

ENERGY FROM WASTE

HOW GM IS HARVESTING ENERGY FROM WASTE

Gary J. Londo
Energy Leader/Senior Energy Engineer
Global Engineering

May 11, 2016



GENERAL MOTORS

AGENDA

GM SUSTAINABILITY

MANAGING WASTE

LANDFILL GAS

WASTE TO ENERGY

KEEPING IT PERSONAL

INTRODUCTION



“Our customer focus underscores why sustainability is and will continue to be a core strategy for GM. People care about more than the cars. They care how we build them, and how we engage with the world around us. This knowledge, and the discipline that flows from it, is transforming our approach to product design, manufacturing, safety, quality, the environment, customer care and a host of other areas at a remarkable pace.”

– GM CEO Mary Barra

ENVIRONMENTAL COMMITMENTS



Environment: Our Commitment

We're committed to continuous improvement as we reduce the environmental impact of our vehicles and facilities. Our culture of environmental responsibility makes us think creatively, consistently innovate, and be leaner and more efficient.

Waste Reduction

We strive to be the automotive industry's waste reduction leader.

Energy Efficiency

We strive to reduce emissions & petroleum dependence by being more energy efficient.

Resource Preservation

We help preserve natural resources, and enhance habitats surrounding our facilities.

Greener Vehicles

We're building fuel-efficient vehicles that fit our customers' needs and lifestyles.

2020 SUSTAINABILITY GOAL PROGRESS

 **VOC Emissions from Paint Shops**
 • Achieved 10% vs 10% Reduction goal (kg/veh)

 **Renewable Energy**
 106 MW vs 125 MW goal by 2020

 **Biodiversity**
 • All sites WHC certified programs (where feasible)
 • 46 certified programs

 **CO₂ Footprint**
 • 11% vs 20% Reduction (CO₂e tons/veh) by 2020

 **Total Waste**
 • 23% vs 10% Reduction (kg/veh)
 • New target 40% reduction

 **Energy Use**
 • 11% vs 20% Reduction (MWH/veh) by 2020

 **Landfill-Free**
 • 131 sites vs 150 sites goal by 2020
 • New aspirational target: all manufacturing facilities LFF

 **Water Use**
 • 11% vs 15% Reduction (m³/veh) by 2020

 **Community Outreach**
 • All manufacturing sites
 • Explore new global coordinated effort



Legend:

-  2020 Goal Met or Exceeded
-  Glide Path Status (RYG)

ENVIRONMENTAL COMMITMENTS: MICHIGAN



Environment: Our Commitment

We're committed to continuous improvement as we reduce the environmental impact of our vehicles and facilities. Our culture of environmental responsibility makes us think creatively, consistently innovate, and be leaner and more efficient.

Waste Reduction

8 manufacturing & 11 non-manufacturing facilities landfill-free

Energy Efficiency

Approximately 26 MW from renewable sources

Resource Preservation

7 manufacturing & 5 non-manufacturing facilities WHC certified
All sites engaged in GM GREEN

Greener Vehicles

40MPG vehicles – 2 of 9 current models Chevrolet Sonic (Lake Orion), Chevrolet Volt (Detroit-Hamtramck)

GM AND TRASH

At GM, we follow the US EPA's guidelines to manage waste.

Waste Management Hierarchy

Levels of the EPA's solid waste management hierarchy

1. Source Reduction and Reuse
2. Recycling/Composting
3. Combustion with Energy Recovery
4. Landfilling and Incineration without Energy Recovery

US Environmental Protection Agency, Waste website:

<http://www2.epa.gov/recycle>

<http://www.epa.gov/wastes/nonhaz/municipal/hierarchy.htm>



LANDFILL-FREE

AVOIDING + REDUCING + REUSING + RECYCLING = LANDFILL-FREE

GM has 131 landfill-FREE sites



USING OTHER PEOPLE'S WASTE FOR POWER

GM is consuming gas produced from landfills to power its plants in three locations

Landfill gas to electricity

GM Assembly - Fort Wayne, IN (6.4 MW electricity)

GM Assembly - Lake Orion, MI (8 MW electricity)

Boiler Fuel

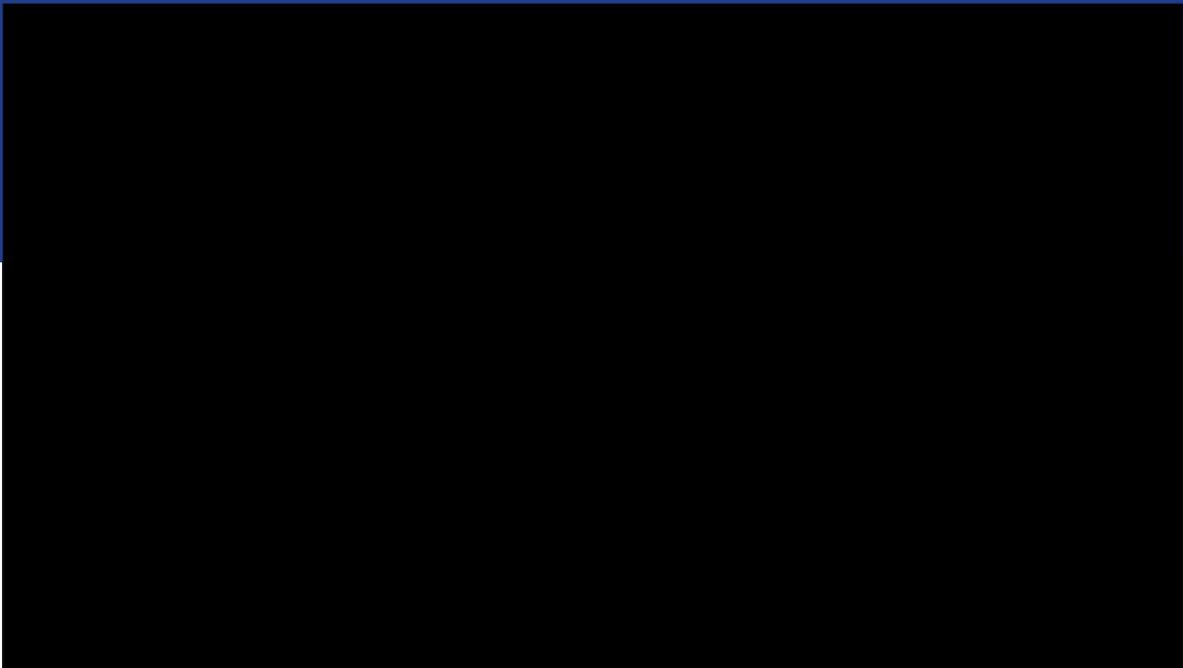
GM Engine/Transmission- Toledo, OH (10.14 MWe - seasonal)

GM is also consuming steam produced from waste in Detroit

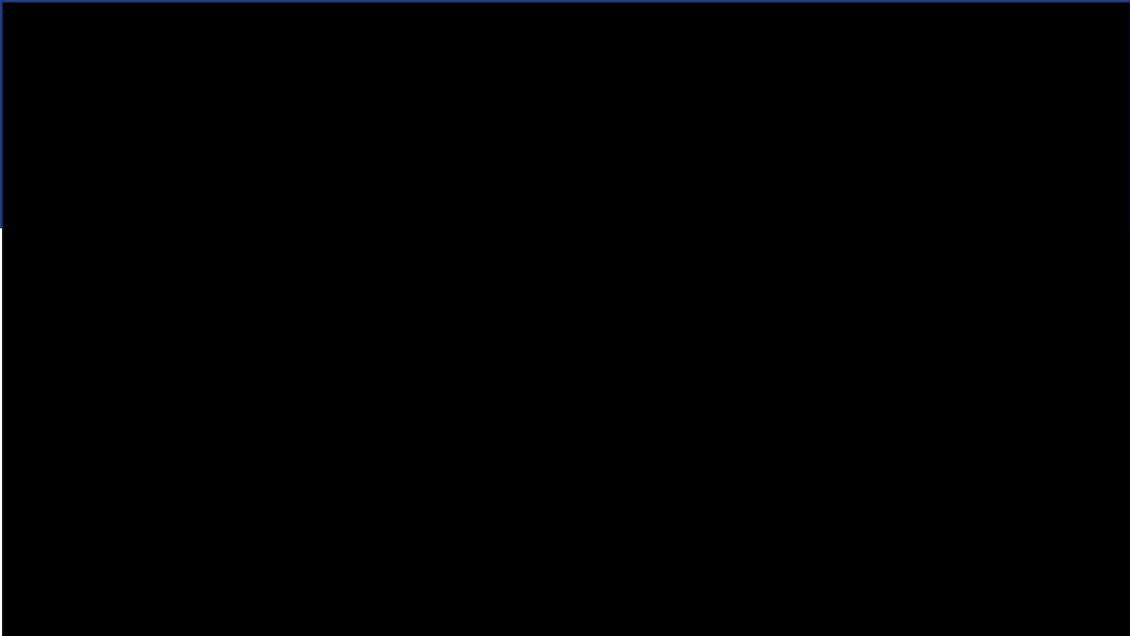
Waste-to-energy (steam)

GM Assembly - Hamtramck, MI (15.8 MWe equivalent)





GENERAL MOTORS





GENERAL MOTORS



GMVM Fort Wayne

GENERAL MOTORS





GENERAL MOTORS

GMV Fort Wayne



GENERAL MOTORS

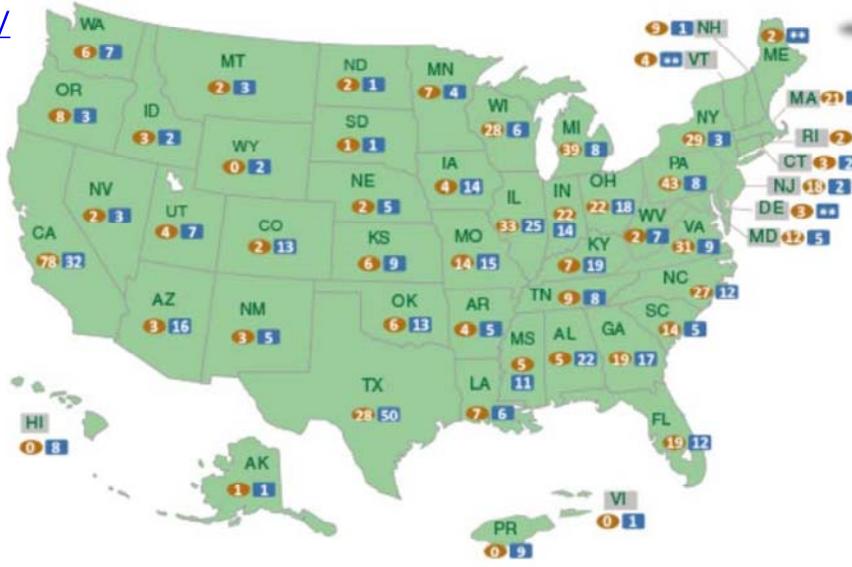
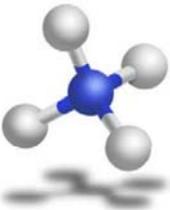
GMV Fort Wayne

US EPA LANDFILL METHANE OUTREACH PROGRAM

We Are Not The Only Ones

Figure 14: LFG Utilization

Source: <http://www.epa.gov/lmop/>



Nationwide Summary
621 OPERATIONAL Projects (1,978 MW and 311 mmscf/d)
~450 CANDIDATE Landfills (850 MW or 470 mmscf/d, 36 MMTCO ₂ e/yr Potential)

- OPERATIONAL PROJECTS
- CANDIDATE LANDFILLS*

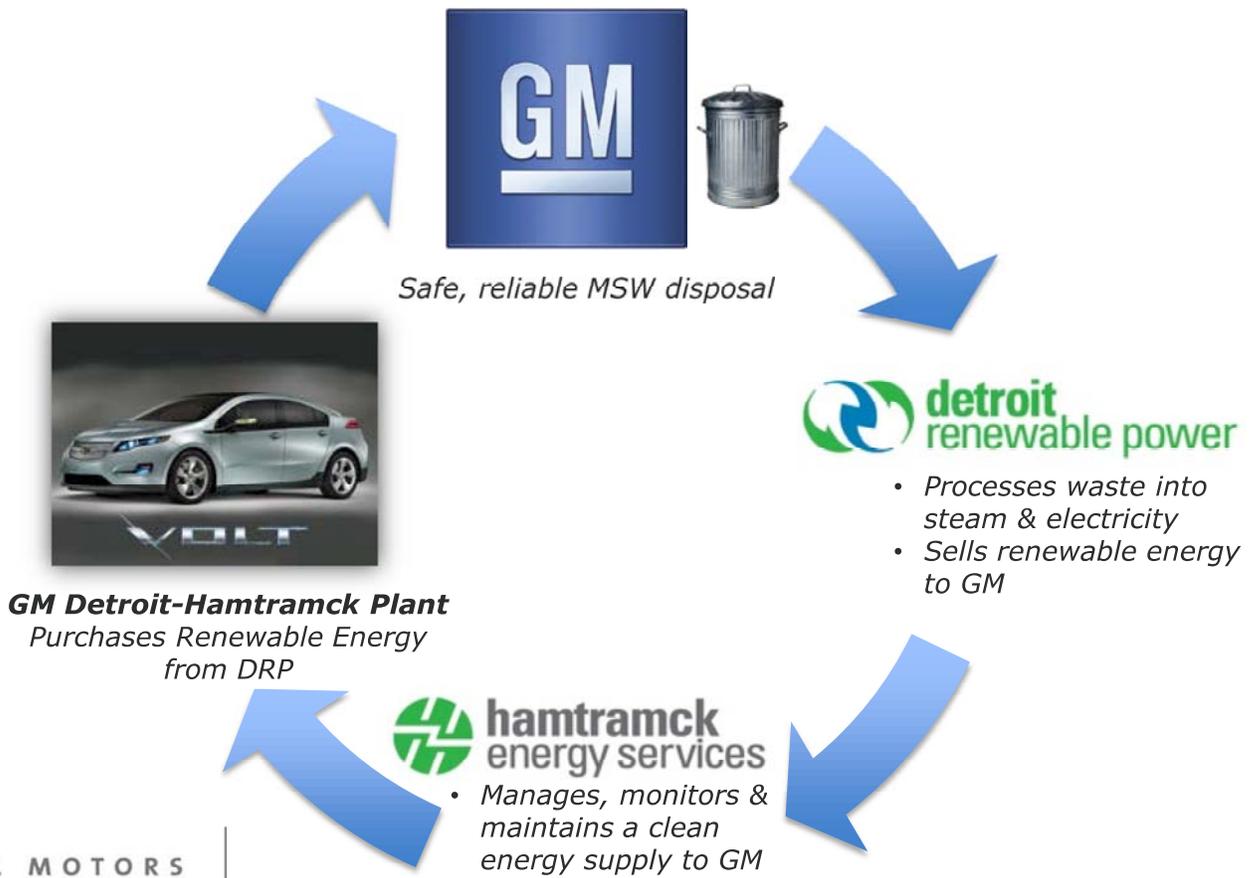
*Landfill is accepting waste or has been closed 5 years or less, has at least 1 mm tons of waste, and does not have an operational, under-construction, or planned project; can also be designated based on actual interest by the site.

These data are from LMOP's database as of July 16, 2013.

** LMOP does not have any information on candidate landfills in this state.

GENERAL MOTORS

SUSTAINABLE & RENEWABLE



PIPELINE



PROPOSED PIPELINE ROUTES



INDUSTRY TRENDS

Quadrennial Technology Review

by R. Neal Elliott, Associate Director for Research

Recently, the Department of Energy (DOE) and the White House Office of Science and Technology released the second [Quadrennial Technology Review](#), or QTR. The 489 page tome bears resemblance to many other government reports that are too often relegated to the TL;DR file--too long; didn't read. That would be unfortunate for those of us who care about the future of energy efficiency technologies.

The report contains a wealth of numbers about energy use and the technologies that can affect the future of energy efficiency in the US economy, and it presents four trends:

- **Convergence.** All sectors of the economy are becoming increasingly interdependent.
- **Diversification.** Energy sectors are shifting to diversified, distributed resources--a trend that ACEEE has been seeing in state and local energy planning.
- **Confluence.** Computing power and simulation are ushering in a new era of "systems by design," much the same as the concept of intelligent efficiency that ACEEE has been advancing.
- **Efficiency everywhere.** Energy efficiency is a critical element in achieving national energy security, cost, and environmental goals--a theme that is at the core of our Energy Efficiency as a Resource Conference that took place last week in Little Rock...

To continue reading this blog post, visit: <http://aceee.org/blog/2015/09/4-energy-efficiency-trends-look-new>

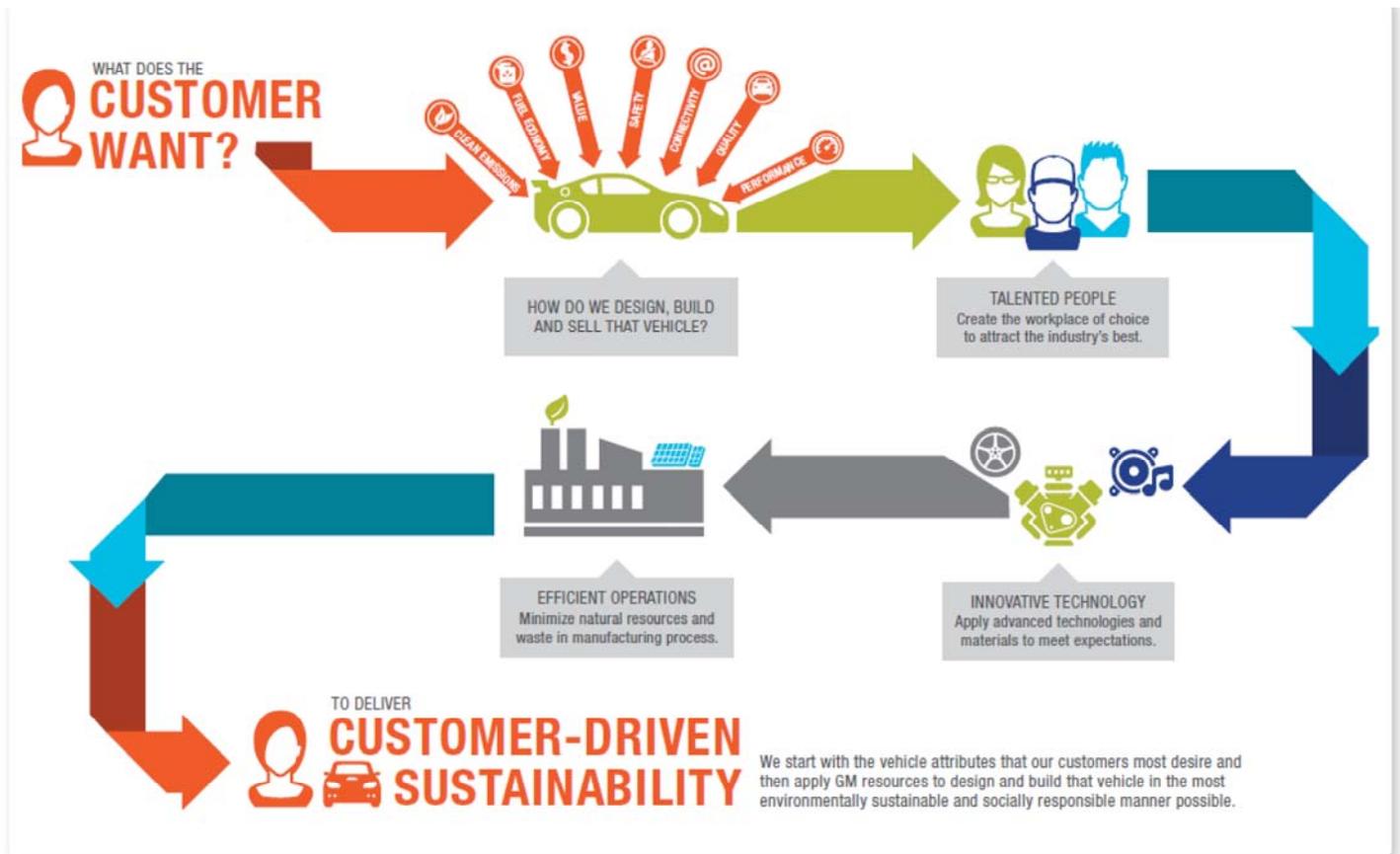
About ACEEE: The American Council for an Energy-Efficient Economy acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. For information about ACEEE and its programs, publications, and

GM is part of a national trend in energy use, as recognized by the US Department of Energy and the White House.

Trending toward more interdependence, diversification, intelligent design, and efficiency, the "US Energy Economy" is changing dramatically.

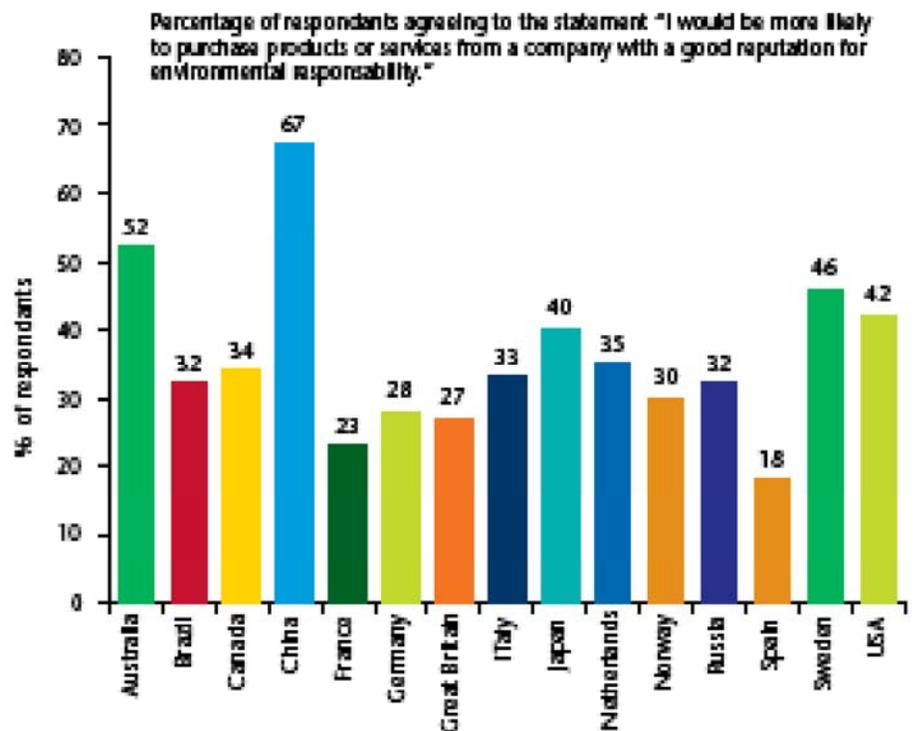
Although GM invests in renewable technology to meet our company goals and commitments, the investment saves GM a lot of money. The investments are good business.

GM CUSTOMER-DRIVEN SUSTAINABILITY FOCUS



INCREASED CONSUMER WILLINGNESS

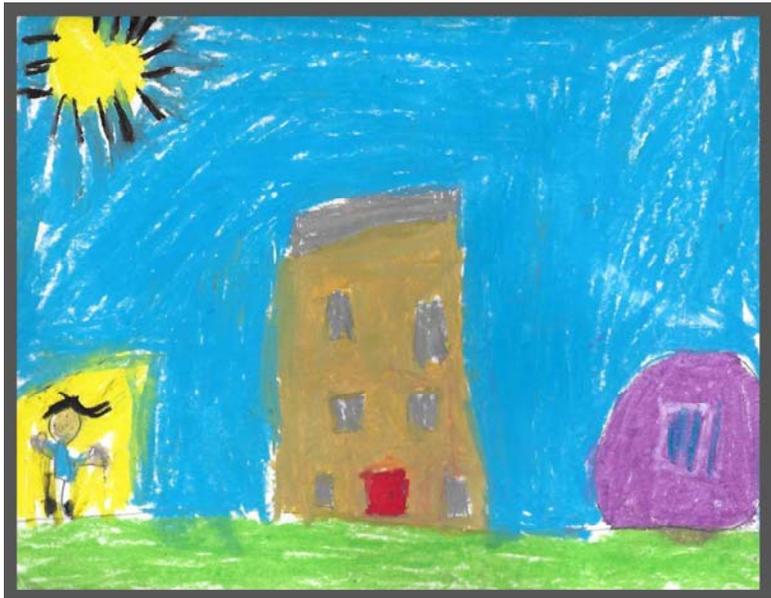
“I would be more likely to purchase products or services from a company with a good reputation for environmental responsibility.”



GENERAL MOTORS

Figure 12: Consumers globally report greater propensity to buy from companies with a reputation for environmental responsibility
Source: Tandberg, 2007.w

KEEPING IT PERSONAL



You cannot get through a single day without having an impact on the world around you. What you do makes a difference, and you have to decide what kind of difference you want to make.”
—*Jane Goodall*

QUESTIONS / ANSWERS

GENERAL MOTORS

28