill.
- Its 90 landfill-free manufacturing sites on average reuse or recycle more than 97 percent of their waste from daily operations and convert less than 3 percent to energy. The company also has 41 non-manufacturing sites that are landfill-free.

Recycling

- GM recycled or reused 2.5 million metric tons of waste materials at its plants worldwide in 2014 – equivalent to 38 million garbage bags. It recycles more waste from its worldwide facilities than any other automaker.
- Today, all of GM's worldwide manufacturing facilities combined – including landfill-free plants and all others – recycle or reuse 85% of the waste they generate.
- From 2000 to 2010, GM reduced non-recycled waste by 73% and total waste by 43% at its global manufacturing facilities. From 2010 to 2013, it reduced total waste 23%.
- GM was one of the first organizations – and to date the only auto manufacturer – inducted into the U.S. EPA WasteWise Hall of Fame, which recognizes continual outstanding waste reduction.