



The Sustainability Business Case for General Motors

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Master's Project for the University of Michigan
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Team

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Abstract

The purpose of this report is to evaluate and articulate the business case for sustainability for General Motors Company (GM). After assessing the company's exposure to risk and opportunities, the team recommends that GM should implement an internal price on carbon and a sustainable supply chain strategy. These recommendations will provide GM with tangible and substantial financial benefit in addition to improved risk mitigation and brand value. Additionally, the team found that these recommendations are viable within GM's corporate structure and can generate systemic benefits throughout the company.

Thank you to our client, David Tulauskas, and our advisor, Professor Thomas Gladwin.

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Executive Summary

The Sustainability Business Case



According to the United Nations Global Compact – Accenture CEO Study from 2013, 97 percent of CEOs see sustainability as important to the future success of their business and 78 percent see sustainability as an opportunity for growth and innovation.¹ Despite this, when compared to the 2010 study, it seems that company efforts on sustainability have stagnated due to the concern of being able to address these types of issues fast enough and at a large enough scale to cause significant change.²

The automotive sector has been no exception to viewing sustainability as an important component of the business. The major companies have all generated sustainability reports over the past few years to track progress and announce internal goals and have been ranked in a number of indices, such as the Dow Jones Sustainability Index and the Newsweek Green Score. GM has been making great strides to strengthen its leadership among other automakers and has begun to recognize the importance of energy diversity, resource conservation, and carbon emissions reduction to their business strategy.

The purpose of making the Sustainability Business Case for General Motors is to encourage further efforts in sustainability and to prepare the company for change occurring at a faster pace and on a more global scale. These changes include trends of increased transparency, the power of the Millennial generation, and the increase in regulations that address carbon, water, and human rights issues. While these changes will continue to provide opportunities for GM to create business value and to enhance the company's post-bankruptcy resiliency, the ability to respond to them will also strengthen GM's leadership in sustainability and brand value within the automotive industry and across sectors.

This report identifies two recommendations in particular that will help to enhance GM's efforts and to protect the company in coming years from the uncertainty of impacts from topics such as climate change legislation and increasing environmental protection. The two recommendations are for GM to implement an internal price on carbon and a sustainable supply chain strategy.

These recommendations will be beneficial to GM in a number of ways and address some of the key challenges in implementing more sustainable practices, including the

- 1) Potential to reduce costs and supply chain disruptions
- 2) Regulatory, financial, and operational risks involved with carbon, energy, and water
- 3) Need to move beyond traditional decision measures for projects

An internal price on carbon has the potential to create funds that can be invested in further efficiency and renewable projects and be used as a decision-making tool for evaluating projects. Implementing a sustainable supply chain strategy will allow the company to continue mapping out its supply chain while tracking supplier metrics and performance, allowing GM to build the capacity to manage its supply chain and make it more robust.

Support for the recommendations is shown through five analyses addressing the overlapping themes. The analyses investigate:

- 1) Financial risk associated with carbon taxes and permits domestically and internationally
- 2) Operational risk in resource-constrained and/or highly polluted geographies
- 3) Potential energy cost savings from using renewable energy amidst rising usage and prices
- 4) Financial risk associated with suppliers' practices and externalities
- 5) Operational risk associated with suppliers' practices and externalities

Through the analyses, the team found that the two recommendations would allow GM to mitigate risk and to enhance its leadership position within the automotive industry. When combining the analyses in terms of the recommendations' importance to GM and their viability in the current organization, it was found that an internal price on carbon was more important to the company due to its capacity to mitigate financial

and regulatory risk and its alignment with GM's corporate strategy. The sustainable supply chain strategy was more effective in terms of mitigating operational risk and was also viable in terms of the organization's readiness and the alignment with GM's strategy.

Viewing the recommendations through a holistic, systems thinking lens shows that they support each other and could result in greater systemic benefits when implemented together than if they were implemented alone.

Introduction

The Sustainability Business Case



This report seeks to make a business case for sustainability that will compel GM to consider the recommendations the team developed. A business case for sustainability was defined by the team as:

Justifying sustainability initiatives in terms of the business value that they will create –for example, through expected dollars saved or earned, or risks mitigated –thus making those initiatives attractive to profit-maximizing corporations.

Approaching corporate sustainability in this way translates environmental and social issues into a language that is familiar to traditional business executives. Additionally, creating a business case for sustainability will enable GM to identify, quantify, and justify sustainability initiatives that will provide opportunities to create business value.

Since corporate sustainability strategies have been evolving, companies have had the opportunity to take a deeper look into their operations. The MIT Sloan Management Review takes a focus on what they call sustainability insurgency inside an organization.

This concept involves breaking the bounds of job descriptions, corporate silos, budget constraints, and the limits of “moral influence”.³ In this review, corporate social responsibility (CSR) executives have typically led this movement by empowering other managers and employees to identify opportunities to improve sustainability performance within their departments. In an effort to capture the momentum of sustainability insurgency, the MIT review states that the goal is to alter the way business is done in every function and unit of the company.⁴

Rather than identifying sustainability strategies that are specific to a department, or piecemeal in nature, the team took the spirit of this insurgency to develop strategies that are overarching to GM’s operations and sustainability goals. Within this report, the team’s approach is outlined, as well as external trends and interviews that led to the specific recommendations.

GM Corporate Overview



Pre-bankruptcy

The birth and rise of General Motors

The General Motors Corporation was founded by William C. Durant on September 16, 1908 in Flint, Michigan. At the time, Durant sought to transition away from manufacturing horse-drawn vehicles in order to capitalize on the growing automobile market.⁵ The company quickly expanded through acquisition during the following years, purchasing “more than 20 companies including Oldsmobile, Cadillac, and [...] Pontiac.”⁶ Through the early- to mid-20th century, GM captured a global leadership position in automotive sales, which it held for 77 years from 1931 through 2007.⁷ Meanwhile, it helped to modernize the industry by introducing the air bag and catalytic converter.⁸ Through the 1980s and 1990s, the company undertook aggressive international consolidation and expansion as it began to face intense pressure from emerging competitors in the high-growth Japanese, Korean, and German markets.⁹ As GM entered the 21st century, it benefited from a strong presence in key emerging markets but struggled to maintain profitable growth. Meanwhile, it pioneered the major U.S. automakers’ foray into electric vehicles by introducing the Chevy Volt in 2007.¹⁰

State before the crash

During the financial crisis of 2007-2008, GM struggled to maintain profitable growth due to unfavorable domestic economic trends and increasing pressure from international competitors. In addition to several areas of internal mismanagement, GM was directly affected by a rapid slowdown in new vehicle sales in the U.S. market, moving from 16 million in 2007 to 10 million in 2009. As the US financial crisis caused a rapid decrease in housing prices and increase in fuel prices, American consumers both delayed purchasing new vehicles and shifted their preference toward more fuel-efficient vehicles from Asian manufacturers. As a result, annual demand for U.S.-manufactured vehicles dropped from 17 million new vehicles in 2000 to 10 million in 2009.¹¹ Meanwhile, the company’s market share in the U.S. light vehicle market declined from nearly 45 percent in 1983 to only 22 percent in 2008.¹² These factors resulted in GM’s \$81 billion in losses from 2005 through 2009.

The Bankruptcy

Arrival at the decision

GM sounded the alarm on its dire financial situation on November 7, 2008, when it reported that without taking decisive action or receiving significant assistance, it would run out of cash in approximately half a year.¹³ The “Big Three” U.S. automakers, otherwise known as Original Equipment Manufacturers (OEMs), – GM, Ford, and Chrysler – unsuccessfully testified for additional aid at a national Congressional hearing on November 19, 2008. However, ten days later, the Bush administration issued \$13.4 billion in bridge loans to GM and Chrysler in the last weeks of 2008.¹⁴ Of these funds, GM would receive \$9.4 billion, only slightly more than half of the \$18 billion that the company had requested to stave off bankruptcy.^{15,16}

After GM posted a loss of \$30.9 billion for the 2008 fiscal year, during which it spent \$19.2 billion of its cash reserves, the company communicated the urgency of its financial situation with the auto industry task force of newly-elected President Obama.¹⁷ However, bankruptcy became GM’s only option when on March 30, 2009, the President opted not to provide the company with additional financial aid.¹⁸ GM filed for Chapter 11 bankruptcy on June 1, 2009 with the Southern District court of Manhattan, New York. In its filing, GM reported \$82.3 billion in assets and \$172.8 billion in debt, making it the largest industrial bankruptcy in U.S. history and the fourth-largest U.S. bankruptcy of any kind.¹⁹

Impact and implications for GM

During GM’s dramatic discourse with the federal government and before the bankruptcy filing even

occurred, CEO Richard Wagoner was forced to resign per the Obama administration’s bailout strategy.²⁰

After the bankruptcy, GM took several significant actions: it sold the Hummer, Pontiac, Saturn, and Saab brands, all of which were underperforming; it eliminated 40 percent of its U.S. dealerships, reducing its previous total of 6,000 to only 3,600; it reduced its number of U.S. plants by 28 percent from 47 to 34; it cut its U.S. employees by 25 percent from 91,000 to 68,500; and, most importantly, it shed \$79 billion in debt through the bankruptcy proceedings.²¹

This smaller GM sought to modernize its image, restore investor confidence by breaking even, and more prudently manage its operations in order to successfully extend its 101-year history. By necessity, GM adopted a short-term focus in order to quickly

gain traction, which had several implications for its business decisions. For example, GM began to strictly enforce short payback periods in order to prioritize investments that generate quick results. The company also focused mostly on financial results that very directly and clearly impact the company’s bottom line.²²



Source: http://www.mlive.com/auto/index.ssf/2013/12/obama_on_auto_bailout_detroit.html

Long-term causes of GM’s decline

In an interview with the national Press Club on December 16, 2013 – after the dust had settled on GM’s bankruptcy proceedings – outgoing CEO Dan Akerson described three main categories of “poor decisions, indecisions, and no decisions” that accumulated over the three decades prior to the company’s bankruptcy:²³

- Failure to manage fixed costs – in the late 1970s, GM substantially increased its pension contributions despite already paying “almost as much in benefits as it earned in net income.”²⁴

- Failure to maintain economies of scale – as GM grew, so did the company’s complexity across areas as disparate as vehicle design and brand management.²⁵
- Under-emphasis on proprietary data management – GM struggled to perform routine but critical financial reporting tasks given its poorly outsourced data management and analytics model.²⁶

Michael E. Levine wrote in the Wall Street Journal that bankruptcy would enable GM to avoid wasteful spending on such “unproductive commitments,” meanwhile hastening its transformation, while a bailout might not have enabled GM to “change enough [or] change fast enough.”²⁷

Post-bankruptcy

Reemergence with a renewed focus

As GM’s board authorized the bankruptcy, Chairman Kent Kresa justified the decision by predicting that “[a] court-supervised process and transfer of assets will enable a new GM to emerge as a stronger, healthier, more focused and nimbler company with a determination not to just survive but to excel.”²⁸ The company states its objective of becoming “the world’s most valuable automotive company over time” on its website. To that end, newly-appointed CEO Dan Akerson communicated in GM’s 2010 Annual Report that the “new GM” would pursue a more focused business model, deliberate global growth in key markets, and a lower risk profile.²⁹ These efforts included tightening financial processes, streamlining data management, reducing complexity within existing product lines, and aggressively pursuing growth opportunities in current and high-potential markets such as the United States and China. This approach has succeeded resoundingly: GM posted four straight profitable quarters in 2010, followed by a record \$7.6 billion net income in 2011 on revenue of \$150.8 billion.³⁰

Current global footprint

GM relies on growth within the United States and China, which fueled its growth in worldwide vehicle sales to 9,288 million units in 2012, up three percent from the 2011 total of 9,024 million units.³¹ Much of GM’s profitable growth during 2012 came from its 11.3-percent year-over-year sales increase in China, where the company gained a full percentage point in its market share by selling a record 2.8 million vehicles.³² GM also has captured meaningful traction in Brazil, where the Onix was named “Car of the Year” by the Brazilian Automotive Media Association, and in Russia, where Chevrolet has been the best-selling foreign brand for six consecutive years.³³ Within 10 years, GM saw Chevrolet’s international sales – as a percentage of global sales – double from 30 percent to 60 percent.³⁴ Though the company also maintains operations in Europe and South America, both of these regions have struggled and therefore contributed reduced vehicle sales from 2011 numbers.

Opportunities and challenges

GM’s leadership has recognized that the company’s profitable growth will come from continued success in the United States and China, which are the two largest markets in the world.³⁵ The company will leverage its current leadership position in both markets in order to capture projected growth opportunities. Specifically, it forecasts that the Chinese market could grow by as much as 58 percent over just nine years, from 19 million units in 2011 to 30 million in 2020.³⁶ GM has identified a significant opportunity in the Chinese domestic market through expanding its dealership network westward, as well as in growing its Cadillac sales by leveraging the brand’s robust international appeal. GM also sees an opportunity to grow profitably through increasing export sales that incorporate low Chinese manufacturing costs.³⁷

In addition, GM will continue to pursue aggressive growth in emerging markets specifically through its Chevrolet brand, which has generated success in Brazil and Russia, as it has become “the world’s fastest-growing major automotive brand.”³⁸ It also will leverage its first-mover position in the U.S. electric vehicle market towards further product innovation and brand enhancement. This will drive performance improvements and cost reductions that in turn will generate broader appeal to American consumers, who seek reliability and affordability in the post-recession economic environment.

Perhaps GM’s largest challenge is weathering the European economic crisis, which has led to recent volume reductions and profit losses throughout the continent. GM recently withdrew the Chevrolet brand in Europe, due in part to a challenging business model and in part due to the European economic crisis.³⁹ GM also must fight a domestic battle against foreign automakers that have captured significant market share: Toyota has nearly 19 percent market share and has attracted consumers who seek reliable and fuel-efficient vehicles.⁴⁰

Recent Senior Leadership Changes

On December 10, 2013, GM announced that Mary Barra would replace Dan Akerson as the company’s CEO. As a three-decade GM veteran, Barra became the first female leader of a major automotive company. She graduated from Flint, Michigan’s Kettering University and previously served as the company’s EVP, Global Product Development & Global Purchasing & Supply Chain, which means that she possesses significant expertise in vehicle design and sourcing. At the same time, GM named Theodore (Tim) Solso to succeed Akerson as Chairman. Solso, 66, is the former chairman and CEO of Cummins, Inc. and has been a member of the GM Board since June 2012. Mr. Solso is widely credited for Cummins’ early and aggressive move into clean engine technology. Given Solso’s track record and Akerson’s public statement that GM’s new CEO should be a “change agent” with an “orientation to risk,” Barra’s and Solso’s appointments provide an opportunity for GM to make sustainability an even higher priority throughout the organization.⁴¹



Source: <http://www.theverge.com/2013/12/10/5195536/gm-names-mary-barra-ceo-first-female-leader-top-automaker>

Sustainability & General Motors



The business strategy at GM is based off of five guiding principles: Safety and Quality First, Creating Lifelong Customers, Innovation, Delivering Long-Term Investment Value, and Making a Positive Difference.⁴² Each of these can be understood in a way that promotes sustainability at GM; however the last three are the most relevant for this project.

Being a new and perpetually evolving field, sustainability provides a great opportunity for innovation, for instance through renewable technologies, efficiency metrics, and recycling programs. At GM, sustainability is a business approach that creates long-term stakeholder value. It is a value proposition that seizes social and environmental opportunities in a continuously changing world to support the long-term success of GM. One of the four strategic pillars of GM's sustainability strategy is innovation with the other three being integration, transparency, and employee engagement.⁴³ Sustainable methods and resources help deliver long-term investment value, which promotes longevity while mitigating a multitude of risks. Whether it is localized impacts through community engagement or global climate change mitigation, sustainability initiatives allow GM to have a positive

impact across many spectrums.

In its recent sustainability reports, GM announced many sustainability goals and projects that reinforce the five guiding principles. In former COE Dan Akerson's 2013 Letter to the Stakeholders, he declared that GM's "sustainability strategy is guided by this simple truth: energy diversity, resource conservation and CO₂ reduction are business imperatives".⁴⁴ As part of their energy diversity, GM has made impressive strides in renewable energies. As of 2012, GM was the number one user of solar energy in the automotive industry.⁴⁵ The company currently has 62.3 Megawatts (MW) of installed capacity and a goal of 125 MW by 2020.⁴⁶ Not only does the expansion of renewable energy capacity help GM maintain their status as an industry leader, but it also assists the company in achieving its goal of a reduction in energy and carbon intensity of 20 percent by 2020.⁴⁷

Carbon

Along with energy diversification and resource conservation efforts, GM has established carbon reduction goals. GM states that by 2020, the company's "global manufacturing facilities are committed to reducing energy and carbon intensity by 20 percent".⁴⁸ Beyond their manufacturing facilities, GM has also joined the Carbon Disclosure Project's Supply Chain Program, which invites selected suppliers to begin reporting their CO₂ emissions in 2013.⁴⁹ Additionally, in 2013 GM joined the EPA's Smart Way program, which will help reduce emissions from their logistical operations.⁵⁰ Joining both of these programs is an important step for GM to better understand the lifecycle emissions of its product, and therefore better understand its susceptibility to various risks such as regulatory risk.



Source: <http://gmsustainability.com/report.html>

While goals are an important part of improving a company's sustainability strategy, achieving these metrics would not be possible without changes to the organizational structure of GM. The Executive Operating Committee at GM created the Environmental Compliance Oversight Committee in 2012.⁵¹ This group not only attempts to ensure GM does not violate any current regulations, it also attempts to ensure compliance with GM's own Environmental Performance Criteria (EPC), which sets the minimum standards to which GM needs to comply, either local laws or the EPC, whichever is more stringent. In addition, to gain a better long-

term perspective, GM has created an External Stakeholder Advisory Group, which is composed of non-governmental organizations (NGOs), socially conscious investors (SCIs), and suppliers.⁵² This group convened two times during 2012 in order to give GM feedback on its current sustainability initiatives, areas of concern, and the material to be featured in upcoming sustainability reports.

Energy

The EPA has recognized GM for their sustainability efforts in energy. In 2012, the company received the EPA's highest level of recognition for corporate energy management, the ENERGY STAR Partner of the Year - Sustained Excellence Award.⁵³ Additionally, GM has met the ENERGY STAR Challenge for Industry at 63 of its facilities, which is more than any other company in the world and has saved GM more than \$90 million in energy costs.⁵⁴ In order for GM to continue to achieve these reductions and cost savings, it is important for the company to understand best practices regarding renewable energy. To accomplish this, GM hosted a Renewable Energy Symposium with over 30 suppliers to discuss ways to employ these technologies, while minimizing the costs and risks associated with renewables.⁵⁵

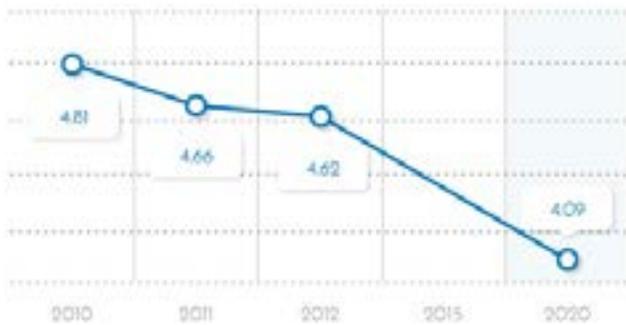


Source: <http://gmsustainability.com/report.html>

Water

Beyond diversifying their energy base, GM has also made progress in conserving resources such as water. Manufacturing facilities are by far GM's largest consumer of water, accounting for around 85 percent of its total water use.⁵⁶ With a goal of a 15 percent reduction in water intensity by 2020, GM has already reduced their water intensity by four percent from the 2010 baseline.⁵⁷ To achieve these reductions, GM is incorporating strategies such as harvesting rainwater and reusing treated water. At the company's San Luis Potosi plant in Mexico, roughly 90 percent of the

GLOBAL WATER INTENSITY
(in M3/vehicle)



Source: <http://gmsustainability.com/report.html>

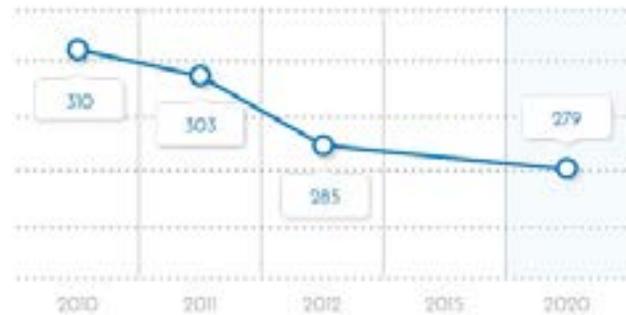
water is recycled, reducing the amount of groundwater required by approximately 264 gallons per vehicle built.⁵⁸ GM is also conscious of water scarcity as a global issue, leading the company to avoid developing facilities in water stressed regions when possible and establishing water policies on a local level to minimize their ecological impact.⁵⁹

Waste

In addition to water, GM has become mindful of its waste. GM's approach to waste management is to view waste as a resource out of place. As a result, it has turned waste streams into revenue streams. GM earns about a \$1 billion a year from selling its wastes instead of paying to landfill them. This has helped GM to achieve 110 facilities being classified as landfill-free, making GM the industry leader in this

area. Furthermore, the company plans to expand this program to 125 facilities by 2020.⁶⁰ There have been returns of scale associated with the expansion of GM's landfill-free program, as it originally cost around

WASTE
(in kg/vehicle)



Source: <http://gmsustainability.com/report.html>

\$10 for every ton of waste avoided but now costs under a dollar per ton.⁶¹ The company has reduced its total waste by 62 percent and is currently recycling around 90 percent of its global manufacturing waste.⁶² Between 2010 and 2020, GM hopes to reduce the total waste generated per vehicle by 10 percent and as of 2012, the company has already achieved an 8 percent reduction.⁶³ In 2012 alone, GM was able to divert 2.6 million tons of waste from landfills.⁶⁴

Sustainability & the Auto Industry

Green Ranking Systems



Newsweek Green Score

The Newsweek Green Rankings ranks the 500 largest publicly traded companies in America on their “actual environmental footprints, management (policies, programs, initiatives, controversies), and reporting practices.”⁶⁵ Companies are sorted into 20 industry sectors, with car manufacturers falling into the Vehicles & Components sector.

The Vehicles & Components sector has a top rank of 50 (Ford Motor) and a bottom rank of 426 (Harley-Davidson) and includes 11 companies. The only two automotive companies included in the list in 2012 were Ford (50) and General Motors (99). Compared to 2011, Ford moved down in rank by 28 and General Motors moved up by 49. See **Exhibit 1** for a breakdown of the 2012 scores for the Vehicles & Components sector.⁶⁶

Dow Jones Sustainability Index

The Dow Jones Sustainability Indices (DJSI) launched in 1999, becoming the first global sustainability benchmarks.⁶⁷ The world’s leading companies are ranked based on economic, environmental, and

social criteria with the goal of providing an effective way to engage companies interested in adopting best practices.⁶⁸ The DJSI follows a “best-in-class” approach. Over 3,000 publicly traded companies are invited to participate by reporting annually on their sustainability practices.⁶⁹ The assessment looks at both general and industry-specific criteria.⁷⁰

The DJSI sorts companies into 24 industry groups, with car manufacturers placed in the Automobiles & Components group. For 2013-2014, the Automobiles & Components Industry Group Leader was Volkswagen AG. GM participated in the survey for the first time in 2013 and was average within the industry.

Carbon Disclosure Project

The Carbon Disclosure Project (CDP) works with cities and companies to measure and disclose environmental measures. The CDP works with companies in the specific areas of climate change, water, forests, and supply chain.⁷¹ Companies are ranked by their disclosure scores, which are determined by points allocated based on the amount of data disclosed and their performance, and then are

Green Rankings 2012: U.S. Companies

Our fourth annual environmental ranking of the 500 biggest publicly traded companies in America.

Here's a comparison of the environmental performance of America's largest public companies. The [Newsweek Green Rankings](#) cuts through the green chatter and compares the actual environmental footprints, management (policies, programs, initiatives, controversies), and reporting practices of big companies. We teamed up with [top leading research organizations](#) to create the most comprehensive rankings available. View our [full methodology here](#).

See more on the [top 25 U.S. companies](#)
 See explanations for [some companies that moved most since 2011](#)
 See our [Global 500 Rankings](#)
 For more about each industry, [click here](#).

SEARCH: INDUSTRY SECTOR:

Showing Results 1 to 11 of 11 Companies View: 25 50 100 ALL

RANK	COMPANY	INDUSTRY SECTOR	INDUSTRY RANK	IMPACT	MANAGEMENT	DISCLOSURE	DISCLOSURE SCORE	2011 GREEN SCORE	RANK CHANGE
56	Ford Motor	Vehicles & Components	1	54.7	74.5	50.6	67.2	59.8	-26
74	Goodyear Tire & Rubber	Vehicles & Components	2	46.8	83	63.6	64.8	51.1	178
81	Navistar International	Vehicles & Components	3	52.5	84	20.5	63.5	55.3	-34
82	Johnson Controls	Vehicles & Components	4	52.1	70.8	60.9	63.4	58	39
99	General Motors	Vehicles & Components	5	53.7	68.2	30.1	61.9	56.5	49
161	Tenneco	Vehicles & Components	6	58	73.7	0	67.9	55	18
222	Autoliv	Vehicles & Components	7	50	68	13.2	54.4	55	-44
241	BorgWarner	Vehicles & Components	8	53	64.5	4.2	63.3	48.2	67
373	Lear	Vehicles & Components	9	53.7	60.7	0	47	45.5	6
412	TRW Automotive Holdings	Vehicles & Components	10	50	43.9	0	44.5	44.5	-18
426	Harley-Davidson	Vehicles & Components	11	50.7	37.2	36.3	43.4	41.3	8

Exhibit 1: 2012 Newsweek Green Scores: Vehicles & Components Sector

Source: <http://www.newsweek.com/2012/10/22/newsweek-green-rankings-2012-u-s-500-list.html>

assigned a letter grade. To calculate a company's disclosure score, the number of points a company receives is divided by the maximum possible and then the fraction is converted into a percentage.⁷² The companies with the best scores for disclosure are listed in the Climate Disclosure Leadership Index (CDLI). In order to be included in the CDLI, companies must also make their responses public.⁷³

The data covered in the CDP are broken down into three categories as follows:

- Scope 1: direct greenhouse gas emissions from sources owned or controlled by the company
- Scope 2: indirect greenhouse gas emissions from the company's consumption of electricity, heat, cooling, or steam (often called "purchased electricity")
- Scope 3: indirect greenhouse gas emissions from the company that are not covered in Scope 2. They are sources that are not owned or controlled by the company but that occur because of its activities.⁷⁴

The automotive industry falls into the Consumer Discretionary sector of the CDP. In 2013, 60 companies comprised this sector, with 46 (77 percent) responding. Automobiles made up 11 of the 60

companies, with 10 responding to the assessment.⁷⁵ In 2013, BMW, Daimler, and GM all achieved a perfect score of 100 in the CDLI. These companies were followed by Honda, Volkswagen, and Nissan, each with a score of 99.⁷⁶ For the Climate Performance Leadership Index, BMW, Daimler, Honda, Nissan, and Volkswagen led with performance bands of A. GM received an A- in this index.⁷⁷ See **Exhibit 2** for the reported amount of metric tons of CO₂ equivalent emitted per unit of revenue for Scope 1 and 2 emissions of the ten largest companies by revenue in the sector.

Fortune: World’s Most Admired Companies 2014

Fortune considers the Most Admired list as a report card on corporate reputations.⁷⁸ The list is developed through a survey that reaches nearly four thousand respondents to select the most admirable companies. Fortune includes a total of 692 companies by choosing companies from the Fortune 1,000 (the 1,000 largest U.S. companies by revenue) and the Fortune Global 500.⁷⁹ From there, Fortune narrows the list down by selecting the fifteen largest companies for each industry.

GM did not make the Top 50 ranking in 2014 but did achieve an overall score of 5.77, which places the company fourth in the Motor Vehicles category.⁸⁰ Within that score, other specific categories are ranked as well. These rankings reflect the company’s standing in its overall industry category. Of particular interest, GM ranked fifth in social responsibility, fifth in long-term investment, and fourth in global competitiveness. BMW was ranked first in Motor Vehicles, with an overall ranking of 14 and an overall score of 7.68. BMW’s specific ratings ranked first in all categories including social responsibility, long-term investment, and global competitiveness.

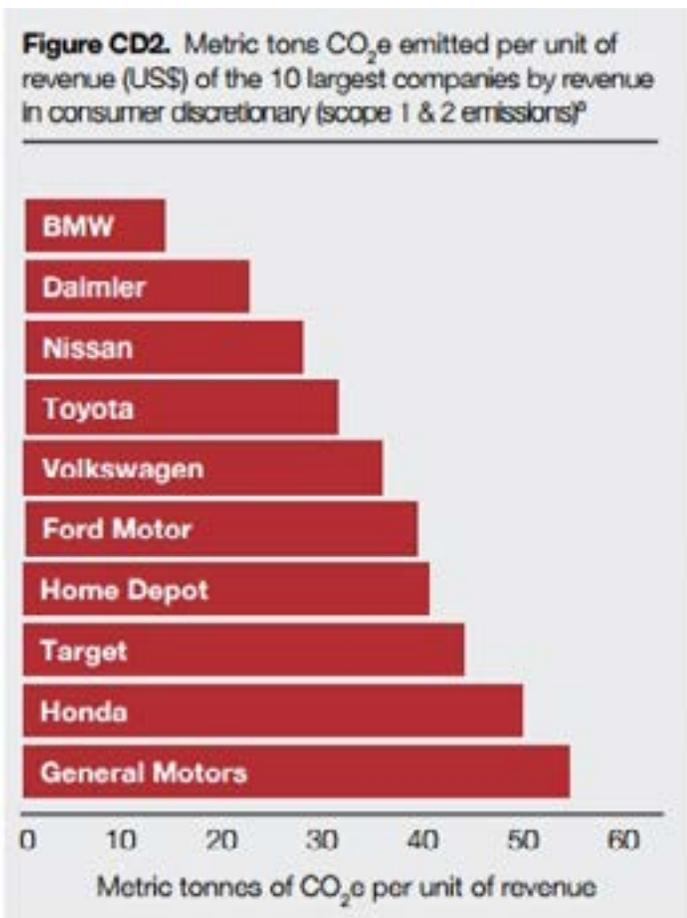


Exhibit 2: CDP reported CO₂e emitted per unit of revenue
 Source: <https://www.cdp.net/CDPResults/CDP-Global-500-Climate-Change-Report-2013.pdf>

Sustainability & the Auto Industry

Competitor Trends



Based on the green rankings for the automotive industry, this section provides an overview of other leading car manufacturing companies' achievements, pursuits, and goals around the topic sustainability. The sustainability initiatives of Ford Motor Company, Volkswagen, BMW, and Toyota are highlighted, with a comparative summary shown in **Exhibits 3 & 4**.

Ford Motor Company

Ford Motor Company's sustainability initiatives fall into three of the six categories included in their Sustainability 2012/13 Report: Climate Change and the Environment, Water, and Supply Chain.

Climate Change and the Environment

In the 2012/13 report, Ford announced a number of goals related to climate change and the environment. These included energy and waste reduction goals as well as continuing to increase sustainable materials in vehicles and reduce VOCs from operations. Two specific goals outlined were to:

- Reduce facilities' CO₂ emissions by 30 percent per vehicle by 2025 when compared to a 2010 baseline and

- Achieve a 40 percent reduction in waste per vehicle sent to the landfill between 2011-2016

These goals stemmed from previous reductions in operational energy use of 31 percent from 2000-2010 and in waste per vehicle sent to the landfill of 40 percent from 2007-2011.⁸¹

Water

Beginning in 2000, Ford began their Global Water Management Initiative, which set a target of three percent year-over-year reductions. This goal has been increased to a 30 percent reduction of water use per vehicle by 2015 over a 2009 baseline.⁸² This follows a reduction in total global water use of 62 percent from 2000-2012.⁸³

Ford's water reduction strategy revolves around a number of technologies, such as:

- Three-Wet Paint Technology
- Dry Paint Overspray System
- Minimum Quantity Lubricant
- Internal Water Metering
- Sustainable Stormwater Practices⁸⁴

An example of these water-reducing strategies is the use of the “Three-Wet” paint process in two of Ford’s new plants in Asia. In addition to saving water, the process also reduces volatile organic compounds (VOCs), CO₂ emissions, and waste.⁸⁵

These actions are further supported by an internal database used to communicate reporting requirements to suppliers.⁸⁹

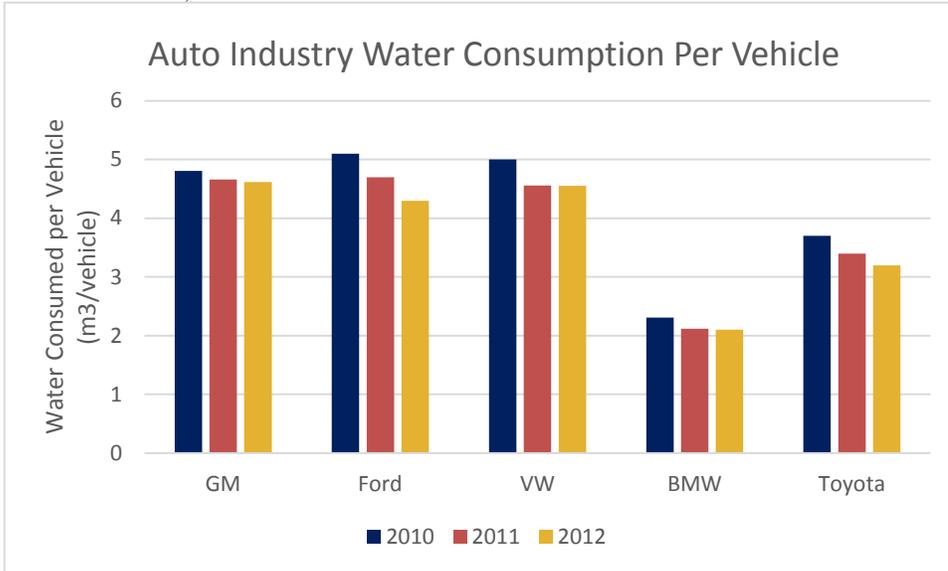


Exhibit 3: Comparison of Auto Company Water Consumption Per Vehicle

Volkswagen Group

Volkswagen Group’s (VW) sustainability report for 2012 addresses sustainability across 11 different areas, including Climate Protection, Efficient Production, Water, and Resource Efficiency. Overall, VW has set the goal to become number one in the automotive industry in ecological terms and reduce the company’s environmental impacts from production operations by 25 percent by 2018.⁹⁰

Supply Chain

Ford approaches sustainability within its supply chain by working with suppliers to improve sustainability and environmental performance and by promoting sustainable raw materials deep within the supply chain.⁸⁶ The company surveyed 135 suppliers in 2012 about their GHG emissions. These suppliers account for more than half of annual purchases and Ford found that overall, suppliers are engaged in climate change and emission reductions but are at various stages in terms of being able to measure and report their GHG emissions.⁸⁷ Ford continues to engage suppliers on these issues.

In terms of materials, Ford approaches sustainability in the following ways:

- Advancing transparency,
- Engaging with policy makers and stakeholders,
- Collaborating with others in the industry through the AIAG,
- Promoting material recycling, and
- Exploring viable alternate materials⁸⁸

Climate Protection

Due to the risks associated with climate change, VW conducted a Scope 3 inventory of the CO₂ emissions associated with its products. Since it was found that 70 percent of Scope 3 emissions was accounted for during the use phase of the vehicle, VW has committed to:

- Producing a portfolio that increases the use of fuel-saving and low-emission technologies without decreasing customer choice
- Communicating through “efficiency badging” which vehicles are the lowest in CO₂ emissions
- Providing information to customers on how to reduce CO₂ emissions through their driving style

In addition, VW has set goals in the mid-term to reduce the CO₂ emissions of its European new vehicle fleet 30 percent by 2015 over a 2006 baseline, equating to a 45 mile per gallon fuel efficiency of

the fleet, as well as ensuring that every new vehicle generation is 10 to 15 percent more efficient than the last. VW's long-term approach to reducing emissions is focused on powertrain electrification, as there are zero emissions at the point of use.⁹¹

Efficient Production

VW's major goals in production are to cut energy and emissions associated with operations 25 percent by 2018 over a 2010 baseline. In Germany, VW is aiming to reduce greenhouse gas emissions from production-related energy supplies 40 percent by 2020 over a 2010 baseline. These goals set the stage for increasing renewable energy projects and investment in renewable energy expansion. The company has set aside €600 million for renewable energy expansion, which will build on the success of projects such as the Volkswagen Chattanooga Solar Park. This solar facility has a peak output of 9.5 MW and is the largest solar facility run by a carmaker in the United States.⁹²

Water

VW's major goal is to reduce water consumption in all plants 25 percent by 2018 over a 2010 baseline. This goal is being pursued by reducing water consumption per vehicle, which fell 0.45 m³ from 2010 to 2012, and through water recycling.

Resource Efficiency

As in other areas, VW has set the goal of reducing waste 25 percent by 2018 over a 2010 baseline. Resource efficiency has been pursued by reducing the amount of materials used per vehicle, such as the 12 percent reduction of material used in the new Golf, and through recycling efforts. Recycling efforts include ensuring that new vehicles are 85 percent recyclable and the Genuine Remanufactured Parts

Programme, which remanufactures over 16,000 components.⁹³

BMW Group

As one of the leaders in the industry, in 2012 BMW Group (BMW) achieved the Industry Leader Award for the eighth consecutive year in the DJSI as well as Industry Leader in the Global 500 ranking and third place in the Carbon Disclosure Leadership Index across industries in the CDP. BMW's sustainability goals cut across three categories: Products and Services, Production and Value Creation, and Employees and Corporate Citizenship. Specific goals are set for CO₂ emissions, renewable energy, and resource consumption.⁹⁴ BMW also works with its supply chain to establish sustainable practices.

CO₂ Emissions

BMW has set the goal to reduce CO₂ emissions in its European new vehicle fleet by at least 50 percent by 2020 over a 1995 baseline.⁹⁵ In order to achieve this goal, BMW has developed the Efficient Dynamics Programme, which moves the company's fleet from efficient technologies for new vehicles, creating hybrid solutions, and producing alternative drivetrain concepts, to eventually moving towards vehicles run by fuel cell technology and electricity from renewable sources.⁹⁶

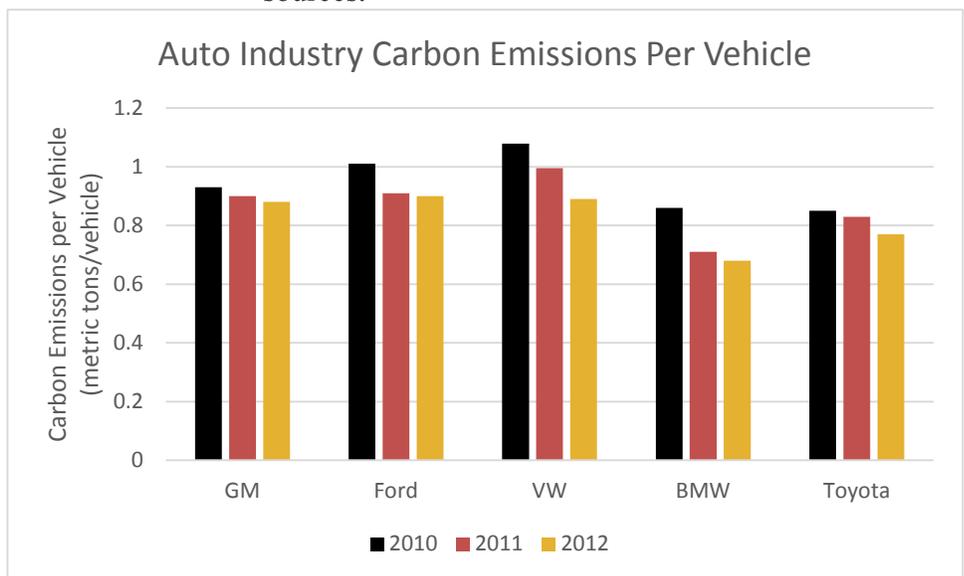


Exhibit 4: Comparison of Auto Company Carbon Emissions Per Vehicle

Renewable Energy

BMW would like to become the leader in using renewable energy for production and value creation.⁹⁷ The company's goal is to meet 100 percent of its energy consumption from renewable sources. This goal will be supported by projects such as the construction of four 2.5 MW wind turbines to support the carbon-neutral production process of the BMW i3 in Leipzig.⁹⁸

Resource Consumption

In terms of resources used to manufacture vehicles, BMW is attempting to reduce energy, water, waste, and solvents per vehicle 45 percent by 2020 over a 2006 baseline.⁹⁹ From 2006-2012, the company had an approximate 36 percent efficiency improvement in their production processes. Over that same time period, the company saw the following reductions:

- 26 percent in energy consumption
- 30 percent in water consumption
- 36 percent in process wastewater
- 65 percent in waste for disposal
- 27 percent in solvents emissions¹⁰⁰

Through the Design for Recycling principle, BMW has a reuse and recycling rate of 85 percent and a 95 percent overall recovery rate since 2008. This principle began in the 1990s by building a network to recover and recycle end-of-life vehicles, with vehicles being recycled at no charge to the last owner.¹⁰¹

Supply Chain

BMW monitors the sustainability of its supply chain through a three-step risk management process that evaluates suppliers on their environmental, social, and governance risk potential, provides a voluntary self-assessment questionnaire for suppliers, and beginning in 2013, will independently audit facilities that are at risk of not meeting sustainability requirements. This process is intended to allow BMW to work with suppliers to improve their sustainability performance.¹⁰²

Toyota Motor Corporation

As the first car manufacturer to introduce a widely available hybrid vehicle with the Prius in 1997, Toyota Motor Corporation has long been viewed as a sustainability leader in the industry.¹⁰³ In this role, Toyota has sold a cumulative total of 4.794 million hybrid vehicles as of the end of December 2012.¹⁰⁴ In 2013, Toyota organized its sustainability report around three major areas: Always Better Cars, Enriching Lives of Communities, which includes the Fifth Toyota Environmental Action Plan 2011-2015, and Stable Base of Business. These areas encompass the environmental areas of eco-cars, CO₂ emissions, energy, water, and waste.¹⁰⁵

Eco-cars

Toyota has been pursuing environmentally-friendly vehicles in a number of ways. While using hybrid technologies as a core, the company is pursuing electric vehicles (EVs), plug-in hybrid vehicles (PHVs), and fuel cell vehicles (FCVs).¹⁰⁶ In order to pursue FCVs, which Toyota considers "very close to the ultimate eco-car," the company is establishing hydrogen-charging stations in metropolitan areas and has plans to mass-produce FCVs beginning in 2015.¹⁰⁷ Toyota is not pursuing this alone, however. In January 2013, Toyota and BMW made an agreement on jointly developing a fuel cell system by 2020.

Low-Carbon Society

In 2011, Toyota set a number of goals around reducing CO₂ emissions that included:

- Increasing the global average fuel efficiency of its fleet 25 percent by 2015 over a 2005 baseline and
- Reducing CO₂ emissions from business activities 29 percent over a 2001 baseline, measured by per unit produced¹⁰⁸

In 2012, both of these goals were met, with 14 out of 15 vehicle weight categories meeting the fuel efficiency goal and CO₂ emissions in tons per unit

produced decreasing by 35 percent.¹⁰⁹ The second goal was met through initiatives such as reducing emissions from the painting process, a process that makes up 20 percent of Toyota's emissions from producing vehicles.¹¹⁰

Environmental Protection

In addition to the initiatives above, Toyota also strives for other environmental protections. For example, in 2012, almost 100 percent of the vehicles produced were certified as an Ultra-Low Emission Vehicle (U-LEV) or higher according to the Japanese LEV emission standards.¹¹¹ The company also reduced VOC emissions from paint by almost 69 percent from 1998-2012.¹¹² In addition, the company pursues biodiversity conservation and forestry initiatives.¹¹³

Recycling-Based Society

The idea of helping to create a recycling-based society includes both water and waste reduction activities. In terms of water use reductions, the company has seen a 33 percent decrease per unit produced from 2001 to 2012. As the majority of water used in manufacturing vehicles is used in the painting process and new goals were set, in 2012 Toyota reassessed every aspect of water use to find areas where water use could decrease.¹¹⁴

In terms of waste, Toyota has pursued initiatives such as creating an "easy to dismantle" mark, using ecological plastic, simplifying packaging containers, switching to returnable containers, and recycling rare earth metals. The total waste volume per unit produced decreased by 59 percent from 2001 to 2012.¹¹⁵ Programs such as the collection of end-of-life hybrid vehicle (HV) batteries for reuse and recycling have helped the company decrease its waste. These HV batteries are reused as replacement Prius batteries, as storage battery systems to reduce peak electricity demand, and recycled for their metal and rare earth elements.¹¹⁶

About the Project

Proposal & Opportunities



GM Master's Project Proposal to the School of Natural Resources and Environment

David Tulauskas, Director of Sustainability for GM (the client), originally submitted a proposal to the University of Michigan School of Natural Resources (SNRE) in January of 2013. The project was internally named “Sustainability Business Case” and was slated for completion in 2014. At the time of submitting a project proposal, the client provided the following objective:

The purpose of this project is to analyze and articulate the business case for sustainability. The main audience would be GM's corporate leadership, and in particular our Chief Financial Officer and our Chief Risk Officer. The resulting report/write-up should discuss why sustainability matters from a dollars and cents perspective.

Suggested goals for this project included:

- Develop a compelling pitch substantiated by data that shows sustainability drives values into the business

- Relate stock price to sustainability through risk reduction, top-line growth, and bottom-line improvements/reduced structural costs.
- Assess what the Social Responsible Investing community primarily measures, and recommend changes GM needs to make in order to be more of an attractive investment to the SRI community
- Assess GM's various impacts on the environment and use a methodology to value those impacts.
- Identify the benefits GM receives from nature's services and use a methodology to value them.
- Generate “mini-business cases” of sustainability in action from various functions.

The client also specified that the report, or parts of it, would be leveraged as an employee engagement tool and widely distributed to employees around the world to encourage all employees to approach their work with a sustainability mindset.

Regarding the specific topics, or functions of business, the client largely left those decisions to the team. The

team began to develop a further understanding of the context of the project by exploring sustainability trends within the automotive industry, how the project could support GM's existing sustainability goals, and how to increase GM's perceived sustainability. With this background research, the team was able to reach recommendations to fit the goals of the client.

Project Opportunities

Opportunity for the project to support GM's sustainability goals

As described previously, GM has a number of sustainability initiatives and goals currently in place. The purpose of the project is to not only support current goals, but to inform GM of other best practices. The team looked at current and pending regulations that could pose risks for GM as well as other opportunities to mitigate risks. Most importantly, the project aims to identify the financial benefits of sustainability initiatives that can improve GM's global footprint as well as the company's bottom-line.

Supporting GM as an Industry Leader

In 2012, GM was the automotive leader for installed solar capacity at 62.3 MW and has a goal to roughly double this capacity by 2020.¹¹⁷ This project seeks to support GM's status as an industry leader in solar energy by identifying the most financially sound approaches to expanding their current capacity. Moreover, the project will provide GM with information on risks and opportunities regarding renewable technologies. GM is also the industry leader in number of landfill-free facilities and plans to expand the program to even more facilities by 2020. GM has already experienced significant returns to scale by expanding this program, but the project has the potential to broaden GM's scope by encouraging waste reduction throughout their supply chain. The team hopes to not only reinforce the strengths of GM's current sustainability initiatives, but to also highlight ways the company can expand its leadership in other areas of sustainability.

Expanding GM's Sustainability Scope

While the project will support GM's existing sustainability goals, it also seeks to identify opportunities for the company to grow while mitigating risk and developing brand value. For instance, there are several risks along GM's supply chain for resource scarcity, including water. GM currently has a goal to reduce water consumption by 15 percent from a 2010 baseline by 2020 and has so far achieved a four percent reduction.¹¹⁸ By creating the business case for sustainability, the project will help to show cost-effective ways to achieve this goal, through efficiency improvements and assessment metrics. Resource risk identification can also apply to other inputs of GM's supply chain, such as conflict minerals or rare earth minerals. Anytime there is an issue of scarcity, there is also the potential for regulation that could restrict the availability of crucial inputs. Therefore, the project will also identify regulatory risk. Regulatory risk can apply to resource scarcity as well as other sustainability issues like climate change. While there is currently no federal climate policy enacted in the United States, carbon legislation exists in several countries globally and regionally in the U.S. As stated previously, GM has a goal of improving carbon intensity at their manufacturing facilities by 20 percent by 2020.¹¹⁹ However, the project will research the development of carbon regulations to put the goals of GM in relation to legislative expectations to understand the severity of risk that regulation poses to the company. Understanding the risks and opportunities within sustainability will allow GM to optimize their current strategies and develop more successful goals for the future.

Opportunity to increase GM's perceived sustainability

While GM has been setting and achieving aggressive, meaningful metrics for sustainability, GM's brand is not perceived to be as green as it performs. Ideally, perception and performance should be at the same level. If there is a gap from perception being higher than performance, there is reputational risk.¹²⁰

However in GM's case, the opposite is true. The company's performance is higher than perception, meaning that GM is not maximizing the value of its performance. Benefits from closing this gap include improved brand image/reputation and increased investments from socially responsible investors (SRIs).

Investment from socially responsible investors

Socially responsible investing in the U.S. grew by 22 percent from 2010 to 2012, with \$3.74 trillion in total managed assets, meaning that an astonishing \$1 out of every \$9 under professional management in the U.S. can be classified as an SRI investment.^{121, 122} Outside of the formal socially responsible investment companies, even traditional investment companies such as Morgan Stanley have devoted a program or at least a fraction of its investments towards socially responsible investments. With these numbers growing, it is as important as ever that companies take advantage of this growth.

GM fits into a subcategory called "ESG Investing", which stands for Environmental, Social, and Governance. This subcategory accounts for \$3.31 trillion or 89 percent of all socially responsible investing.¹²³ The other two subcategories, Shareholder Advocacy and Community Investing, are less applicable to GM. ESG asset managers and owners typically seek out companies with strong corporate social responsibility (CSR) policies and practices, and also look for leaders on CSR issues. To that degree, most SRIs integrate risk and return in choosing companies for their portfolio. By focusing on ESG, GM would become more attractive to SRIs.

Trends

According to the 2012 Report on Sustainable and Responsible Investing Trends in the U.S., the top five types of environmental and social issues among SRIs from 2010-2012 include political contributions, environmental issues, climate change, Equal Opportunity Employment, and sustainability reporting.¹²⁴ Among the top ten ESG Considerations for Institutional Investors, the most applicable causes

related to GM are "Climate Change/ Carbon" and "Labor", ranking eighth and ninth respectively.¹²⁵ More information regarding the specifications and metrics that are attractive to SRIs, can be found at socially responsible investment companies, such as Calvert Investments and Krull & Company. Individuals or institutional investors may seek out a socially responsible investment company to build a portfolio. These companies often times have a thorough process for evaluating companies, a wealth of data including SEC filings, and may even reach out to NGOs to inform the process. The metrics and trends within the SRI community are not surprising, as most are pressing issues in GM's sustainability reporting. However, by assessing the competition, more can be learned about perceived sustainability, and what areas are prime for GM to enhance its leadership.

Competition

To better understand consumers' perceptions of sustainable and responsible automakers, two respected ranking systems that help qualify these perceptions are Consumer Reports and Interbrand. Consumer Reports is a report that delivers only perception scores, while Interbrand uses both perception and performance scores.

According to ConsumerReports.org, Toyota topped the list for "environmentally friendly/green" brands in the automotive industry, with 38 percent of consumers ranking it their number one choice, followed by Smart at 32 percent, Honda at 16 percent, Ford at 16 percent, and Chevrolet at 12 percent.¹²⁶

Three automakers top Interbrand's 2013 Best Global Green Brand list, with Toyota named the top Best Global Green Brand for the third year in a row in 2013. Ford and Honda are close behind at spots two and three respectively.¹²⁷ Along with a ranking, brands are given a gap score, which has a magnitude that is either positive or negative. A positive score implies that the brand has a higher performance score, while a negative score implies a higher perception score. Toyota, Ford, and Honda all had negative

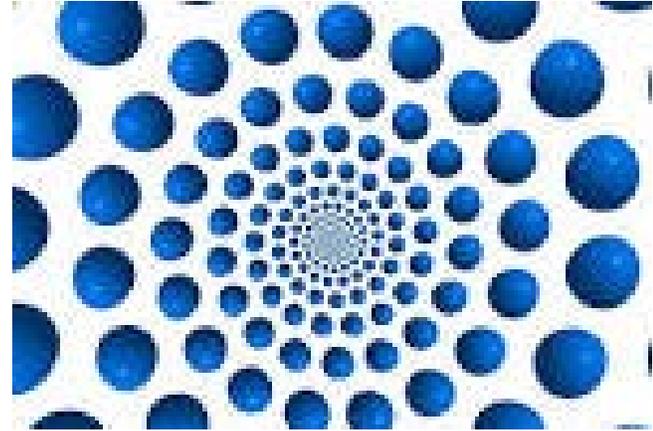
scores. Deloitte assessed the performance scores, which measured across six elements: Governance, Operations, Transportation and Logistics, Stakeholder Engagement, Products and Services, and Supply Chain. Interbrand assessed the perception scores by conducting surveys and interviews to consumers based upon six elements: Authenticity, Differentiation, Relevance, Consistency, Understanding, and Presence.

Closing the Gap

Both Consumer Reports and Interbrand credit the Prius brand as a large contributor to Toyota's perceived sustainability performance. Interbrand attributes Ford's placement as the second highest ranking brand to the promotion of the EcoBoost engine along with its water stewardship strategy and the Lifestyle initiative.¹²⁸ The trends investigated within the SRI community provide a roadmap to how GM can hit important benchmarks in increasing the brand's perceived sustainability. Upon examining the competition, it is clear that several automakers are still benefiting from brands in their fleet that have become imprinted in consumers' minds as being "green". There are still several opportunities to seize that other automotive makers have yet to achieve. The following section on recommendations explores exciting options for GM to strengthen its leadership within the industry and to gain a firmer hold on the SRI community, along with social and environmentally minded consumers.

About the Project

Scoping



Many Master's Projects have the end goal, or product, determined by the client. Typically, the goal is communicated within the project proposal or early on in the process. As mentioned earlier, this project was slightly different. The topic and client on this project allowed for flexibility in selecting exactly what the group would focus on. Rather than simply making a path to connect the beginning of the project to the end goal, the team was able to work together with the client to determine what the ultimate goals were and how the team planned to reach them.

With the team consisting of two Environmental Policy and Planning students, two Sustainable Systems students, and one student pursuing a dual degree in Sustainable Systems and the Ross School of Business, the flexibility allowed the team to scope the project to fit the abilities of the members. This made the project unique and allowed all team members to focus on their interests, but added some challenges along the way.

Initial Research

The project began with all team members doing background research on GM and getting up to

speed on GM's sustainability initiatives and how sustainability fits into the context of GM. The team also had many opportunities to speak with the client and get an idea for what he felt would resonate most with GM and the audience that he intended the final recommendations for. Ultimately the client wanted the final presentation to be made to the Chief Financial and Chief Risk Officers, making the team aware from the beginning that the project would have a strong focus on GM's bottom line.

The team's discussions with the client led to a list of potential topics stemming from GM's initiatives that could be expanded on for the project. Many of the topics were extremely broad (ex. water, energy efficiency, etc.) and required clarification from the client. Once the topics were understood, in order to get an idea of where the team stood, each member indicated which areas they had interest in and which areas they would prefer not to work on.

In addition to discussion with the client, the team also met with the faculty advisor, Professor Thomas Gladwin. Professor Gladwin suggested some topics that the team may want to focus on, or at least receive

clarification on GM's stance and interest. These areas included timescale: would the project focus on short term or long-term goals; geography: would it focus on the U.S. or GM's impact worldwide; and impact: would the focus be social, environment, or both.

Narrowing the Scope

This first iteration of preferences and meetings eliminated several topics and allowed the team to see where there was overlap in interests. From here the team began to look at sustainability resources that Professor Gladwin had recommended in order to make decisions on the scope of the project beyond what the topics would be. The team decided to focus on longer-term goals, and global solutions over short-term, United States focused issues. The decision on impact was left open, pending further research.

These decisions on the overall scope of the project gave the team more context when considering possible topics. From these decisions, the team was able to rank their interests in the subject areas and begin researching at a very high level and specifically in relation to the automotive industry. This research then allowed the team to rank their topics of interest and further narrow down subject areas.

Making a Strong Argument

With all team members comfortable with the topics on the table and aware of the information currently available, an important part in choosing the topics was determining impact. While all of the topics had interest from one or more group members, several stood out as having the potential to make the strongest case towards sustainability at GM.

This was important to consider since GM's bottom line was a major focus for the project. If a subject had the ability to make a compelling case for sustainability, but did not allow GM to profit, or would cost GM money, it did not rank well among other topics for what would appeal most to the CFO in the final presentation. While these topics were interesting, they would not have the incentives to convince a

major OEM to take action.

The consideration of which topics would make the most compelling argument led the team to focus on topics that were at the heart of GM's operations, topics that were already woven into GM's current processes and that the group saw as areas with significant room for improvement and the potential for GM to cut costs throughout its operations.

Subject Areas of Interest

Ultimately, the list was narrowed to five areas of interests. The team chose five subjects with the intent that each team member would lead one topic and the rest of the team would add support to each area. The final five topics were approved by the client and included in the team's interim Master's project proposal to SNRE. The areas that the team chose were water, supply chain, energy efficiency, on-site renewables, and green logistics.

These topics were chosen for several reasons. The team had interest in learning more about these areas, felt that there was substantial material available to make business cases surrounding these topics, and felt their impact to GM make a strong case to support sustainability efforts. The next step in the process was to assign leads to each topic and begin researching and making contact with individuals at GM that could inform the topics moving forward.

GM Interviews



David Tulauskas, Director of Sustainability at GM

The team interacted significantly with David Tulauskas, GM's Sustainability Director, for two main reasons: to receive guidance on project scope and to make connections with relevant internal and external resources and subject matter experts. In terms of scope, the team worked closely with David to define the project. He gave the team insight into where GM currently is in terms of the team's proposed research and what information and rationales leadership at GM would find compelling. To further educate team members and lend guidance to the team's research, David set up meetings with the team and members of GM's finance department, GM employees in Australia, South Korea, and China, representatives from companies with an internal price on carbon in place, such as Microsoft and Disney, and fleet customers, such as ThyssenKrupp.

David helped logistically with the team's survey on potential avenues of research once the scope of the project changed from five individual topics to two or three broader recommendations. He also gathered data and sent the team useful information on GM

both in general and in terms of its environmental performance.

Adam Miller, Green Logistics Intern

Adam Miller was the team's contact for green logistics at GM. Logistics for GM include the incoming deliveries to manufacturing plants from suppliers and the outgoing deliveries of finished vehicles to dealers. While most of the emissions related to automobiles are in the use phase of the vehicle, logistics is the third largest emitter of carbon at 1.5 percent, only behind suppliers manufacturing parts and facility operations.

Adam took a holistic approach to researching how GM and other companies handle logistics and what impact logistics has on GM's carbon footprint. Adam emphasized that while there is recognition that sustainability is important, there is a lack of knowledge regarding how to proceed with such a short-term focus on reducing costs. Logistics operations are an \$8 billion per year expense and GM has set a goal to cut \$1 billion of these costs by 2016.¹²⁹ To meet this goal, GM may open more logistics operations centers near assembly plants as

well as extend rail lines to decrease haulers.¹³⁰ These increased efficiencies should not only save money, but also logistics-related emissions.

However, a problem still exists, as emissions in the use phase of vehicles decrease through CAFE standards, the percentage of emissions produced by logistics will go up, even with reductions from the actions mentioned above. In discussions on shifting focus from logistics itself to an internal price on carbon, Adam thought that changing the metric for measuring carbon emissions for logistics from a percentage to cost savings would help to more accurately portray improvement and would make a good case for carbon-reducing efficiencies in the future.

Marilyn Smith, GPSC Manager for Conflict Minerals Program at GM

Members of the team met with Marilyn Smith to better understand how GM manages the reporting process of conflict minerals to the SEC. These conversations were important to understanding how supply chain reporting works logistically in order for GM to comply with the SEC. Since GM created its own system and database to track conflict minerals through their supply chain, it would be relatively feasible to expand the scope of the database to include sustainability metrics.

Marilyn was very receptive to the idea of expanding the conflict minerals tracking database to incorporate a sustainable supply chain database, which would be a part of the overall recommendation for a sustainable supply chain strategy. She saw value in being able to track metrics that could potentially identify risks for GM and saw the more holistic vision for addressing inefficiencies within the supply chain. In addition, she noted that it would be equally as important to create a communication strategy to accompany a tracking system for sustainability metrics. The reasons for this are simple: suppliers are concerned with keeping their information confidential and they may not have a clear understanding of the reasons behind the tracking or what resources are available to them. The database and strategy could also become a platform for GM

and its supply chain to share lessons learned. In conversation, it became clear that this endeavor could become a very powerful tool, but may take years for some tiers of the supply chain to get involved or be able to take full advantage of the resources.

In a later meeting, the team gained a better sense for how GM assesses risk as it relates to conflict minerals within their supply chain. Marilyn suggested that the recommendation for the supply chain database would be most fruitful for suppliers below the tier 1 level, as GM already has a relationship with a portion of its tier 1 suppliers, but it is much more difficult to communicate, let alone manage risk, lower in the supply chain.

This meeting solidified the team's thinking that a sustainable supply chain strategy should be tied to the conflict minerals system. The rationale for this is twofold: the tracking system for conflict minerals has to reach each supplier every year and the IT infrastructure is already set up to secure confidentiality. After the meeting, the team set out to understand which sustainability metrics would be most useful to track and to quantify the benefits from risk mitigation and efficiency from this recommendation.

Alfred Hildreth, Energy Manager at GM

Team members met with Al and David to discuss potential energy projects at GM and how energy decisions at the company are made. Al was able to explain that energy projects fall into three "buckets" based on the length of their payback period. The payback ranges are typically under one year, one to three years, and performance contracts. Performance contracts are different from the other two in that GM works with an outside company that puts up capital to fund the project; after a given time frame, GM starts to receive payback as well.

An important consideration for the team was the fact that energy projects are not funded from capital but rather count as expenses. Both Al and David were interested in exploring business drivers that made

the case for investing in energy efficiency projects, including carbon monetization. David mentioned that several other companies use carbon prices to fund alternative energy projects and that this might be something to look into.

**Will Sarni, Director and Practice Leader,
Enterprise Water Strategy at Deloitte Consulting**

The conversation with Will and David focused on GM's water resource management and the potential for GM to develop a corporate water strategy, or "water stewardship strategy." Will stressed that water strategy is important to any company for three reasons:

- 1) Minimizing risk
- 2) Bottom line: cutting costs
- 3) Top line: revenue and brand value

From these drivers the team decided that this was an area with great potential for the project. Some areas that were brought up as possible topics were how to address water dependent processes (such as paint processes that use more water vs. VOC paint) and metrics for citing plants in water stressed areas. David emphasized that he would like to focus on long-term risk and these two areas could be expanded into a corporate policy.

Conferences



In order to gain a better understanding of what the auto industry sees as pressing issues in sustainability and of what issues companies in other industries are dealing with in the sustainability and corporate responsibility realms, team members attended two conferences during the course of the project: the Automotive Industry Action Group (AIAG) 2013 Corporate Responsibility Summit in Novi, Michigan and the 2013 Net Impact Conference in San Jose, California.

AIAG

Four team members attended the AIAG 2013 Corporate Responsibility Summit in April 2013. The conference was focused on topics associated with corporate responsibility and sustainability, environmental sustainability, and global purchasing and supply chain issues at companies in the automotive, heavy industry, and technology sectors.¹³¹ The purpose for attending this conference was to better understand what issues are currently the most pressing in the automotive industry and to ensure that the team pursued timely topics.

Overall, the sessions at the AIAG CSR Summit helped team members get a firm grasp on what topics the automotive industry is concerned with at the present time and helped validate the research the team set out to conduct.

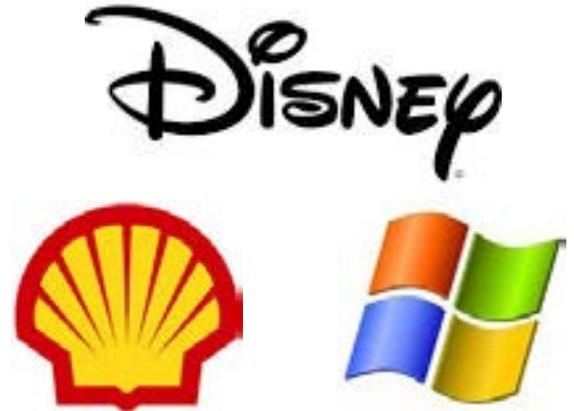
Net Impact

Two team members attended the 2013 Net Impact Conference in October 2013. The purpose for attending this conference was to better understand how different companies are dealing with sustainability issues and to understand best practices in various aspects of sustainability. Sessions were chosen on their applicability to issues being explored by the team.

Overall, while few sessions were specifically focused on the automotive industry, team members were able to learn what other companies are doing successfully in the sustainability space and what might translate well to potential GM actions.

See **Appendix A** for session summaries, key take-aways, and influences of the most useful sessions that team members attended.

Corporate Trends & Innovations



Within the past few years, at least 29 companies have begun incorporating a price on carbon into their long-term financial plans and corporate strategies.¹³⁴ The companies include: Microsoft, General Electric, Walt Disney, ConAgra Foods, Wells Fargo, DuPont, Google, Delta Airlines, Duke Energy, Exxon Mobil, Shell, Walmart, American Electric Power, ConocoPhillips, Chevron, and BP. Tom Carnac, North American President of CDP, stated that

The five big oil companies seemed to have determined that a carbon price is an inevitable part of their financial future. It's climate change as a line item.

They're looking at it from a rational perspective, making a profit. It drives internal decision-making. Companies see that the trend is inevitable. What you see here is a hardening of that understanding.¹³⁵

In the sections below, the team outlines the carbon reduction strategies and methodologies used by Disney, Shell, and Microsoft. An overview is provided in **Table 1**. This analysis is meant to help inform decisions at GM, and help guide decision making as to what strategies and methods best fit the needs of GM.

Table 1: Overview of Carbon Reduction Strategies

Company	Goal	Current Value of Carbon	Methodology
Disney	Work towards zero net emissions	\$11-\$14 per ton of CO ₂ equivalent ¹³⁶	Price acts like a tax; money is placed in a Climate Solution Fund, which finances energy efficiency and renewable projects. Carbon neutral is accomplished by purchasing offsets
Shell	To show that carbon conscious decision-making can be done in a cost effective manner	\$40 per ton of CO ₂	Price guides capital allocation and shape decision-making; no cash is exchanged ¹³⁷
Microsoft	To be carbon neutral	\$6-\$7 per ton of CO ₂ ¹³⁸	System "tracks and taxes" emissions by department; funds are placed in a cloud software and redistributed for efficiency grants

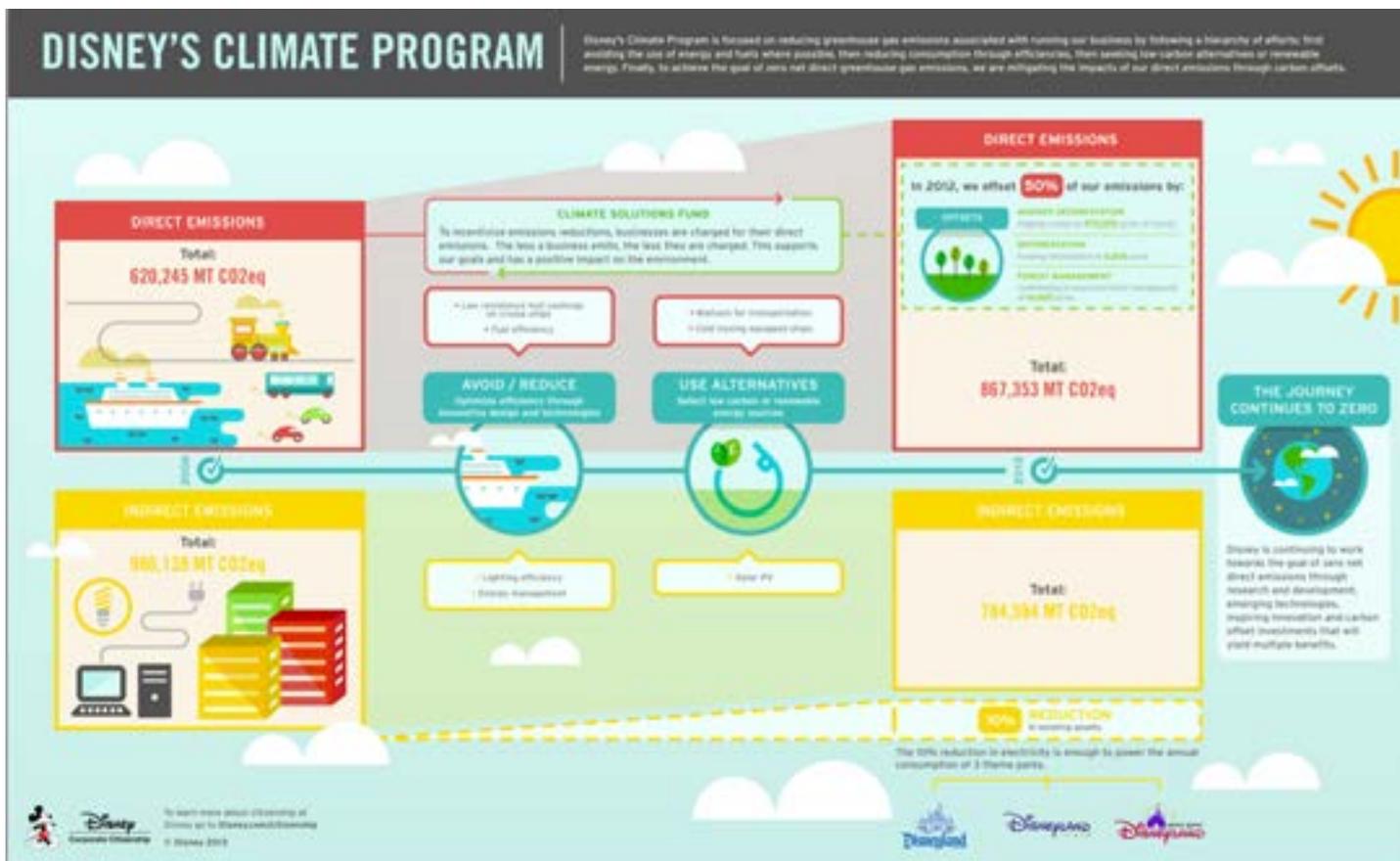


Exhibit 5: Disney Carbon Reduction Strategy

Source: http://thewaltdisneycompany.com/sites/default/files/Disney%2BGOOD_ClimateIG_Final_3-14%20%281%29.pdf

Disney

Disney's Carbon Solution Fund has raised a total of \$35 million from 2009 to 2013. Because of this investment, emissions have been cut in half from 2006-2012.¹³⁶ The tax provides an incentive for the business to innovate. The less a business emits, the less they are charged. Disney sets the price depending upon costs of offsets and the volume of reduction needed to reach their emission targets.¹³⁷

In order to achieve zero net emissions, some emissions are mitigated through the use of carbon offsets.¹³⁸ For carbon offsets, Disney has invested in certified forest carbon projects both internationally and domestically.

Disney faced challenges with hurdle rates, especially for renewable fuels. To combat this, improved efficiency was needed to reduce emissions.¹³⁹

Shell

Shell established an internal price on carbon, “not to deliver major change, but to demonstrate the possib[ility] of carbon pricing driving change in a cost-effective way.”, according to David Hone, Shell's climate change adviser.¹⁴⁰ Shell advocates that a strong, stable price will help to drive the right investments in low-carbon technologies.

Shell's VP for CO₂ strategy, Angus Gillespie, states, “[i]t's based on the level of mitigation that we think is necessary to make sure that our products are robust in the long term.”¹⁴¹ Examples of outcomes of Shell's internal value on carbon are its use of more natural gas, as well as the development of carbon capture and storage technologies. Increased investment in biofuel and the improvement of energy efficiency are also examples of outcomes from Shell's price on carbon.¹⁴²

Microsoft

The “track and tax” system that Microsoft developed, utilizes technologies to measure the impact of the company’s operations. Business groups are then charged according to their actual carbon impact. According to Microsoft’s website, this adds discipline to decision-making and helps to guide the resource choices made.

In an interview with the team, Microsoft shared some of the logistical details on how the funds are collected and distributed. Kilowatt-hours are counted and multiplied by an emissions factor, which are multiplied by the internal fee. The money is collected quarterly and is spent on renewable energy sources, offsets, or efficiency grants.¹⁴³ Business units across the world are able to submit proposals to receive funds from the efficiency grants. This function elevates awareness and opportunity, allowing different units from around the world to communicate in a convenient forum.¹⁴⁴

This methodology includes scopes one, two, and three of the CDP, which Microsoft respectively defines as onsite emissions, electricity consumption, and indirect emissions such as air travel. Metrics used to help meet targets include: power usage effectiveness, carbon usage effectiveness, and water usage effectiveness.¹⁴⁵ Microsoft uses software designed by CarbonSystems to track the tax, and also works with Sterling Planet to purchase the certified renewable energy certificates (RECs).

To make this program successful, the strategy had to be relevant to each department. To do this, Microsoft consulted its stakeholders and internal departments to get feedback while developing the carbon fund.¹⁴⁶ The office of the CFO played an integral role in configuring the approach of carbon reduction.¹⁴⁷ The decision to become carbon neutral was also reinforced by competition. Since Google was becoming carbon neutral, Microsoft saw it in their best interest to respond accordingly.¹⁴⁸

Microsoft did cite that risk mitigation also played a role in its decision to pursue carbon neutrality. There were reports of a NGO attack that came after its data centers for their carbon intensity.¹⁴⁹ With the commitment to carbon neutrality in place, Microsoft is able to tout its relationship with a number of NGOs.¹⁵⁰

Carbon neutrality mitigates risk for Microsoft, but it also has other tangible benefits¹⁵¹. Customers of Microsoft that are tasked with having to report out carbon are easily able to account for Microsoft’s products and services. Not only does this make the transition easy, it lowers each customer’s overall carbon intensity.¹⁵²

The company faced challenges along the way and learned some important lessons. Gaining support from top leadership, including the CEO and CFO, was cited as the most important challenge to overcome.¹⁵³ One of the more insightful pieces of advice from Microsoft was to not overwhelm the system by immediately implementing a price on carbon. During the first year of using the track and tax system, Microsoft valued carbon at a low rate, in order to avoid “shocking the system.” This first year also provided the opportunity to create education, excitement, and awareness around the new policy. Since 2012, Microsoft has raised the price incrementally to fund additional projects. In order to make this process and policy relevant to each department, and to its stakeholders, Microsoft had to deliver the right message. This was partially accomplished by aligning the strategy with corporate values.¹⁵⁴ Microsoft is carbon neutral as of 2014.¹⁵⁵

Regulations & Legislative Activity

Since mitigating risk was such a large part of the project, the team stayed up-to-date on any regulations that could impact GM or the automotive industry in general. While car manufacturers are directly regulated through policies like the Corporate Automotive Fuel Efficiency (CAFE) standards, there are universal policies that have significant influence across industries. Therefore, monitoring regulations and legislative activities became a significant portion of this project.

In order to stay current with existing and pending regulations, the group monitored news media as well as sources like GovTrack.us, which provides information on the status of bills in Congress. While it is critical to understand existing regulations – they have an immediate impact on GM’s strategy – the group also focused on pending legislation, particularly climate policy that has been receiving greater attention. Although some of these bills may not pass through Congress, understanding current discussions can shed insight on regulations that might influence GM in the near future.

Forecasting policy, whether market-based or command-and-control, can have important implications for how GM should be positioning themselves within the industry. Being an industry leader in an area such as carbon emissions has additional benefits should any regulations be implemented. In the case of a market based policy, such as a trading scheme, having the lowest carbon footprint would mean that the company would be

able to sell their permits as opposed to needing to reduce their emissions or purchase additional permits. Additionally, a command-and-control policy, such as a fine or a tax, would require companies to meet a certain standard, and being an industry leader would put GM ahead of other companies in terms of mitigation and avoid the most regulatory penalties. Thus, understanding the subject and type of policies being discussed helps the team better understand the type of risk facing GM, while still promoting the company as an industry leader.

Additionally, since GM is such a global company, the group had to stay knowledgeable about domestic as well as international policies. To understand how some of these foreign companies were responding to different legislative activities, the team conducted interviews with GM employees – generally someone involved in Government Relations – who worked in the subject country. For instance, in response to recent changes in carbon policies, the group held teleconferences with GM employees in Australia and Korea to assess how these changes affected GM’s strategy. Therefore, legislation can pose significant risks or present lucrative opportunities, depending on the legislation and how GM has prepared themselves in terms of any changes to their corporate strategy.

Recommendation Development



While performing research around the original topic areas, the team recognized that they overlapped in terms of underlying challenges and potential opportunities. That is, the most impactful recommendations might span across the organization, helping leadership to connect the dots between seemingly disparate groups and functions in order to maximize the value of sustainability.

With the goal of maximizing the potential impact at GM, the team reasoned that while the subject areas represent some of the most salient sustainability issues at GM, they are not exhaustive in their scope. The team believed that the project's recommendations should be broad and adaptable in order to best add value as GM's business rapidly evolves on its exciting post-bankruptcy growth trajectory. The scope of the project and the team's focus shifted to catalyze systemic change in the organization. The initial research of key sustainability subject areas provided a lens through which to frame overarching risks and opportunities that span significant portions of the GM organization. Therefore, this project provides a highly visible platform from which to present new ideas outside of traditional boundaries and decision-making framework, facilitating fundamental changes to the

framework and generating a more profound impact. Additionally, the project benefits from auspicious timing as GM's newly-appointed CEO, Mary Barra, has publicized her top priorities of building the company's brand and reducing costs as it continues its aggressive globalization efforts.¹⁵⁶

Broadly, the team perceived several risks to operating business as usual: GM is exposed to potential market price fluctuations on inputs such as electricity, due to higher costs resulting from planned (e.g., South Korea) and potential (e.g., U.S., etc.) carbon pricing legislature, as well as to the potential shutdown or slowdown of operations in emerging markets, especially those within resource-constrained geographies. Opportunities include saving potentially significant costs, enhancing the GM brand, increasing sales through attracting and maintaining fleet and individual consumers, increasing employees' workplace satisfaction, and facilitating innovation.

The team recognized that GM does not currently consider key externalities – such as the carbon and greenhouse gas intensity of its supply chain and energy supply – explicitly within its internal operations and supply chain. The team developed two

recommendations to improve the company’s capacity to evaluate these issues: implement an internal price on carbon and implement a sustainable supply chain strategy. See **Exhibit 6** for an explanation of how the two recommendations encompass issues within the original topic areas.

**Recommendation #1
Implement an Internal Price on Carbon**

Placing a price on carbon helps companies streamline their sustainability initiatives and gain competitive advantages within their industries. Valuing carbon enables companies and organizations to better account for the impact of their emissions into daily operations, thereby aiding decision-making regarding new projects or ventures.

An internal price on carbon also introduces a more robust view of risk that includes threats that previously were ignored or underestimated. This has the potential to shift the prioritization of internal projects within GM and to incentivize emission reductions in a way

that can be incorporated into internal accounting metrics, better reflecting estimates of payback periods and ROI. It also has the potential to help the organization reduce costs through securing long-term renewable power purchase agreements (PPAs) – which have lower carbon footprints than traditional “dirty” energy sources – as well as achieve its sustainability goal of reaching 125MW of renewable energy supply by 2020.

**Recommendation #2
Implement a Sustainable Supply Chain Strategy**

Tracking various sustainability metrics and engaging suppliers through a sustainable supply chain strategy enable companies to comprehensively, quickly, and adaptively manage risks and costs throughout their entire supply chain. Since suppliers’ increased costs or noncompliance with legislature might introduce supply reductions or cost increases for GM, prudent risk assessment requires the active management of information around suppliers’ sustainability practices.

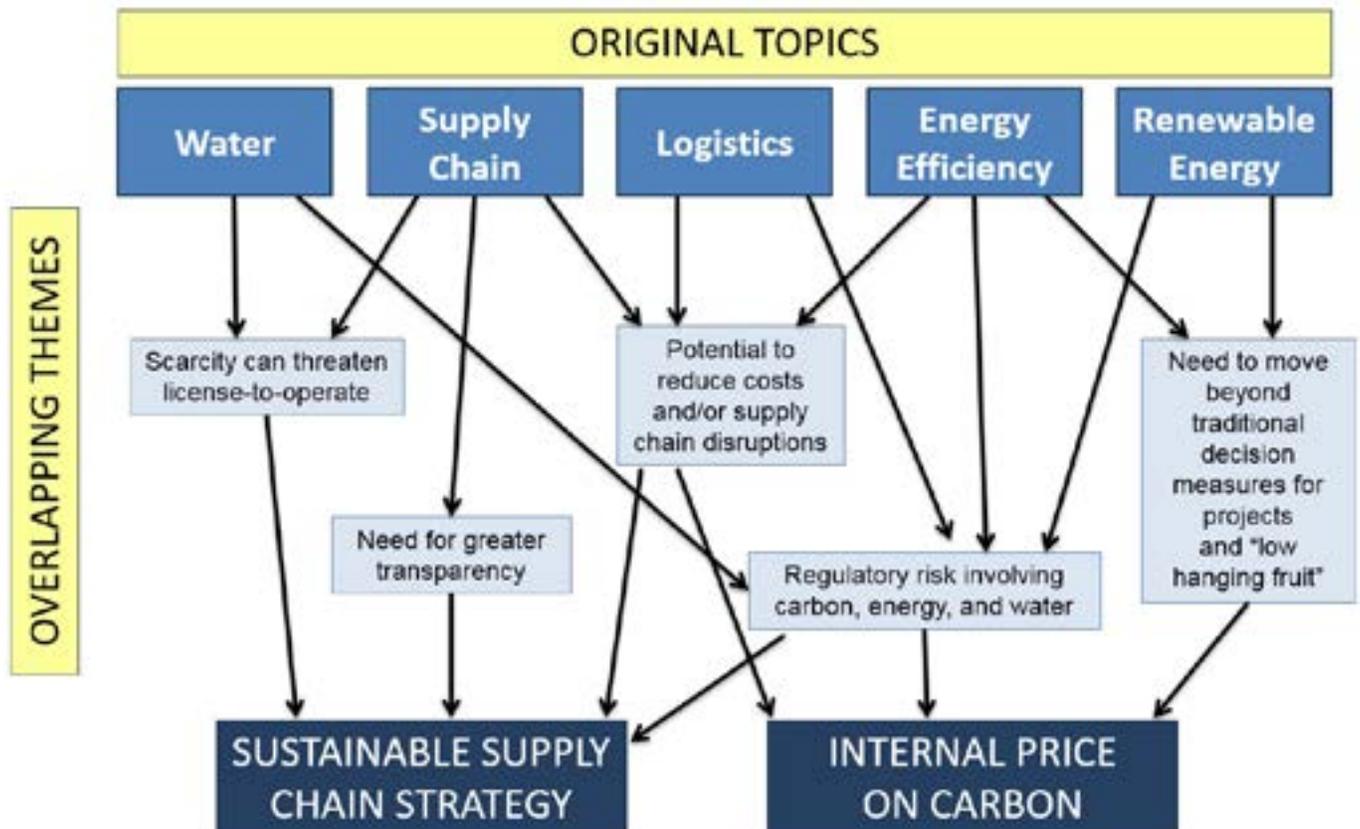


Exhibit 6: Overarching Themes in Recommendations

The team's research supports the potential impact of these recommendations. For example, through interviews with sustainability professionals at Microsoft and Disney – brands that have implemented internal costs on carbon – the team learned that this effort is not only feasible with sufficient executive sponsorship, it is also incredibly valuable in its power to enhance the value of a company's brand. In terms of a sustainable supply chain strategy, sustainability metrics could be integrated into GM's current platform tracking conflict minerals. By tracking metrics at risk of becoming regulated, such as carbon emissions and water, and working with suppliers to reduce these risks, GM would have a more robust picture of its ecological and social impact and be better equipped to identify areas of high risk.

The team also identified the following factors that indicate the potential of these recommendations to have a significant positive impact on GM:

- Ability for enhanced brand value to increase GM's market share by gaining new consumers
- Likelihood that future sustainability and resource-related policy changes in key geographies will impact the cost structure of operations
- Business paradigm shifts to impact cost structure, both directly to operations and indirectly through the supply chain
- Within resource-constrained geographies, increasing scarcity of required resources and difficulty of maintaining license to operate
- Limitations in supply chain's adaptability to comply with future sustainability constraints
- Large impact due to global scale of operations and magnitude of inputs (electricity, water, etc.)

Recommendations

Carbon Monetization



Supporting Information and Trends

Although the conversation of climate change has existed for decades, legislation to address the issue has been slow to emerge. However growing public awareness of global warming and increased visibility of environmental degradation have increased the pressure on public officials to mitigate current damages, as well as to prevent future damage.

Originally introduced in 2003, the McCain-Lieberman Climate Stewardship Act attempted to regulate roughly 85 percent of U.S. carbon emissions through an allocation system and fines for excessive emitters, but failed in the 2005 Senate 43-55.¹⁵⁷ Even though the policy was not enacted, it represents a growing consensus among policy makers of the need for carbon emissions regulation. In 2007, Senator Sanders (I-VT) introduced the Global Warming Pollution Reduction Act, which would mandate emissions standards and authorize the EPA to create market systems for emissions abatement, but the bill did not pass through committee.¹⁵⁸ The American Clean Energy and Security Act of 2009, also known as the Waxman-Markey bill, would have created a national emissions trading scheme that would lower carbon allowances

over time. While the bill was able to pass the House 219-210, the bill died in the Senate.¹⁵⁹

Although the US has not implemented a national carbon policy, there have been and still are regional carbon markets within the country. Probably most well known is California's Emissions Trading Scheme (CA ETS), as it is the second largest carbon market after the EU ETS, regulating over 2.7 billion tons of CO₂ (tCO₂). In 2012, the CA ETS only applied to power producers and large industrialists, but in 2016 the market is set to expand to include residential, commercial, and transport fuels. The average price of permits ranged from \$13-15 per tCO₂. The overall goal of this regulation is to reduce emissions 80 percent from 2012 levels by 2050.¹⁶⁰ California regulators have made a point to design the market such that it could potentially link up with other carbon markets, like the EU ETS and the Western Climate Initiative (WCI). In fact, as of January 2, 2014, Quebec officially linked on to California's carbon trading market.¹⁶¹ Being able to merge regional carbon markets allows states to progress towards a national or international carbon mitigation strategy, without having to wait for federal policies to be enacted.

The WCI includes some of the western states of the U.S. (Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington) as well as some Canadian provinces (British Columbia, Manitoba, Ontario, and Quebec). This regulation applies to electricity generation, industrial fuel combustion, transportation fuel use, and residential and commercial fuel use. The price for 2013 was similar to the CA ETS at \$15 per tCO₂, but the price is projected to increase up to \$73 per tCO₂ as early as 2020.¹⁶² Another significant regional carbon market in the U.S. is the Regional Greenhouse Gas Initiative (RGGI), which applies to power producers in the Northeastern U.S. This market is auction based and while the permits have an average price of only \$2.79, they have been priced as high as \$12.85.¹⁶³

Although only certain regions of the U.S. have implemented carbon markets, there are two bills in the Senate for a carbon tax. The Climate Protection Act of 2013 (S.332) is currently in the Senate Environment & Public Works Committee. The legislation would have implemented the carbon tax at the start of 2014, beginning at \$20/ton CO₂ content, increasing by roughly \$1 each year, and seeking to reduce emissions by at least 80 percent from 2005 levels by 2050.¹⁶⁴ Representative Waxman (D-CA) introduced another potential carbon tax in March of 2013, referred to as a Carbon Pollution Fee. While only a discussion draft, the proposed legislation would also begin at the start of 2014, but does not define any specific reduction targets and gives a range of initial prices (\$15-30 in 2014), which would escalate over time.¹⁶⁵ This is in contrast to the Waxman-Markey bill that Representative Waxman introduced in 2009. That policy was based on a carbon market and sought to reduce emissions by 83 percent by 2050.

Although the U.S. has not had any significant carbon legislation on a national level, carbon markets and taxes implemented by other countries impact GM as an international company. Most predominantly, the Kyoto Protocol was adopted in 1997 by 37 countries with initial targets of five percent emissions reduction from 1990 levels by 2012. In 2012, the

Doha Amendment was adopted, which seeks to reduce emissions 18 percent below 1990 levels by 2020. Another important carbon market, the EU ETS spans over 31 countries and seeks to reduce emissions by 21 percent below 2005 levels by 2020.¹⁶⁶ Based on an auction system, the price for permits in the EU varies, but in September 2013 the price rose 9.9 percent to the equivalent of \$6.60.¹⁶⁷ Australia also developed an ETS in 2012, which began as a carbon tax and was set to switch to a cap-and-trade market in 2015. However, changes in political power have caused the program to be discontinued as of 2013. South Korea is expected to introduce a national carbon market in 2015 with prices equivalent to roughly \$11.29 per ton and a goal of 20 percent emission reductions from 2010 levels by 2030. Carbon markets have also been appearing in China as pilot programs and have become a topic of discussion in Tokyo. Generally, these policies are designed to mirror existing policies, so that in the future these markets may link up and create a global carbon market. Similar to regional policies in the U.S. potentially combining to form a national policy without any federal regulation, merging national policies would allow countries to create an international carbon mitigation strategy without the need for a universal policy, like the Kyoto Protocol.

Expected Impact

As illustrated above, the future of carbon regulation and pricing is uncertain and it is likely that it will continue to be implemented on a smaller scale before there is a decision made at a national or international level. However, if GM intends to continue to operate in countries with these uncertain conditions, carbon is something that needs to be considered. With uncertain carbon regulation worldwide, pricing carbon internally would be a strategic move for GM. The company would be positioned to be successful under carbon markets that arise and could set GM up for several opportunities, including the ability to mitigate risk.

The benefits would be realized for years to come as carbon markets become established worldwide. Even in the absence of international carbon markets, pricing

carbon internally would provide opportunities for GM to become more aware of energy and resource flows throughout its operations, reduce costs, and potentially spur investment in GM.

Risk Mitigation

Implementing a carbon price creates significant risk-reduction opportunities for GM. This is informed by interviews with companies leading the field in carbon pricing (Disney and Microsoft), and by the uncertainty surrounding carbon markets. The future of carbon regulation is unclear and there is potential for it to vary greatly from one location to another in the absence of an internationally agreed upon policy.

Many companies are currently unaware of their carbon footprint and may be unprepared when carbon policies arise. GM, however, has been participating in the Carbon Disclosure Project (CDP) and is becoming more aware of its impact and how carbon policies may impact the company. Pairing its CDP efforts with an internal price on carbon would make GM aware of the impacts carbon has on their operations and how a larger scale policy would impact the company. Having experience at a smaller scale would prepare GM to adapt to any policy that is ultimately enacted. By pricing carbon internally, GM would position itself to excel while others in the industry may struggle to adapt due to lack of preparation.

Avoid Cost

Along with mitigating risk, carbon pricing could help GM avoid carbon-related costs. If carbon policies are enacted, companies will have to abide by regulations in the countries where they operate and pay fees based on their impact or carbon footprint. By pricing carbon ahead of national and/or international carbon policies, GM will be aware of areas where they could make changes that would reduce their carbon footprint.

These changes reveal cost savings in two ways. Implementing an internal price on carbon would allow GM to track carbon, reduce the related resource use (electricity, raw materials, etc.), and help reduce its

carbon footprint. Streamlining processes is beneficial since fewer resources reduce cost while also cutting carbon intensity. In addition to reduced operating costs through the use of fewer resources, making these cuts ahead of time would allow GM to avoid significant costs related to its original large footprint if carbon regulation does get enacted.

There is concern about being the first mover in an industry to cut carbon footprint, with the fear being that once the carbon cap is set, a company may have no more room to decrease footprint or may not receive benefits from the previous cuts. This, however, is an unlikely outcome. Caps are not set based on individual companies; they are set for the industry. So the leader in the industry will benefit by receiving credits that make up the difference between their performance and the average for the industry. These credits can then be sold for a profit.

Support Innovation

Monetizing carbon is a relatively new concern and consideration. Few countries have put effective policies in place and even fewer companies have taken it upon themselves to create internal policies around the issue. This leadership would attract the SRI community and make the company more attractive to investors that perceive risk associated with evolving global carbon policies. In 2012, sustainable and responsible investing accounted for over \$3,500 billion.¹⁶⁸ With an internal price of carbon in place, investors will be more confident in GM's ability to adapt to carbon policies that may arise globally over the next decade.

In the absence of international carbon policies, this effort will prepare GM for other potential sustainability challenges in the future such as water or other resource shortages and restrictions. This initiative will show investors that GM is focusing on the long-term rather than on short-term gains and will be able to profit well into the future. In addition, it could potentially make stakeholders willing to invest in other innovative initiatives within GM.

Recommendations

Sustainable Supply Chain Strategy



Supporting Trends and Information

Multinational companies have played an integral role in the expansion of the globalized economy. Globalization has led to an increased desire to improve supply chain transparency. With complex supply chains, working to increase transparency can be challenging. This is especially evident in the manufacturing sector and the automotive industry.

There have been several legislative actions that have signaled greater emphasis on transparency and social responsibility in supply chains:

Conflict Minerals: The 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act and the 2012 rule from the US Securities and Exchange Commission (SEC) required that companies subject to SEC filing rules would have to report if their products contained conflict minerals.¹⁶⁹ Currently the conflict minerals include cassiterite, columbite-tantalite, wolframite, and gold.¹⁷⁰ More commonly known, these minerals produce tin, tantalum, and tungsten when extracted.

The Carbon Disclosure Project (CDP): The CDP has a Supply Chain Program that “enables organizations to implement successful supplier engagement strategies, reduce supply chain emissions, control water impact, and manage risk in a changing climate.” GM is one of the 64 member companies that are engaged in CDP’s Supply Chain Program. Essentially, this shows how multinational companies are willingly exposing their global footprint to gain insight as to how to reduce risk and impact up and down their supply chains.

The 2010 California Transparency in Supply Chains Act (SB 657): This law requires companies doing business in California to publicly disclose on their website the degree to which they are addressing the prevention of human trafficking and forced labor in their supply chain.¹⁷¹

The requirement to report conflict minerals to the SEC is impactful not only in deterring sourcing from conflict mines in the Democratic Republic of Congo (DRC) and surrounding countries, but also in forcing

companies to take a critical look at their supply chain. The endeavor to trace the conflict minerals found in products back to the smelter required many companies to devote significant staff hours to this task. A tier 1 supplier revealed that the cost of compliance for the first year was approximately \$500,000, and \$200,000 annually thereafter.¹⁷² An OEM cited resource impacts in investments into data collection and management systems, consultants, and auditors.¹⁷³

The reality is that the term “conflict minerals” could expand to incorporate other rare earth metals as well. This means if the State Department modifies its list of conflict minerals, or countries, the SEC rule automatically follows suit.¹⁷⁴ Because of this, many OEMs and other reporting companies have set up their tracking systems in a way that they are easily expandable for these future changes. How companies track conflict minerals could potentially expand to include sustainability metrics and become a benefit to GM.

Expected Impact

The team recommends expanding GM’s Conflict Minerals Database to include metrics of sustainability. The reasoning behind using the same system as conflict minerals is twofold; first, the conflict minerals procedure reaches GM’s entire supply chain and second, the proposed metrics will play an important part in mitigating operational, financial, and reputational risk. Two important metrics to consider tracking would be carbon intensity and water usage. However, each region has different realities in terms of resource availability and regulations, so priorities should be ranked appropriately within the tracking system. Other metrics that would be useful include energy intensity, rare earth minerals, and waste. Tracking the aforementioned metrics, the team expects GM will be able to deduce from the database risk of supply shortage, risk of increased regulatory costs, risk of losing a license to operate, or even risk of stakeholder action. Based on feedback from suppliers, GM can assess whether risks are low, medium, or high and act accordingly.

Collecting and assessing metrics of sustainability from the entire supply chain would better inform GM of the risks associated with sustainability issues especially in lower tiers that are usually not in direct contact with the OEM. Beyond raising awareness of risks, the database would allow GM to better communicate with suppliers regarding issues specific to each supplier and be able to connect the supplier with resources to reduce said risk. By working through the cycle of identifying risks, working to mitigate risks, understanding what methods or tools work best, and sharing lessons learned, GM’s supply chain can become stronger and more responsive.

Risk Mitigation

Supply chain risks for GM can be categorized as both financial and operational. As documented in the trends above, if policy is established that affects the automotive industry, GM needs to not only be concerned about their practices, but also those of their suppliers. By enhancing their relationship with suppliers, GM can assist suppliers to become more resilient and reduce risk. This would help strengthen weaker links within the supply chain. Mitigating financial risk helps reduce vulnerability to price volatility, which in turn can stabilize profits. Furthermore, since supplier-sourced parts comprise approximately two-thirds of GM’s automotive costs, the supply chain contributes greatly to profitability.¹⁷⁵ Additionally, in times of crisis, such as a natural disaster, a sustainable supply chain database would better equip GM to absorb supply disruptions and to adapt accordingly.

Support Innovation and Sharing Best Practices

GM has two forums through which they collaborate with suppliers: The GM Supplier Business Council and the Global GM Supplier Business Meeting.¹⁷⁶ The first forum consists of ten global suppliers that meet on a monthly basis with the Vice President of Global Purchasing and Supply Chain to address high-level industry topics. The second forum is a monthly webcast that gathers feedback from

suppliers on specific GM topics.¹⁷⁷ Since this forum represents 80 percent of the value of GM's vehicles, the Global Supplier Business Meeting would be an excellent means for GM to share risks identified by the sustainable supply chain database and develop solutions or share lessons learned.¹⁷⁸ These two forums would provide guidance for what to incorporate into the database, which will build deeper analytical capabilities, enable greater responsiveness to supply chain shocks, and minimize financial impacts of disruptions. Incorporating a sustainable supply chain database into GM's current supply chain forums would allow for greater collaboration and visibility, both up and down the supply chain. This would be especially beneficial for operational departments that manage manufacturing plants' energy and water use.

Heighten Leadership

There are a number of initiatives GM has taken to ensure that their supply chain is socially and environmentally responsible. Some examples include joining the CDP Supply Chain Program, providing funding for suppliers to attend AIAG's Supply Chain Responsibility Training, directly training suppliers on human rights and labor practices in high-risk countries, and conducting a renewable energy symposium with suppliers.¹⁷⁹ GM has also been working with other OEMs and AIAG in developing a common method for suppliers to report GHG emissions.¹⁸⁰ Creating a more holistic supply chain sustainability strategy would allow GM to reduce duplicate efforts that these individual strategies can create. Increased supply chain transparency gives conscious consumers the ability to purchase vehicles that are mindfully manufactured.

Supporting Statements

Support for Recommendations



While research supported the two recommendations, the team also conducted targeted analysis in order to adequately validate and substantiate the recommendations. Towards this end, the team generated a list of potential supporting statements that, if validated, would support the recommendations. For each recommendation, the team developed supporting statements based on existing research, and then prioritized them according to the following criteria:

- Clearly-defined – can serve as a discrete and provable (or disprovable) hypothesis
- Sufficient access to data – the team has or can gain access to the necessary quantitative and qualitative data, both primary and secondary sources within and outside of GM
- Compelling value proposition – if validated, would provide a compelling argument to an audience of GM executives
- Feasible within constraints – the team can follow through in validating the supporting statement considering both the project's timeline and the team's experience

See **Appendix B** for the initial list of supporting statements.

GM Survey

After developing the recommendations and generating a list of supporting statements that would either validate or refute the recommendations, the team wanted to gain a better understanding of how these issues are viewed within the GM organization. The team wanted to gain a sense of which of the supporting statements are important to and considered viable for the future of GM.

The supporting statements were explained to survey respondents as initiatives that GM could potentially pursue. Respondents were asked to rate each of the initiatives on a scale of one to eight, with one being not likely or not important and eight being very likely or very important, on the basis of the initiative's criticality (magnitude of importance) to GM and its viability (ability for GM to make it happen). See **Table 3** for the survey initiatives that respondents were asked to rank.

The survey was sent to GM employees in various functions, such as finance, communications, public policy and government relations, and facilities and manufacturing. They were also in various countries,

Table 2: Survey Initiatives

Initiative Number	Initiative
1	Strengthen GM's leadership by leveraging lessons learned in sustainability strategy and initiatives from other innovative companies
2	Build capacity to identify value in mitigating a broader set of long-term risks in the near-term
3	Identify the most efficient, well-managed suppliers and proactively provide cost reduction and relationship building opportunities for those that are less efficient
4	Mitigate financial risk associated with...
a	...fluctuations in energy prices
b	...penalties or the need to purchase extra credits for emitting more carbon than GM's credits allow (under cap-and-trade programs or a carbon tax scheme)
c	...suppliers' practices and externalities
5	Mitigate operational risk associated with...
a	...license-to-operate in resource-constrained and/or highly polluted geographies (e.g., China)
b	suppliers' practices and externalities
6	Mitigate reputational risk associated with suppliers' practices and externalities
7	Enable GM to meet its target of generating 125 MW of renewable energy by 2020 by reducing the payback period, therefore increasing its prioritization vs. other projects competing for funds
8	Use carbon reduction strategies to open doors to marketing and corporate reputation building opportunities (e.g., SmartWay Program Logo)
9	Enhance brand equity with fleet customers, NGOs, and SRIs by...
a	...enabling the optimization of sourcing decisions around social/environmental impact
b	...creating a channel for communicating successes in sustainability throughout GM's supply chain
10	Unlock cost savings opportunities by sourcing renewable supply through PPAs
11	Create a "revolving fund" used to pay for carbon reducing projects by internalizing the price of carbon

including Canada, Europe, Australia, China, and Brazil.

Survey Results

16 people located in either Australia, Brazil, and the United States responded to the survey. When the responses were aggregated and averaged, none of the initiatives ranked lower than a five out of eight in terms of their criticality to the organization and none ranked lower than a 4.5 in terms of their viability. This indicated that the team had identified topics of at least some importance to the organization. See **Exhibit 5** for the spread of the initiatives based on their criticality and viability.

Interpretation of Survey Results

After reviewing the survey results as a group and discussing the results with the client and faculty advisor, the team chose initiatives 4b, 4c, 5a, 5b, and 10 to pursue for analysis.

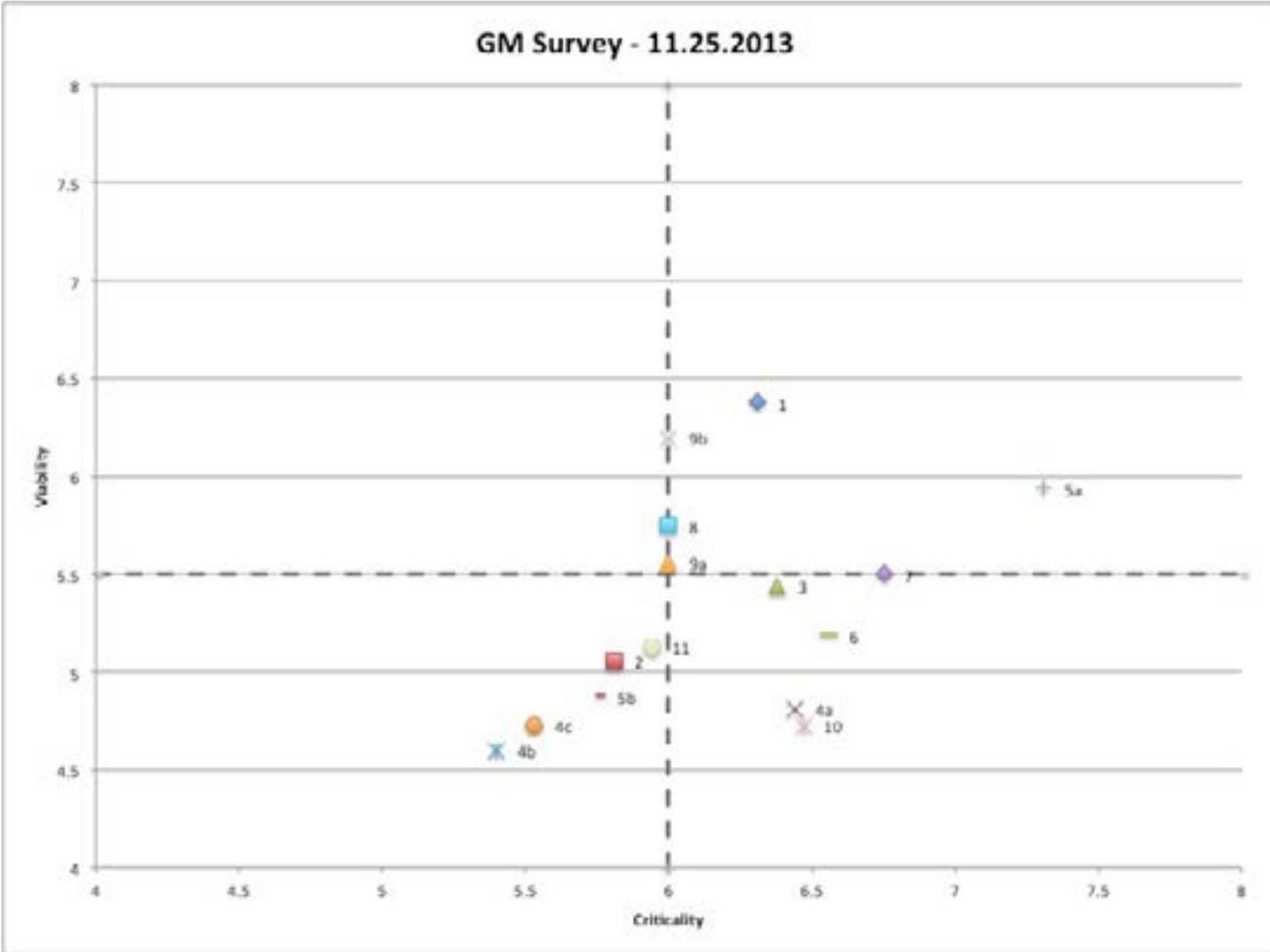


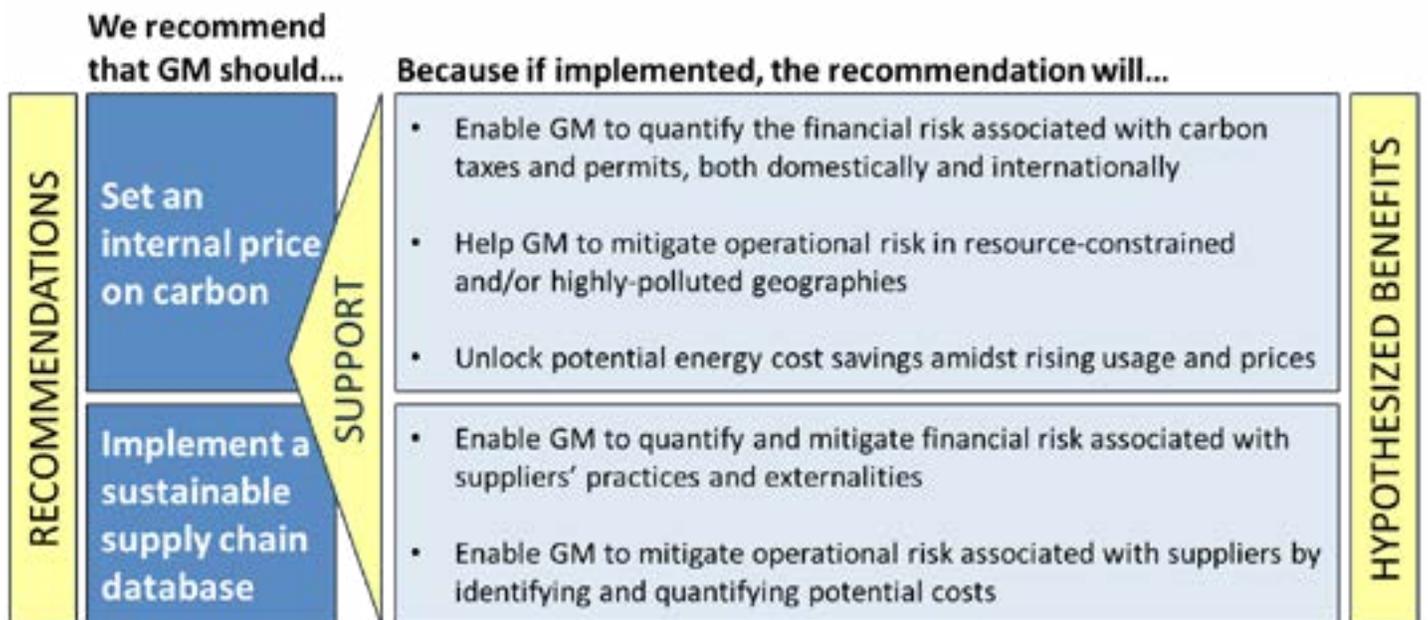
Exhibit 8: GM Survey Matrix

Survey recipients were asked to rate each initiative listed in Table 3 from 1 to 8, with 1 being not likely/not important and 8 being very likely/very important, on the basis of its criticality (magnitude of importance) to GM and its viability (ability for GM to make it happen).

Supporting Statements

Supporting Statements and Analysis Framework

Exhibit 9: shows the final list of supporting statements for analysis and the framework for validating the recommendations.



Supporting Statements

#1: Reduce GM's exposure to the financial risks associated with carbon regulations

Introduction

Climate policy has been gaining attention across the globe, pushing carbon regulation into action or onto the agendas of a number of countries. Whether these policies take the form of a carbon tax or a cap-and-trade carbon market, they will result in increased costs for industry. In order to reduce GM's exposure to these regulatory risks, the company must first understand the potential burden that these costs could impose. At least during initial implementation, carbon regulation generally only applies to utilities, but these costs are passed on to the end user. Implementing an internal price on carbon would give GM the opportunity to prepare for the costs associated with these impending policies and identify countries where financial risk may be greater due to a higher cost on carbon, higher emissions, or a combination of both. Additionally, GM suppliers are also exposed to these potential costs. To better understand this risk, a sustainable supply chain strategy to track energy use and carbon emissions throughout the supply chain would enable GM to be more aware of, and therefore more capable of mitigating, this additional financial risk.

Methods

To estimate GM's exposure to the regulatory risk surrounding carbon, several steps were taken. First, carbon data provided by GM was divided by the country or region in which a carbon policy is in place, is scheduled to be put in place, or is likely to occur in the near future. Based on GM's goal to reduce its carbon emissions by 20 percent by 2020, these values

were projected forward and an appropriate price of carbon was assigned depending on the region. The Net Present Value (NPV) of these costs was calculated and then assigned a probability value based on the likelihood of the policy becoming and/or remaining enacted through 2020.

Aggregating GM's global carbon emissions

As described above, the first step in evaluating the potential costs of carbon policy to GM was to determine the company's carbon emissions from electricity usage in countries where carbon regulation exists or is likely to exist in the near future. In 2012, GM announced its goal to reduce the energy and carbon intensity of their manufacturing facilities globally by 20 percent by 2020.¹⁸¹ This "20-2020" goal was used to project the 2012 emissions over the next eight years, with emissions decreasing at an annual rate of 2.5 percent to allow GM to achieve this goal.

Setting prices for carbon by country or region

While most carbon policies only apply to utilities at least for their initial phases of implementation, studies have shown that the end users of the energy are ultimately responsible for paying these costs.¹⁸² Even in carbon markets where energy producers are given carbon permits for free, utilities raise their prices in anticipation of extra costs or to cover the costs of any subsequent efficiency projects.¹⁸³ Therefore, for this analysis, it has been assumed that GM will bear the costs of any carbon regulation put in place for the countries or regions in which they operate, based on

Table 3: Range of Carbon Prices by Region in 2014 and 2020

	2014 Price (\$/ton of CO ₂ e)			2020 Price (\$/ton of CO ₂ e)		
	Low	Medium	High	Low	Medium	High
<i>EU</i>	\$6.17	\$8.22	\$10.28	\$5.14	\$6.85	\$8.56
<i>South Korea</i>	\$23.79	\$31.72	\$39.65	\$69.75	\$93.00	\$116.25
<i>China</i>	\$21.57	\$28.76	\$35.94	\$69.75	\$93.00	\$116.25
<i>U.S.</i>	\$15.00	\$22.50	\$30.00	\$16.89	\$32.25	\$47.61
<i>WCI</i>	\$11.00	\$16.25	\$35.00	\$82.00	\$87.25	\$106.00
<i>Australia</i>	\$9.04	\$18.55	\$28.05	\$13.57	\$27.83	\$42.10

the emissions resulting from their electricity demands.

While carbon markets or taxes are becoming more prevalent around the world, the price set for carbon varies greatly by country and region, as shown in **Table 3**. The six primary carbon policies in place or somewhat likely to take place in the next several years are located in the European Union (EU), South Korea, China, the United States, the Western Climate Initiative (WCI), and Australia. Although the WCI could potentially include several U.S. states, including California, and multiple Canadian provinces, the only area in which GM has operations in, and is therefore at risk, is Ontario. For each of these regions, a range of cost estimates (Low, Medium, and High) were developed for each year between 2014 and 2020, based on policy research and estimated projections.

While the European Union Emissions Trading Scheme (ETS) is the oldest and largest carbon market in the world, the price of carbon in this market crashed in 2006 and has been slowly declining ever since.¹⁸⁴ One of the main reasons for the crash in the price of carbon was an over-allocation of permits, which has continued to cause the price to decline.¹⁸⁵ However, prices are estimated to begin recovering in 2014, peaking again in 2018 as shown in **Table 4** below. To account for any variability in this estimate, these

values were used as the Medium estimate and values 25 percent less and 25 percent greater than these were used for the Low and High estimates, respectively.

Although prices in the well-established EU market have been declining, the cost of carbon permits in the new South Korean market are expected to increase significantly by 2020. The introductory price of carbon per ton in South Korea is expected to be around \$11.29 in 2015, with the price of permits expected to rise as high as \$93.00 by 2020.¹⁸⁶ This drastic increase is due to the country’s ambitious goal of reducing its carbon emissions by 30 percent from a 2012 baseline by 2020.¹⁸⁷ Again, to account for variability in these estimates, Low and High values were calculated to be 25 percent lower or higher for each year.

While the Chinese carbon market is only active in five particular regions of the country, these markets are likely to grow and link up with each other. Moreover, interviews with members at GM Korea expected that carbon markets would link throughout Asia, particularly between South Korea and China. Although the price of carbon in the Chinese market is currently trading between \$4.83 and \$9.85, which is lower than prices in the South Korean market, it can be assumed that these prices will become equal in the near future.^{188,189} Moreover, Chinese carbon prices

Table 4: European Union Projected Carbon Price

	2013	2014	2015	2016	2017	2018	2019	2020
<i>EU price (€/t)</i>	5	6	8	10	10	11	7	5
<i>EU price (\$/t)</i>	6.85	8.22	10.96	13.70	13.70	15.07	9.59	6.85

may increase faster and catch up to the South Korean market due to the country's even more ambitious reduction goal of 45 percent by 2020 from a 2005 baseline.¹⁹⁰ Thus, it was assumed that the price of carbon in the Chinese market would start lower than the South Korean market, but reach this same price level by 2020.

While the United States has not passed a national climate policy, there have been several attempts at legislation, including the current US Carbon Pollution Fee Discussion Draft. This draft includes estimates of carbon prices for the US between 2014 and 2020. In 2014, the price of carbon in the US might have ranged between \$15 and \$30, growing at an annual rate between 2-8 percent, reaching somewhere between \$16.47 and \$47.61.¹⁹¹ Although it is a large range, it can be assumed that the longer the US postpones enacting a climate policy, the more drastically the price will increase over time. Additionally, these values were used as the Low and High price estimates of carbon in the US, while their average was found to be the Medium value.

Although the WCI has not been fully implemented, it is likely that the initiative will build off of the current California carbon market. The figure below shows the price estimates for the California market. While the carbon price for the California ETS was only around \$16.25 per ton of CO₂e at the end of 2013, analysts have projected that the costs of a joint WCI program would more than double the cost to around \$34.00 due to limited permit availability.¹⁹² For this reason, the values in **Table 5** below for the California carbon market have been used as the Low values for the WCI through 2020. High price values begin with the \$34.00 estimate in 2012, and grow in line with the California price estimates. Medium price values were found as the average between the Low and High price estimates.

Although Australia repealed their carbon tax on

November 4, 2013, the tax was valued around \$24.50 per ton of carbon.¹⁹³ A market-based policy would place a much lower value on carbon, closer to \$7.90.¹⁹⁴ Thus, the price of a carbon tax, \$24.50, was used as the High estimate, while the carbon market price of \$7.90 served as the Low value and their average was used for the Medium price. Based on similar numbers in U.S. and South Korean policies, an annual growth rate of 7 percent was applied to each price estimate of carbon in Australia from 2013 to 2020.

Determining present values

For every year between 2014 and 2020, the annual projected tons of emissions for each region were multiplied by the Low, Medium, and High carbon price estimates per ton to produce a dollar value. Since 2014 is already in progress, the value for this

Table 5: California Carbon Market Projected Carbon Price¹⁹⁶

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Price	\$10	\$11	\$11	\$13	\$19	\$30	\$47	\$64	\$82

year was divided in half to assume these costs are beginning in the third quarter of this year. Therefore, from Q3 of 2014 through 2020 and using a typical corporate standard discount rate of 15 percent, the Net Present Value (NPV) of the Low, Medium, and High estimates for the price of carbon in each region was calculated.

Assessing probability

To account for the uncertainty in the existence of these markets through 2020, probability values (Low, Medium, and High) were assigned as shown in the figure below. Since the EU ETS is the oldest and most robust carbon market, its probability values were the highest; followed by South Korea where a policy is intended to be implemented in 2015. However, due to potential changes in political power or other unforeseen circumstances, a range of probability values was assigned. Since the carbon markets in China are currently only regional and may not fully apply to a national level by 2020, a much greater range of probability values were used for this country. In the other markets where a policy

is not currently in place, the probability values were set significantly lower. Although climate change is not seen as the most pressing political issue for most Americans, there have been attempts for carbon regulation in the U.S. Member states of the WCI are generally more accepting of carbon legislation than other states, but establishing cooperation and commitment among states has proven challenging. However, it is important to note, that there may be double counting by assessing both the WCI and US carbon, so probability values for both regions were set particularly low in attempts to minimize this effect. While Australia did have a carbon tax as recently as 2013, a change in political power has made reestablishing a carbon policy unlikely but not out of the question. These probabilities are shown in **Table 6**.

probabilities and cost estimates for all regions, GM faces more than \$88 million in added costs due to carbon.

Conclusion

While many of the other regulations discussed previously are not currently in place and although the costs on carbon may not be directly imposed on GM, the analysis has accounted for these issues and carbon regulation has still shown to have significant financial risk in GM's global operations. An internal price on carbon as well as a sustainable supply chain strategy would help GM identify regions of particularly high regulatory risk. This information could be used to allow the company to reduce their emissions in areas that pose the greatest financial threat. Additionally,

in areas with a carbon market or where carbon legislation is being proposed, an internal price on carbon would serve as a valuable benchmark for determining the impact of the legislation on GM's operations.

Table 6: Probability of Implementation of Carbon Prices by Region

Probability of Implementation	Low	Medium	High
<i>EU</i>	80%	90%	100%
<i>South Korea</i>	60%	80%	100%
<i>China</i>	20%	50%	80%
<i>U.S.</i>	1%	5%	10%
<i>WCI</i>	5%	10%	25%
<i>Australia</i>	5%	10%	25%

Findings

The probabilities from above were multiplied by the NPV values for the respective country's Low, Medium, and High estimates of carbon costs. The resulting values for each country were then aggregated to produce the total estimated financial risk for GM as a result of carbon regulation. These numbers are shown in **Table 7**. Even assuming both low

Table 7: GM's Financial Risk Exposure Due to Carbon Regulation

		Range of Costs		
		Low	Medium	High
Probability of Implementation	Low	\$88,384,662.97	\$118,406,725.72	\$148,928,043.28
	Medium	\$159,022,168.23	\$215,102,167.22	\$272,180,675.84
	High	\$234,315,205.53	\$318,475,470.73	\$405,132,009.99

Supporting Statements

#2: Mitigate operational risk in resource-constrained and/or highly polluted geographies such as China

Introduction

This supporting statement explores if an internal price on carbon and a sustainable supply chain strategy will reduce the risk of GM factories or suppliers shutting down or expansions being denied due to social license-to-operate (SLO) issues, especially in resource constrained or highly polluted areas such as China.

SLO issues are a challenge for all corporations, as they can be very subjective and vary considerably both between and within industries.¹⁹⁵ This issue is especially important for companies in the resource extraction and manufacturing sectors, as these require government approval of projects and financing support from local communities and companies, but it has increasingly become important for other industries due to stakeholder involvement.¹⁹⁶

Even though SLO is subjective, it nevertheless has important implications for companies, including GM. If a license is revoked or a plant expansion delayed, companies can experience financial losses, including declining stock prices and a decrease in brand value due to a negative public perception of the company. This supporting statement aims to show that implementing the recommendations can reduce the chance that GM will lose its SLO, particularly in areas with potentially aggressive carbon reduction goals and serious environmental issues, such as China. These types of actions will help to diminish negative attention from governments and stakeholders and bolster corporate reputation.

Methods

Based on conversations with the client and an employee in the Chinese office, as well as indirect communication with a contact in marketing, quantification of this supporting statement is challenging, as GM does not track specifics around SLO at this time. However, as there is an indirect relationship between corporate reputation and protecting the right to operate in foreign countries, implications of reducing risk from SLO for GM were drawn from case studies of other companies that have run into operation issues due to environmental problems, BMW in China and Coca-Cola in India, and applying these situations to GM's operations.

By looking at SLO issues in other companies, it is possible to picture what the implications for GM might be should one of their licenses, either for current or new facilities or expansions, be revoked. Following the case studies, a hypothetical situation for a GM facility is explored using the situations for BMW and Coca-Cola as templates. In order to investigate the potential effect that a loss of license-to-operate could have on the company, the following calculations were made to determine the financial effect of a shutdown or expansion denial:

- For eight assembly plants in China, the total units produced by each plant were added up for each year from 2010-2012 and an average yearly production for each plant was found
- The assembly plants were separated into three

groups depending on their average production totals: small (<100,000 units), medium (100,000-300,000 units), large (>300,000 units)

- An average for number of vehicles produced for each plant size was found
- Using data from the 2012 Annual Report, the following averages were calculated from 2011 and 2012:
 - Total Vehicle Sales
 - Net Sales and Revenue
 - Revenue per Vehicle (found by dividing the average net sales and revenue by the average total vehicle sales)
- The average revenue per vehicle was rounded to \$16,500
- The average revenue per vehicle was applied to the average annual production of each size class of plant to get the average net revenue for each size class
- The average annual production of each size class was divided by 365 to obtain an average daily production for each size class and this number was multiplied by the average revenue per vehicle to get a daily net revenue for each plant size
- A sensitivity analysis was run on both the annual and daily revenue numbers for each plant size at the 1, 5, and 10 percent levels to take into account the different likelihoods of license-to-operate issues

Findings

BMW case study

As described earlier in this report, BMW is considered one of the leading automotive companies in terms of its sustainability work and reporting. Despite this reputation, however, the company ran into licensing issues for a factory expansion in China due to environmental issues in July 2013.

Planned Project

The plant expansion under review is for one of two plants that are part of a joint venture (JV) with Brilliance China Automotive Holdings Ltd. This expansion is key to BMW's operations, as the JV represents a large portion of its growth in the country.¹⁹⁷ The facility is scheduled to expand in three phases: the first phase is waiting to pass inspection and the second phase was approved in June 2012.¹⁹⁸ At the completion of the second phase, planned for 2014, the combined annual capacity of the two plants will be 200,000 vehicles.¹⁹⁹ BMW's proposed expansion to its Tiexi plant represents a significant step towards the doubling of the company's manufacturing capacity in China to 400,000 vehicles a year over an unspecified time frame, as the expansion would allow the facility to produce up to 300,000 vehicles per year.²⁰⁰

The Problem

The denial of the license to expand the plant is associated with the third phase of the plant. The Ministry of Environmental Protection (MEP) in China gave three reasons for the denial, stating that:

- 1) There was "insufficient analysis of wastewater emissions and calculations for chemicals including ammonia and nitrogen... weren't in accordance with regulations"
- 2) The project did not meet requirements in *The 12th Five-Year Plan on Air Pollution Control in Key Regions*
- 3) The treatment of wastewater and exhaust in the third phase depends on facilities that have not received final clearance or been completed, requiring that more documentation is needed to show that requirements will be met.^{201,202}

The government also wants to see more investment in environmental protection measures at the facility.²⁰³ When denied, the planned \$1.5 billion investment included only \$11.5 million for environmental protection measures.²⁰⁴

Impact on BMW

As competition in China is increasing and sales in the luxury car segment are slowing down, BMW is concerned about keeping its position in the country strong. When the news of the rejection first appeared, Brilliance shares fell 2.2 percent in Hong Kong.²⁰⁵ In addition, the Tiexi plant represents around \$2 billion dollars in total investment that could be in jeopardy should BMW not meet the necessary requirements to move forward with the expansion.²⁰⁶

Broader Implications

The denial of the expansion to an existing plant and project is an atypical action for the Chinese government.²⁰⁷ This type of action signals that project approval by regulators is becoming increasingly difficult in China and that this could be the beginning of the Chinese government stepping up environmental protection.²⁰⁸ As China represents a region for significant growth for GM, these trends will be increasingly important to securing a competitive advantage.

Coca-Cola case study

While not an automotive company, Coca-Cola's pesticide, water, and toxic waste issues in India serve as a recent example of what can happen when a company does not take SLO into account. In March 2004, the company was forced to shut down one of its largest bottling plants in the country due to water shortages.²⁰⁹ This case shows the importance of responsible resource use by companies, especially for those resources that are a necessity for local communities. While water is the resource in question in Coca-Cola's situation, and is a resource that is becoming a topic of interest across sectors and including the automotive industry, it can apply to any resource that can become degraded and put a company in competition with local use.

Coca-Cola in India

Until 1977, Coca-Cola was the leading soft drink in India. The company left the country at that time, as it did not want to disclose its formula under the Foreign Exchange Regulation Act (FERA). By 1993, after India began pursuing liberalization and repealed FERA, Coca-Cola reentered the country. Since then, the company has invested \$1 billion dollars in the country, making it one of India's largest international investors.²¹⁰

The Problem

Problems for Coca-Cola began in 2003 when the company, along with PepsiCo, was accused of having pesticide residues in its products. In response to findings that showed the pesticide level above global standards, the Indian government banned Coke products and ordered state governments to launch their own investigations of the products in their own regions.²¹¹ In response, Coca-Cola launched a campaign to reassure the public of the safety of its products and performed their own tests.²¹² While the government tests resulted in levels that were acceptable to local standards, a majority of the samples did not meet European Union (EU) standards, causing the government to insist that those water purity standards be met moving forward.²¹³

Despite these findings, protests sprang up around the country in the following months and in December 2003, Coca-Cola had a new problem on its hands: an order to stop drawing the ground water needed for one of its franchise bottling plants in southern India due to water shortages.²¹⁴ Protests around these issues spread from India to other parts of the world, including the United States, where students began demanding that some universities cancel their contracts with the company due to its poor social and environmental responsibility record.²¹⁵

Table 8: Average Annual and Daily Production and Net Revenue Based on Plant Size

Plant Size	Average Annual Production (vehicles)	Annual Net Sales & Revenue	Average Daily Production (vehicles)	Daily Net Sales & Revenue
<i>Small</i>	61,476	\$1,014,359,500	168	\$2,772,000
<i>Medium</i>	269,929	\$4,453,831,250	740	\$12,210,000
<i>Large</i>	448,548	\$7,401,043,833	1,229	\$20,278,500

Impact on Coca-Cola

In the two weeks after the banning of Coke products due to pesticide residue, sales of Coca-Cola products dropped nearly 40 percent.²¹⁶ In addition, stock prices dipped \$5 on the New York Stock Exchange from \$55 to \$50 in the six sessions after the disclosure.²¹⁷ While the plant that was shut down represented less than two percent of Coke’s production in India, the impact on the company went beyond financial.²¹⁸ As a company with a reputation for corporate responsibility, Coca-Cola suffered damage to this reputation and encountered a public relations nightmare when the conflict expanded beyond India’s borders. The company was threatened with losing contracts with U.S. universities, including the University of Michigan, which not only bring in revenue but also have significant name recognition and advertising power. In order to help redeem its reputation, Coca-Cola spearheaded a national water sustainability project to help educate communities about water use and conservation.²¹⁹

Broader Implications

While this case is extreme in the severity of the fallout to Coca-Cola, it represents a worst-case scenario of how a situation can quickly get out of control due to concerned stakeholders and activists. Even though the direct monetary costs may not have been extremely large due to the initial plant closure, the indirect costs included diverting time, attention, and money from normal business operations to controlling brand image and reputation. In terms of implications for GM, this represents another case that took place in a region of high competition and growth for the company, similar to the importance of China to BMW and GM. When trying to remain competitive in a newer market, diverting attention to rebuilding brand image can

direct funds and other resources away from securing market share and improving brand growth.

Hypothetical GM license revocation scenarios

In order to better envision what a license revocation could mean for GM in China, GM’s numbers are applied to situations similar to the two mentioned above. **Table 8** shows the vehicle and revenue numbers for different plant sizes used in the two scenarios.

Denial of New Plant Construction or Existing Plant Expansion (BMW Scenario)

Based on the numbers calculated from GM plant data for 2010-2012 and information provided in GM’s 2012 Annual Report, the denial of a license to build a new plant lasting a year could cost GM anywhere from \$1 billion for a small plant up to \$7.4 billion for a large plant, representing approximately 0.7 to 4.9 percent of GM’s average total net sales and revenue for 2011 and 2012. Taking the sensitivity analysis into account, the potential annual loss ranges from \$10 million for a small plant at the lowest probability of license denial (one percent) up to \$740 million for a large plant at the highest probability of license denial (ten percent). While this entire range is under 0.5 percent of GM’s average total net sales and revenue for 2011 and 2012, they are still significant numbers, especially considering the projected industry growth of 36.4 percent in China from 2013-2017 and GM’s desire to increase its market share in this region.²²⁰

In terms of a denial for an expansion, using an expansion of a mid-sized plant to a large plant (similar to the expansion BMW is seeking) as an example, the annual revenue loss from the denial could be as much as \$3 billion, found by taking the difference between

the Annual Net Sales and Revenue of a large plant and the Annual Net Sales and Revenue of a medium plant. **Table 9** shows the sensitivity analysis for annual revenue. This equals a potential loss of approximately \$8 million per day for every day the expansion is not in use that it was planned to be in operation. Even at the lowest probability (one percent) of a denial of expansion, the annual loss of being unable to expand a medium-sized plant into a large plant represents an approximate \$30 million per year loss for GM, the difference between the annual net revenues of a large and a medium plant. This potential loss gets larger if the expansion is for a small-sized plant to a medium-sized plant, which represents a \$34 million per year loss, or when the probability of a denial increases.

depend on how quickly the reason for the revocation is fixed and the license reinstated.

Conclusion

Overall, the case studies demonstrate both mild, short-term delays and devastating, long-term impacts from losing licenses-to-operate. Due to the ambiguous nature of SLO and the potential risk of serious ramifications of license revocation, it is in a company's best interest to seriously consider license-to-operate issues when making decisions on environmental and social measures. As shown in the application of the case studies to GM, license-to-operate issues have the ability to impact the

Table 9: Sensitivity Analysis of Annual Net Sales & Revenue

Probability of License Loss	Small Plant	Medium Plant	Large Plant
1%	\$10,143,595	\$44,538,313	\$74,010,438
5%	\$50,717,975	\$222,691,563	\$370,052,192
10%	\$101,435,950	\$445,383,125	\$740,104,383

Existing Plant Shutdown (Coca-Cola Scenario)

Based on the numbers calculated from GM plant data for 2011-2012 and information provided in GM's 2012 Annual Report, a complete shutdown of a plant similar to the Coca-Cola situation could cost GM anywhere from \$2.7 to \$20.3 million dollars per day during the length of the shutdown, depending on the size of the plant. Taking the sensitivity analysis shown in **Table 10** into account, the potential daily loss due to a shutdown ranges from \$27,720 for a small plant at a one percent probability of license revocation up to over \$2 million for a large plant at the ten percent probability. The importance of these numbers and the severity of their impact on GM's overall revenue

company's ability to grow in the Chinese market and also impact overall revenue. As far as could be determined, GM currently does not have a way to track this risk and relies heavily on its joint ventures (JVs) to manage the status of their JV plant licenses, it would be in the company's best interest to implement internal policies and policies for its JVs that are viewed favorably by governments and stakeholders. This is especially important as those companies that are seen as leading the industry in environmental action, such as BMW, have run into licensing issues due to environmental impacts. As carbon emissions are one of the top environmental issues today, an internal price on carbon would show governments that are making plans for intensive carbon reductions, such as China, that GM and its JVs are serious about

Table 10: Sensitivity Analysis of Daily Net Sales & Revenue

Probability of License Loss	Small Plant	Medium Plant	Large Plant
1%	\$27,720	\$122,100	\$202,785
5%	\$138,600	\$610,500	\$1,013,925
10%	\$277,200	\$1,221,000	\$2,027,850

reducing their impact on the environment both locally and globally. A sustainable supply chain strategy would further reinforce this commitment, showing the responsibility the company is taking in this area in its supply chain. These types of actions would not only help to secure licenses-to-operate but would also set GM apart from its competitors in the region.

Supporting Statements

#3: Reduce exposure to electricity cost increases and generate revenue from renewable energy credits

Introduction

Large corporations are more compelled than ever before to meet their growing demand for electricity through renewable energy projects. Stakeholders increasingly expect companies such as GM to engage in these projects in order to adhere to corporate sustainability standards, both formal (e.g., set by the Sustainability Accounting Standards Board) and informal (e.g., per shifting consumer preferences). However, evolving energy market economics present the clearest case for greater reliance on renewables: according to internal GM estimates²²¹, the company's cost of electricity from "brown sources" (non-renewable) will grow by four percent annually, while the costs of renewables will continue to decrease with ongoing technological advances. According to estimates by the U.S. Energy Information Administration, onshore wind will have a lower levelized cost than conventional coal by 2018²²².

GM has exhibited substantial leadership in renewables by committing to install 125 MW of global renewable capacity by 2020.²²³ The company is nearly halfway to its goal due to significant solar installations, as well as a new landfill gas investment at its Fort Wayne, Indiana and Orion, Michigan assembly plants, which will fulfill over ten percent of its 125 MW target while saving the company \$10 million in annual energy costs.²²⁴

However, significant opportunities remain for GM to increase its renewable sourcing and decrease its

long-term energy costs. By further shifting electricity sourcing from brown energy to renewable energy, GM will strengthen its sustainability leadership, stakeholder perception (especially among SRIs), and brand value. GM also will increase its long-term profitability by decreasing its exposure to cost increases through fixed, long-term pricing contracts under power purchase agreements (PPAs). In turn, these new renewable projects will generate renewable energy certificates (RECs) that GM can sell on national markets as an additional revenue source.

Methods

Several steps were taken to demonstrate that setting an internal price on carbon would make a positive impact on GM's bottom line through the use of renewables. The methodology seeks to prove that this action would encourage further investment in renewables. This will help GM to achieve its strategic sustainability goals, as well as improve its long-term profitability by (1) reducing exposure to long-term electricity cost increases and (2) increasing revenue by obtaining RECs for increased renewable generation.

Reducing GM's exposure to long-term cost increases

The first area of analysis focuses on how setting an internal price on carbon will enable GM to reduce long-term costs by securing attractive pricing in long-term PPA contracts.

Risk Exposure to National Electricity Cost Increases

It is important to first establish the magnitude of long-term cost increases that GM is currently exposed to with its mostly brown energy electricity sourcing. A timeline of 20 years was agreed upon during a phone call with David Tulauskas and Rob Threlkeld, Manager of Renewable Energy at GM. To perform the analysis, historical GM2100 data for U.S. electricity usage was projected into the future using annual increase rates of five, seven, and nine percent. The middle assumption of seven percent was based on GM's increase in U.S. sales by the same percentage from 2012 to 2013 – in other words, it posits that electricity usage will rise at the same rate as vehicle production. For each of the next 20 years, and for each of the three usage increase rates, the estimated electricity consumption volume was multiplied by an estimated cumulative increase in electricity prices over a 2012 baseline of \$0.075/kWh; this electricity rate itself was increased by four percent annually, per internal GM estimates. For example, if it were projected in a given year that GM will use X kWh of electricity nationwide at a cost of \$0.095/kWh in that year, its risk exposure to electricity cost increases in that year would be $X * (\$0.095 - \$0.075)$. If the electricity usage rises to Y kWh in a later year, with an increased rate of \$0.10, then its cost exposure would be $Y * (\$0.100 - \$0.075)$ in that year. All values were adjusted to reflect their present-day values by a 15 percent discount rate, which is GM's standard rate for renewable and efficiency projects.

Calculations were performed both without a cost on carbon and with a cost on carbon in order to demonstrate the risk to GM of not acting in advance of carbon legislation. This risk is expressed as the percentage increase – over expected electricity cost increases – that GM would face if it does not value carbon internally but later is forced to value it, e.g., per external markets or regulations. This analysis considered three different carbon costs per the team's research on estimated U.S. carbon prices outlined in supporting statement #1.

State-Wide Risk Exposure Analysis

After establishing that GM should implement an internal carbon price in order to mitigate the risk of sudden and significant electricity cost increases, it is important to consider how GM might act on this knowledge. In particular, by exploring differences in consumption and emissions data across the many states in which GM currently operates manufacturing facilities, the company's managers and executives can identify which states are the best candidates for new renewable projects or new facilities construction. Therefore, state-wide electricity consumption and carbon emissions data from GM2100 were analyzed at a snapshot in time, at the end of 2012, in order to estimate the percentage cost increase – over estimated historical costs – that a cost on carbon would introduce for each state. As this percentage increases, a state becomes a more attractive candidate for renewable energy projects and a less attractive candidate for new facilities construction; the inverse is true as this percentage decreases. The analysis assumed the "medium" price on carbon of \$22.50 per ton of CO₂ was immediately applied to the entire volume of electricity generated in each state during 2012.

10 MW Renewable Project Opportunity

After performing a state-by-state comparison of consumption and emissions profiles for 2012, it is possible to identify which states will be exposed to the highest and lowest risk of sudden electricity cost increases when external carbon regulations do arise. The states with the highest per-plant percentage increases in costs – when carbon costs are included in the overall electricity cost calculation – are the best candidates for future renewable projects. The two states at the top of this list will be evaluated alongside a baseline case that assumes national average values.

For these states, the 20-year cost avoidance opportunity was calculated for sourcing a 10 MW wind project in that state (or elsewhere but on behalf of that state). To do this, the savings was calculated first *without* a price on carbon, then with low, medium, and high carbon prices per the team's research. Next,

it was determined what cost increase GM would face in each state for an equivalent amount of electricity generation over 20 years if it does not invest in such a project. High numbers indicate that GM should be compelled to introduce renewable projects in these states immediately, as well as to avoid new construction in those locations, at least in order to minimize long-term energy-related costs.

The states at the bottom of the list would face the lowest per-plant percentage electricity cost increases. Therefore, in order to minimize long-term exposure to carbon costs and overall cost increases, they are the best locations for the construction of new manufacturing facilities.

Increasing GM's revenue by obtaining RECs

The second analysis focuses on how setting an internal price on carbon will enable GM to increase revenues by obtaining RECs for newly-generated renewable energy. Specifically, the internal price produces this effect indirectly by encouraging further investment in renewable energy projects, which provide a supply of credits for electricity generated.

10 MW Renewable Project Opportunity

Implementing a 10 MW renewable energy project will enable GM to generate RECs that have a value, and therefore can be sold, on national markets. These credits will be attractive to less-sustainable consumers of electricity that seek a more favorable emissions

profile, for example in order to adhere to state-specific renewable portfolio standards or other regulations.

In order to quantify the value of these RECs, it's important to determine the volume of credits that would be generated under such a project, identify the appropriate value per credit, and then multiply these two in order to yield the total market value. First, the standard assumption was made that one REC is granted for each MWh of electricity generated from a renewable source. To calculate the volume of credits, 10 MW were multiplied by the number of hours in a year (8,760) and the estimated capacity factor for the renewable source (30 percent). This yielded 26,280 MWhs for an equivalent number of RECs. For each of the next 20 years, this annual volume was multiplied by assumed values per credit of \$2.50 (low), \$5.00 (medium), and \$10.00 (high), which were based on a conversation with GM and recent REC market data.²²⁵ These values were held constant over time due to the lack of available data regarding long-term REC market values. A discount rate of 15 percent was applied as per the above analysis.

Findings

GM's exposure to risk of increased electricity costs due to external carbon prices

Table 11 illustrates that GM is exposed to significant percentage cost increases if the company has not implemented an internal price on carbon when an external carbon price ultimately does arise. Even in

Table 11: 20-Year Exposure to Electricity Cost Increases, with and without Internal Carbon Prices

Size of Annual Carbon Emissions Increase	No Internal Carbon Price	Internal Carbon Price					
	Opportunity	Low carbon price (\$15/t CO ₂)		Medium carbon price (\$22.50/t CO ₂)		High carbon price (\$30/t CO ₂)	
		Total opportunity if pursued	% cost increase if not pursued	Total opportunity if pursued	% cost increase if not pursued	Total opportunity if pursued	% cost increase if not pursued
Low (5%)	\$745,014,179	\$1,048,980,768	41%	\$1,200,964,062	61%	\$1,352,947,357	82%
Medium (7%)	\$963,712,769	\$1,323,284,394	37%	\$1,503,070,206	56%	\$1,682,856,018	75%
High (9%)	\$1,250,753,203	\$1,679,209,992	34%	\$1,893,438,386	51%	\$2,107,666,780	69%

the most conservative case – with a low carbon price and a high (nine percent) annual increase in carbon emissions – GM should expect a 34-percent increase in its 20-year electricity costs. Therefore, GM should immediately set an internal price on carbon in order to avoid several hundred million dollars in sudden cost increases due to an emergent carbon price, which the group projects will emerge per team’s research as cited within this paper’s other supporting statements.

Kansas and Michigan present the most compelling cases for future renewable projects

As shown in **Table 12**, the highest per-plant percentage electricity cost increase would occur in Kansas, which would see a 25-percent electricity cost increase in its single manufacturing facility if carbon costs were introduced. This analysis assumed a “Medium” cost of \$22.50 per ton of CO₂ emitted. The next-highest percentages are observed for Missouri (24-percent increase) and Michigan (23-percent increase). Since GM has 15 plants in Michigan versus a single plant in Missouri, Michigan is a more practical candidate for renewable projects as it is more likely that GM would be able to find an appropriate site(s) there. Therefore, Kansas and Michigan were selected for deeper analysis into the cost-mitigation potential of a 10 MW renewable project.

10 MW renewable projects present compelling long-term cost-saving opportunities

The results of the analysis shown in **Table 13** illustrate that 10 MW renewable projects represent significant cost mitigation opportunities for GM across its U.S.-based manufacturing facilities. In fact, the company can expect to avoid 20-year costs of over \$5MM – avoiding a 47-percent rise in electricity costs as carbon costs arise – per a typical U.S. manufacturing site. These cost risk mitigation numbers rise to approximately \$6MM in Michigan (avoiding an 88-percent rise in electricity costs) and over \$6MM in Kansas (avoiding a 96-percent rise in electricity costs). Therefore, these projects should be pursued nationwide but with prioritized attention in Kansas, Michigan, and other high-potential states per the above state-wide analysis and results.

10 MW renewable projects generate modest revenue based on REC market prices

As would be expected, the 20-year NPV of RECs generated by a 10 MW renewable energy project depends directly on the assumed value per credit. As shown in **Table 14**, the value of such a project ranges from a low of approximately \$400,000

Table 12: State-Wise Direct Electricity and Indirect Carbon Cost Exposure in 2012

State	Number of Plants	Average Direct Costs per Plant	Average Carbon Costs per Plant	Average per-Plant % Cost Increase over Direct Costs
<i>Kansas</i>	1	\$11,472,389	\$2,849,318	25%
<i>Missouri</i>	1	\$10,094,140	\$2,416,346	24%
<i>Michigan</i>	15	\$5,443,036	\$1,236,014	23%
<i>Ohio</i>	5	\$10,094,140	\$2,416,346	24%
<i>Indiana</i>	4	\$7,594,393	\$1,579,870	21%
<i>Kentucky</i>	1	\$2,405,806	\$446,843	19%
<i>Tennessee</i>	3	\$5,018,752	\$932,160	19%
<i>Texas</i>	1	\$15,812,986	\$2,552,335	16%
<i>Louisiana</i>	1	\$6,747,630	\$923,825	14%
<i>Maryland</i>	1	\$1,616,984	\$209,612	13%
<i>New York</i>	3	\$6,906,604	\$575,240	8%
NATIONAL	36	\$6,855,448	\$1,371,048	18%

Table 13: 20-Year Cost-Saving Opportunity of 10 MW Renewable Project for Highest-Potential States

	No Internal Carbon Price	Internal Carbon Price					
State	Opportunity	Low carbon price (\$15/t CO ₂)		Medium carbon price (\$22.50/t CO ₂)		High carbon price (\$30/t CO ₂)	
		Total opportunity if pursued	% cost increase if not pursued	Total opportunity if pursued	% cost increase if not pursued	Total opportunity if pursued	% cost increase if not pursued
<i>U.S. Nat'l Average</i>	\$3,182,185	\$4,687,760	47%	\$5,440,548	71%	\$6,193,335	95%
<i>Michigan</i>		\$5,049,878	59%	\$5,983,724	88%	\$6,917,571	117%
<i>Kansas</i>		\$5,224,912	64%	\$6,246,276	96%	\$7,267,639	128%

Table 14: 20-Year REC Revenue-Generation Opportunity of 10 MW Renewable Project

Value per Credit	Total 20-Year NPV
Low (\$2.50)	\$411,238
Medium (\$5.00)	\$822,476
High (\$10.00)	\$1,644,952

(assuming the low value of \$2.50 per credit) to over \$1.6MM (assuming the high value of \$10.00 per credit). Therefore, the revenue that GM can generate through renewable electricity sourcing is variable and unpredictable.

initiatives will supply GM with RECs, their market value is heavily influenced by unpredictable state and national renewable portfolio standards that impact participation in and dynamics of REC markets.

Conclusion

GM should implement an internal price on carbon because this recommendation will deliver significant business value. As a result, GM will have the incentive to pursue additional renewable energy projects that will enable the company to minimize long-term electricity costs, as well as to avoid potentially massive relative cost increases when external carbon prices ultimately do arise. A state-by-state analysis of consumption and emission profiles indicates that GM should focus its renewable efforts in Kansas, Missouri, and Michigan, where the company faces the largest exposure to long-term electricity cost increases within the U.S. On the other hand, GM should seek to construct its new manufacturing facilities in states with small exposures, most notably New York. Though new renewable generation

Supporting Statements

#4: Mitigate financial risk associated with suppliers' practices and externalities

Introduction

Like many companies, GM has little visibility into its suppliers beyond tiers one and two. The lack of knowledge of practices in lower tiers creates risk in GM's operations because it relies on each tier to influence and pass down policies and expectations to the next tier below. This lack of transparency and influence over processes in a multiple tiered supply chain can lead to inefficiencies in the manufacturing process throughout the value chain. To reduce financial risk associated with suppliers' practices and the associated inefficiencies, GM should first improve communications with lower tiers. Therefore, a sustainable supply chain strategy should be implemented in a way that prioritizes the communication of best practices throughout GM's supply chain. Best practices allow for improved resource use at all tiers. Even within the data currently available on GM's supply chain; there are potential inefficiencies that could be eliminated through improved communication. By tracking resources, such as carbon and water, GM can compare supplier emissions and pinpoint areas where processes can be made more efficient, therefore reducing resource use, mitigating risk, and lowering operating cost.

Methods

To quantify the financial risk mitigated by implementing a sustainable supply chain data strategy, calculations were performed on GM's current Carbon Disclosure Project (CDP) data from 2010, 2011, and 2012. The primary countries, or regions, of interest for the team's overall project were China, South Korea,

Australia, the E.U., the WCI, and the United States since these are all areas where a carbon policy is likely to be implemented in the next several years. The WCI was eliminated from the calculations in the beginning, due to most of the WCI (with the exception of Canada) already being included in the analysis of the U.S. Data for the other five countries or regions was separated out and used to assess potential inefficiencies.

Manufacturing processes

Data was provided for seven business units within GM. These units were Assembly, GMPT Engine, GMPT Transmissions, GMSC (stamping), GMPT Foundry, GMCH (components), and CCA. Since these business units were not evenly distributed in each of the areas of interest, only Assembly, GMPT Engine, and GMPT Transmissions were used for the analysis. These three business units were chosen because, with the exception of GMPT Transmission in Australia, each business unit occurred at least once in each area of interest. Australia did not have any GMPT Transmission units and had only one of each of the other two units. Because of this lack of data, Australia was removed from the further analysis.

Carbon per unit produced

The team was provided with data on the production totals of suppliers and their carbon emissions, from electricity use, that are associated with each facility. For each facility, the CO₂ for each year was summed and then divided by the total output of the facility for the year. This resulted in an average CO₂ emissions rate per unit produced at each facility.

These averages were compared for similar business units in similar regions. It is important to compare facilities only to other facilities in a given region due to variations in electricity grids, which can vary the carbon intensity of a production process. For instance, an engine produced in China may come across in the data as having much higher emissions per unit rate than the same piece manufactured in the EU. This does not mean that the processes in China are dramatically less efficient, but could be solely due to the fact the China the majority of electricity in China is produced from coal powered plants while the EU has more renewable energy sources. Similarly, only identical business units can be compared. It is not expected that manufacturing an engine would have the same emissions as manufacturing an entire vehicle and so assembly business units were only compared to other assembly units in the same region and likewise for GMPT engine and GMPT transmission.

Pricing carbon

As the team did not know the exact processes and resources involved at each business unit, carbon prices were used to put a dollar value to the variability in emissions per unit produced and the possible inefficiencies that may be underlying. These carbon prices were informed by supporting statement #1 and are shown in **Table 15**. Both high and low carbon prices were used to provide a range of potential impact since future carbon pricing is uncertain. The values used were 2014 estimates since these values fell closest to when the carbon data was collected (2010-2012).

Calculating potential inefficiencies

Table 15: Carbon Price by Region in 2014

	2014 Price (\$/ton of CO ₂ e)	
	Low	High
<i>EU</i>	\$6.17	\$10.28
<i>South Korea</i>	\$23.79	\$39.65
<i>U.S.</i>	\$15.00	\$30.00
<i>China</i>	\$4.83	\$9.85

The total CO₂ emissions for each facility were provided in the CDP data. The CO₂ emissions per unit production for each facility were used to find an average emissions rate for each business unit in each region (example: assembly plants in China average .35 tons of CO₂ per unit produced). For this analysis it is assumed that, since the facilities operate in the same region and are the same business unit, the average emissions is potentially achievable for all facilities.

The average emissions per unit produced was then multiplied by the total units produced over the three years of data to get the CO₂ emissions that would occur if any similar business unit that had emissions rates above the average were brought down to average. In China, the baseline assembly emissions were 2,180,000 tons of CO₂ and 1,852,000 tons of CO₂ when all similar business units operated at the average emissions rate (.35 tons of CO₂/unit produced). The carbon prices were then applied to the difference to get the potential saving by operating at average emissions.

Similar calculations were done using the lowest emissions value for each business unit to estimate the potential maximum savings. This low emissions value could be considered a high-end goal, since these low emissions rates may not be as achievable for each facility as average emissions rates would be. Again, high and low carbon prices were applied to calculate the potential reduced costs if GM was able to operate all facilities at the lowest possible emissions for a given business unit.

Findings

Though GM has begun to track carbon and other metrics throughout their supply chain, the data is not being used optimally. Data is being collected, but there is more information that can be gained from it. Within the data that is currently available, there are potential inefficiencies. Though this analysis was not performed on water, similar analysis could be done to reveal whether or not there are additional inefficiencies in GM’s water usage. Continuing this process further into the

supply chain would likely reveal further possible improvements that could mitigate financial risk.

Table 16: Potential Cost Savings in China Based on Assembly, Engine, and Transmission

		Emission Rate	
		Low	Average
Carbon Price	Low	\$7,981,501.87	\$2,606,702.46
	High	\$16,276,975.87	\$5,315,946.01

As shown in **Tables 16 & 17** respectively, China and South Korea had similar results, due

Table 17: Potential Cost Savings in South Korea Based on Assembly, Engine, and Transmission

		Emission Rate	
		Low	Average
Carbon Price	Low	\$7,068,484.80	\$1,474,456.62
	High	\$11,780,808.00	\$2,457,427.70

to similar calculated emissions rates and production rates. Emissions rates in South Korea ranged from 0.02 tons of CO₂ per unit produced to 0.39 tons of CO₂ per unit produced while emissions rates in China ranged from 0.06 tons of CO₂ per unit produced to 0.89 tons of CO₂ per unit produced. Though these may seem like wide ranges, they are much smaller than the range observed in the U.S.

The U.S. had much higher values than South Korea of China, as shown in **Table 18**, primarily due to the higher emissions values and large variations in emissions rates. Emissions rates in the U.S were as high as 5.88 tons of CO₂ per unit produced. (Note: There were two values that exceeded 40 tons of CO₂ per unit produced that were eliminated from the analysis as outliers).

The values in the EU were the lowest of the areas analyzed. This is likely due to the much lower emissions per unit produced in EU facilities as well as the lower overall production in the EU compared to the three other regions.

Conclusion

While carbon regulation may be years off, a sustainable supply chain data strategy and an internal price on carbon could allow GM to identify suppliers and practices of high financial risk and significantly improve GM’s resource use. From 2010 to 2013, GM’s costs would have been reduced by at least \$34 million had all business units been operating at average emissions rates per unit produced. The savings calculated could potentially be two-fold if looked at from a carbon perspective as well as a resources perspective. As illustrated above, in the face of a carbon market, assessing in efficiencies would allow GM to minimize their carbon footprint. This would mean GM would not have to pay for addition permits and could potentially sell permits. In addition, assessing inefficiencies in the absence of a carbon market, by pricing carbon independently within GM, could serve to create an internal fund for future improvements at GM.

Table 18: Potential Cost Savings in U.S. Based on Assembly, Engine, and Transmission

		Emission Rate	
		Low	Average
Carbon Price	Low	\$40,589,080.20	\$14,885,421.00
	High	\$81,178,160.40	\$29,770,841.99

Supporting Statements

#5: Mitigate operational risk associated with suppliers' practices and externalities

Introduction

In light of evolving carbon policies, it is important not only for GM to be prepared to cut excessive carbon intensity, but for its suppliers to be ready as well. Since the supply chain makes up about two-thirds of the value of a vehicle²²⁶, the risk associated with suppliers' practices is significant. In addition to the growing risk posed by carbon policies, the risks associated with water use, and the use of rare earth minerals will become increasingly important in the global market.

Methods

The purpose behind investigating this subject is how implementing an internal price on carbon and implementing a sustainable supply chain data strategy would mitigate operational risk associated with suppliers' practices and externalities. In order to understand how suppliers' practices and externalities can affect GM, the team explored cases that can be used as examples. These examples start to quantify and qualify the effects of several factors: total supply chain cost, supply disruptions, stock price, and shareholder value. In addition, survey results from the consulting firm Pricewaterhouse Coopers (PwC) and the MIT Forum for Supply Chain Innovation were used to gauge the significance of these factors that add to the operational risk faced by OEMs and other multinational companies.

As part of this analysis, scenarios are described in which suppliers' practices and externalities result

in increased operational risk. The first section, "Suppliers' Practices", describes the results of specific actions, or lack thereof, from internal management decisions. The next section, "Externalities", depicts risk scenarios that a company has little control over. Finally, the results are broken down into the above-mentioned factors and quantified and/or qualified using results from literature review.

Scenarios

Suppliers' Practices

The first group of scenarios looks at the implications from a policy measure that was either not anticipated or not prepared for. Examples include the implementation of a carbon tax or cap and trade scheme, tracking of rare minerals, or limitations of water use. The effects of an unanticipated policy may include supply disruptions and/or passed down cost. It is inferred that with the nature of a policy or law change, the results would be abruptly felt.

While regulatory risks can change drastically in a relatively short amount of time, efficiency based risks are more gradual. As water and energy prices increase, inefficiencies weigh heavier on a company's bottom line. As inefficiencies accumulate, their costs may be passed through the supply chain. In extreme cases, the increased overhead costs could cause supply disruptions if lower tier suppliers are not able to afford their inputs and therefore unable to meet the purchasing company's needs.

Externalities

Situations where costs are external to the company can partially determine the broad effects on not only the supplier, but also the parent company. Externalities may be in the form of an attack by an NGO or the media, linking a supplier to the parent company. The team hypothesized that a decrease in shareholder value and stock price are possible in such a situation, which represents operational risk for the parent company and supplier.



Findings

Total supply chain cost

Total supply chain costs are a sum of five factors; material, labor, inventory holding, logistics, and overhead costs.²²⁷ Reducing any of those factors will result in lower costs for that supplier. An example of reduced overhead costs that benefited the parent company, when Wal-Mart started its sustainability program in 2005; one of the goals was to cut 20 million metric tons of GHG emissions from its supply chain. The New York Times commented, “(...) while the initiative may be good for the environment, it may also be good for Wal-Mart. Driving down costs out of the supply chain could result in savings for Wal-Mart

that can be passed along to consumers—enabling the company to uphold its reputation as a destination for rock-bottom prices.”²²⁸ Having cost savings benefit the parent company is not always a given due to contracts or agreements, but in some cases, benefits can be realized throughout the entire supply chain.

Supply disruptions

PwC and the MIT Forum for Supply Chain Innovation surveyed global companies to determine supply chain operations and risk management approaches. The study analyzed operational and financial performance specifically in regards to supply chain disruptions. Of the participants surveyed, 32 percent were from the automotive and industrial sectors. The survey found that:

- 38 percent of companies responded that energy and price volatility pose the greatest risk to their supply chain.²²⁹
- 22 percent of companies responded that the greatest risk that their supply chain is exposed to is supplier bankruptcy.²³⁰
- Total supply chain cost went up by 69 percent for companies that suffered a 3 percent or higher impact on their performance indicators as a result of supply chain disruptions.²³¹
 - Compared to companies with a less mature supply chain and risk management processes, mature companies were impacted by an average of 28 percent less.
- Supply chain disruptions can reduce shareholder value by 8-10 percent, or more in “time-sensitive” environments where early market introduction is critical to success.²³²
- Stock market reactions to supply chain disruptions have seen their shareholder value decrease by 10.28 percent on average, with an average recovery time of 50 trading days.²³³
- Quantitative losses from natural disasters can be used as an example to show the resulting implications from stoppages:
 - The Great Sendai Earthquake and the Japanese tsunami of 2011: The Japanese manufacturing industry experienced

facilities shut down for months, hurting auto manufacturers who relied on parts made in Japan.²³⁴

- For example, Nissan had a loss of production capacity equivalent to 270,000 automobiles.²³⁵

Disruptions can damage profitability, stock price, and market reputation. Requiring suppliers to track their carbon as well as other sustainability metrics helps prevent disruptions and improves efficiency.

Stock price

MIT's Sloan School of Management's *Corporate Social Responsibility and Stock Prices* cites three specific examples that help qualify and quantify the affects of environmental initiatives and eco-harmful events to stock price.

- Hamilton (1995) documents a decrease in stock prices when the EPA released the data on toxic chemicals in 1989.²³⁶
- Klassen and McLaughlin (1996) sampled 140 "aware announcements" from 1987 to 1991, and found a positive stock market reaction.²³⁷ The announcements displayed transparency in response to a known harmful event.
- Gunthorpe (1997) found negative stock market reaction when illegal corporate activities were detected using a sample of 69 announcements (example: EPA violations).²³⁸

Shareholder value

Drivers of shareholder value include capital efficiency and cost reduction. Supply chain strategy directly and indirectly affects both of those factors. By creating a sustainable supply chain data strategy, information will be able to flow more freely between GM, the supplier, and shareholders. Christopher and Ryals argue in "Supply Chain Strategy: Its Impact on Shareholder Value" from the International Journal of Logistics Management that "...the quality of

relationships with upstream and downstream firms is one of the most significant drivers of shareholder value."²³⁹

To better understand how shareholders value or penalize companies for environmental initiatives or eco-harmful behavior, the team used findings from MIT's Sloan School of Management's *Corporate Social Responsibility and Stock Prices: The Environmental Awareness of Shareholders*. From this, it was found that average cumulative abnormal returns (the difference between the expected return on a stock and the actual return) reflect that shareholders reward companies for eco-friendly initiatives and punishes them for eco-harmful behavior. The study also suggested that penalties for eco-harmful behavior have increased.²⁴⁰

These findings help qualify the effects of suppliers' practices and externalities, but tend to be more difficult to quantify as company shareholders vary so greatly. However, understanding the trends that either enhance or decrease shareholder value help in mitigating risk.

Conclusion

By implementing an internal price on carbon and developing a sustainable supply chain data strategy, many of the negative effects on the factors described above could either be lessened or reversed. Placing a price on carbon at GM would work to create greater transparency and heighten leadership status within the automotive industry. This would also help suppliers understand their own carbon footprint and how excessive carbon emissions may put them at risk.

Creating a sustainable supply chain strategy would help GM better identify hot spots in regards to carbon emissions, or water use for instance throughout its supply chain. The hot spots are vulnerable to regulations and/or scarce resources, specifically in the case of water. The strategy would help GM provide targets for sharing of best practices and it would also allow GM increased flexibility in the case of disruptions. In addition, the sustainable supply chain

strategy would help GM recognize potential issues and risks before becoming problematic. This may also help to increase ease in which a dual sourcing strategy can be implemented; meaning GM could establish a redundant supplier in the event of a disruption. Further integration will allow for greater collaboration and visibility, both up and down the supply chain.

Evaluation Framework



Purpose of the Evaluation Framework

The team sought to introduce an evaluation framework that can guide GM's structured decision-making amidst the myriad of opportunities available to the company. This framework would incorporate many factors that together provide a comprehensive view of the recommendations' potential value to GM. It also would enable a straightforward comparison between these recommendations and any other initiatives that GM is evaluating for potential investment, both related and unrelated to sustainability, and both now and in the future.

Rationale behind the Framework Structure

The team approached the project with the ultimate objective of helping GM to capture greater business value through pursuing sustainability opportunities. Though the team has illustrated how its actionable recommendations conceptually will enable GM to accomplish this objective, it recognizes the necessity of estimating the initiatives' potential values to GM. In particular, structured analyses will enable GM to evaluate these initiatives alongside other projects. It's also critical to consider GM's readiness to implement

and derive value from these initiatives: since GM would invest significant time and resources to pursue these recommendations, stakeholders would expect timely results.

Therefore, the team decided to evaluate each recommendation according to the magnitude of the opportunity presented and its importance to GM, which the team will refer to as the recommendation's criticality, as well as the company's current ability to implement it, or its viability. These two axes (criticality and viability) together will assist GM in determining if and when to pursue each recommendation.

Composition of the Framework

Components of each axis

Each recommendation will be evaluated according to each component of the two axes.

Criticality is composed of the following components:

- Financial impact – size of the quantitative and qualitative financial opportunity, e.g., NPV, IRR, ROI, and cost-benefit calculations

- Competitive pressure – importance to defending current market position or increasing market position relative to competitors, considering industry trends and competitors’ progress
- Stakeholder demand – importance according to consumers, NGOs, socially-responsible investors (SRIs) and other stakeholders whose opinions directly impact GM’s bottom line
- Financial risk – magnitude of financial risk exposure resulting from GM’s failure to pursue the opportunity, e.g., from cost increases resulting from GM’s failure to pursue the opportunity
- Operational risk – magnitude of operational risk exposure resulting from GM’s failure to pursue the opportunity, e.g., from failure to maintain license to operate in particular geographies
- Regulatory risk – magnitude of regulatory risk exposure resulting from GM’s failure to pursue the opportunity, e.g., from noncompliance with legislation

Viability is composed of the following components:

- Adequate financial returns – financial returns meet or exceed internal hurdle rates, e.g., in terms of quick payback, high ROI, positive (or size of) NPV, etc.
- Organizational readiness – extent to which GM currently possesses the necessary capabilities, and can leverage the necessary resources, to pursue the recommendation in the near term
- Strategic alignment – extent to which the recommendation aligns with GM’s corporate strategy and sustainability strategy, as well as its ability to gain sufficient internal buy-in to materialize and create value in a timely manner

Quantitative and Qualitative Methodologies

Several quantitative assessment methods can be employed – to the extent that they’re both relevant and feasible – to demonstrate the value of the team’s recommendations. Specifically, net present value and

sensitivity analyses will aid GM in understanding how its operations impact the environment, as well as how its dependence on ecological goods and services impacts the company’s bottom line. Where relevant, the team will consider the appropriate internal hurdle rates when assessing the financial viability of sustainability initiatives. Whenever feasible, this will be done using GM’s own cost data. To the extent that this is unfeasible – considering the availability or reliability of data, for example – the team will use the best-available industry data as a benchmark in assessing the expected benefit to GM.

To the extent that quantification is not possible or does not tell the entire story, the team will assess and communicate value by employing qualitative methods with prudent assumptions. For example, recommendations can be prioritized by assigning them numerical scores based on qualitative analysis: on a scale of 1 (low) to 5 (high) for potential magnitude of financial impact, one initiative might be assessed a score of 4 because it’s expected to have a relatively significant positive financial impact, whereas another might receive a 2 because knowledge and assumptions indicate that it will have a much smaller relative impact.

Process for Creating the Framework

The team arrived at an initial draft of the framework through an internal brainstorming session, during which several quantitative and qualitative factors were identified as relevant to GM’s decision-making process. Early interviews with GM provided guidance as to which factors would be relevant to a diverse audience within the company’s executive team. During this phase, the concepts of criticality and viability were introduced as the two axes that subsume all criteria that GM might consider.

Next, the team discussed the draft with David, who requested a review of – and reconciliation with – the Sustainability Accounting Standards Board’s (SASB) guidelines for determining materiality. In fact, SASB created a map that encompasses a set of over 40

sustainability issues that were generated according to three criteria: evidence of interest, evidence of financial impact, and forward-looking adjustment, which accounts for sustainability issues' magnitude, probability, and externalities.²⁴¹ Per **Exhibit 10**, the business drivers listed under evidence of interest and financial impact aligned closely with the team's initial draft framework.

The team believed, however, that SASB's two axes for assessing the materiality of forward-looking issues – magnitude of impact and probability of occurrence – are the most appropriate for this project, per **Exhibit 11**.²⁴²

- 1) Since this Master's Project is inherently and deeply forward-looking, SASB's orientation towards action and change aligns closely with the team's intentions for this project
- 2) SASB's magnitude of impact directly matches the team's criticality axis, whereas its



Exhibit 10: SASB Sustainability Drivers

Source: "Determining Materiality," Sustainability Accounting Standards Board, Accessed February 17, 2014, <http://www.sasb.org/materiality/determining-materiality/>.

probability of occurrence axis closely aligns with the team's viability axis. As a slight caveat, the team's usage refers to GM's own internal ability to ensure success rather than the likelihood of some uncontrollable external event's occurrence.

Finally, the team incorporated these observations into the initial framework. The revised framework incorporates the criteria that SASB lists under evidence of interest and financial impact categories, grouped in the criticality and viability categories that match closely with SASB's own axes. The team also incorporated regulatory risk, operational risk, and strategic alignment based on discussions with GM and the conviction that they would provide valuable guidance.



Exhibit 11: SASB Materiality Assessment

Source: "SASB Conceptual Framework Exposure Draft," Sustainable Accounting Standards Board, Accessed February 17, 2014, <http://www.sasb.org/wp-content/uploads/2013/06/SASB-Conceptual-Framework-Exposure-Draft.pdf>.

Evaluation of Recommendations

It is important to evaluate the attractiveness of the two recommendations in a consistent way. Given that some of the supporting statements are more quantifiable than others, the team qualitatively applied the evaluation framework across all five supporting statements in order to provide a uniform assessment for each metric within the framework. Ultimately, the team compared the results of the five supporting statements, ultimately producing a spotlight analysis that provides a high-level view of the recommendations' potential impact within GM.

Specifically, by considering and comparing the results of the five supporting statements, the team evaluated to what extent each recommendation would positively impact GM per each of the nine metrics in the evaluation framework (six under criticality and three under viability). Criticality refers to the

importance to GM of pursuing the recommendation, whereas viability refers to the readiness of GM to pursue them.

Tables 19 & 20 summarize the analysis that led to the team's conclusions:

From this analysis, the team reached the following main conclusions:

Both recommendations are attractive – the two recommendations are generally critical and viable for GM. They will generate moderate expected financial impact and a high degree of risk mitigation, which together outweigh the anticipated organizational resources needed to pursue them. The company would benefit from pursuing both recommendations together

Table 19: Criticality of Recommendations According to Evaluation Metrics

Metric	Internal Price on Carbon	Sustainable Supply Chain Strategy
Financial Impact	Moderate	Moderate
Competitive Pressure	Low	Low
Stakeholder Demand	Low	Low
Financial Risk	High	Moderate
Operational Risk	Moderate	High
Regulatory Risk	High	Moderate

Table 20: Viability of Recommendations According to Evaluation Metrics

Metric	Internal Price on Carbon	Sustainable Supply Chain Strategy
Adequate Returns	Moderate	Moderate
Organizational Readiness	Moderate	High
Strategic Alignment	High	High

given the systemic benefits that will result, as outlined in the systems thinking exercise.

Risk identification, quantification, and mitigation are the primary benefits – both recommendations will reduce GM’s exposure to risk. Specifically, the company can better understand, anticipate, and respond to risks associated with emerging carbon regulations and prices, rising electricity costs, and issues around scarcity, costs, and license-to-operate within resource-constrained geographies. The type of risk differs across recommendations, however; whereas an internal price on carbon is expected to mitigate both financial and regulatory risk, a sustainable supply chain strategy will more directly mitigate operational risk. On the other hand, given the long-term nature of the cost savings and revenue opportunities that the team identified, as well as the difficulty to estimate the likelihood and timing of regulatory changes (for example), there is only moderate certainty around the degree of direct financial impact that ultimately will result.

Competitive pressure and stakeholder demand are not as compelling – given the early stage of these particular sustainability efforts among automotive companies, there is little to no direct pressure to implement them. Rather, if GM were to pursue an internal carbon or a sustainable supply chain strategy, it will become a leader in these specific areas. Though such leadership possibly could provide GM with a competitive advantage, the argument isn’t as compelling as for the risk mitigation opportunities.

Both recommendations can readily be implemented – it is clear that these two opportunities can achieve internal buy-in given their alignment with GM’s sustainability and corporate strategies. With the appropriate executive sponsorship,

both also can be implemented in a timely manner, though this would require significant collaboration with internal and external stakeholders. Implementing an internal carbon price will require a broad and deep collaboration to identify the best pricing and accounting methods, as well as the necessary communications practices. Meanwhile, implementing a sustainable supply chain strategy will require a similarly intense collaboration with suppliers to understand their practices and externalities, as well as how best to quantify, monitor, and evaluate their performance. GM already is pursuing similar supply chain strategies for conflict minerals, which will facilitate the implementation of this recommendation.

Systems Thinking Approach



Systems Thinking analysis discovers how the structure of a system determines its behavior.²⁴³ The components of these models are connected by either supporting or opposing links. A supporting link indicates that an increase in the first variable causes the second to increase as well, or if the first decreases, the second will decrease. Conversely, an opposing link signifies that the dependent variable will move in the opposite direction of the first variable. As chains of these links are created, loops can be identified which demonstrate how these variables influence each other over time, referred to as systemic changes.²⁴⁴ These loops are classified as either balancing or reinforcing. A balancing loop will consist of an odd number of these opposing loops, which make the system resistant to change and relatively constant over time. A reinforcing loop is composed of all supporting links or an even number of opposing links, which cancel each other out over time. These reinforcing loops push a system in primarily one direction, but are more easily influenced by external forcing factors or system shocks.

There are several ways to illustrate these relationships, but for the purpose of this analysis a Causal Loop

Diagram was constructed (see **Exhibit 9**). The model demonstrates not only how our recommendations could create systemic changes within GM, but the diagram also shows how other factors, such as Reporting & Transparency, Greenhouse Gas Emissions, or multiple types of risk, influence the implementation of these recommendations. While there are countless loops within the full diagram, there are a few of primary significance to this project. Identifying these loops will allow GM to better understand how these recommendations can have changes beyond some of the direct impacts identified earlier in the report and through the supporting statements.

Exhibit 12: Causal Loop Diagram – arrows indicate the cause-and-effect relationships between any two given variables. An “S” identifies a supporting link, while an “O” indicates an opposing link as described above.

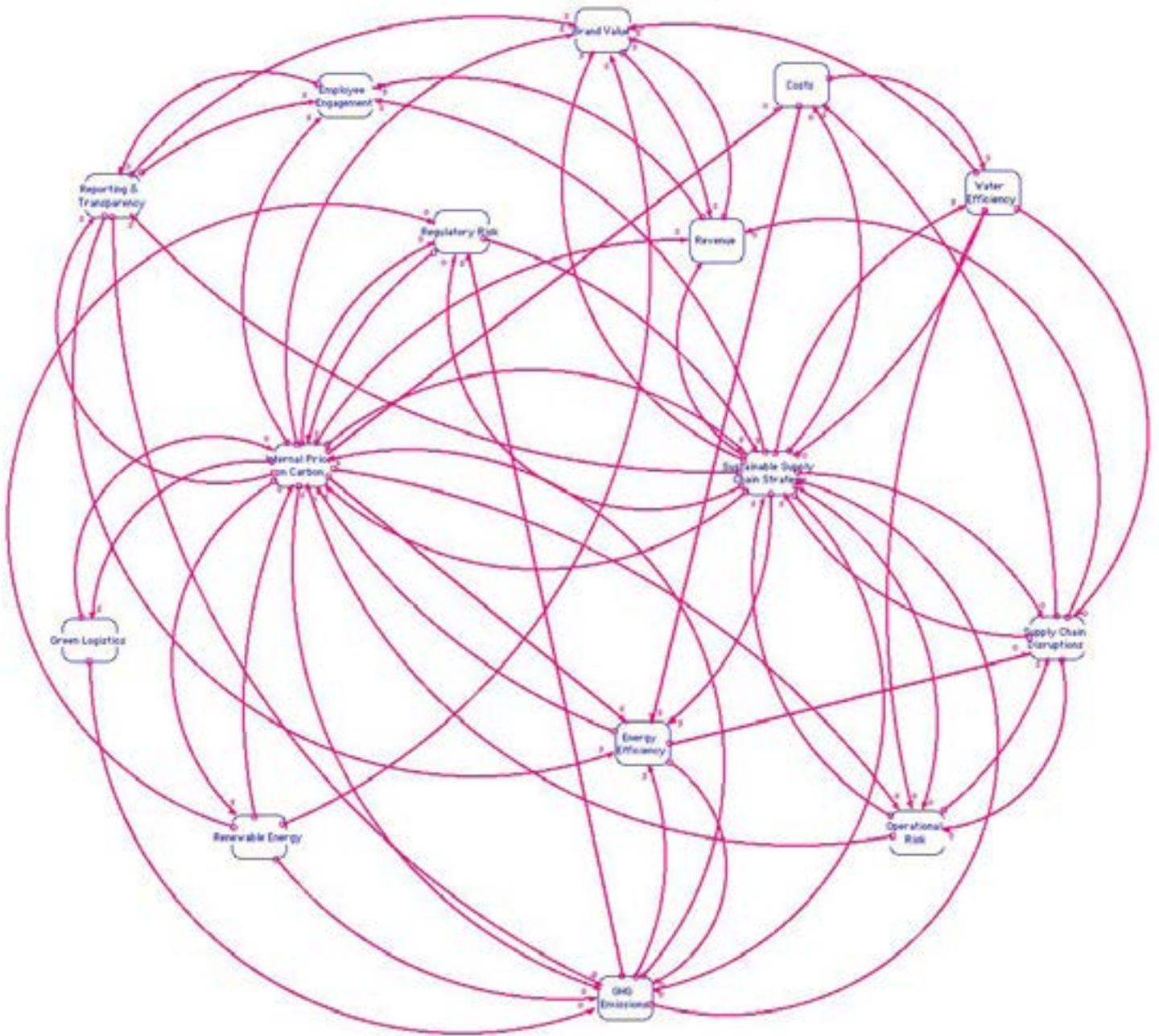


Exhibit 12: Causal Loop Diagram

Causal Loops

Recommendations loop

Perhaps the most basic and important loop within the diagram exists between the two recommendations. Exhibit XA indicates that each recommendation supports the other. The reasoning for this is that having a Sustainable Supply Chain Strategy will already be tracking a variety of sustainability metrics, including carbon emissions, and a better understanding of the emissions produced in GM's global supply chain will allow the company to more accurately price carbon. Similarly, having an Internal Carbon Price will promote a Sustainable Supply Chain Strategy by tracking carbon emissions and providing a clear metric for reductions.

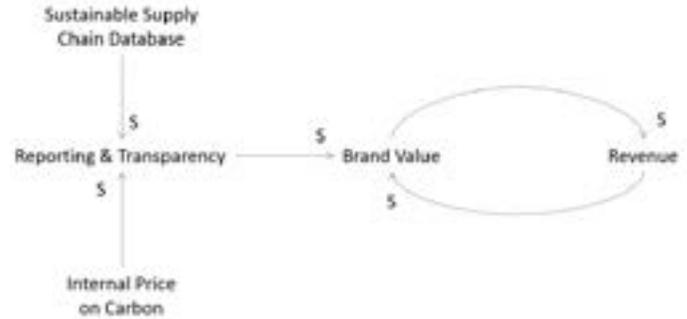


Exhibit 14: Brand Value and Revenue Loop

Brand value and revenue loop

As external forcing variables, the recommendations independently support the value of Reporting and Transparency (see Exhibit XB). More transparent companies tend to experience greater brand value. As brand value increases, it can also increase revenue, which has a reciprocal effect on increasing brand value. An Internal Price on Carbon and a Sustainable Supply Chain Strategy would each serve as a powerful tool to push this mutually reinforcing relationship between revenue and brand value beyond what GM has historically experienced. Implementing both of these recommendations would further amplify this effect.



Exhibit 13: Recommendations Loop

Exhibit 13: Recommendation Loop – implementing one of the recommendations supports the implementation of the other as demonstrated through this reinforcing loop.

Exhibit 14: Brand Value and Revenue Loop – Brand value and revenue continually reinforce one another, but through improved Reporting and Transparency, the recommendations further advance this relationship

Internal price on carbon and energy loop

An Internal Price on Carbon will encourage increased deployment of Renewable Energy systems, which reduce GM’s total Greenhouse Gas Emissions, as shown in Exhibit XC. Implementation of a carbon price improves efficiency, which further reduces emissions. While fewer emissions discourage energy efficiency metrics, greater efficiency discourages the implementation of a carbon price. Thus, this loop shows the potential for a carbon price to continually improve GM’s relative energy performance. As energy standards become more intense and competitive, a carbon price would allow GM to perpetually improve their energy sourcing and efficiency.

Exhibit 15: Internal Price on Carbon and Energy Loop – Pricing carbon encourages the implementation of Renewable Energy technologies as well as Energy Efficiency metrics, which oppose, or work to decrease Greenhouse Gas Emissions

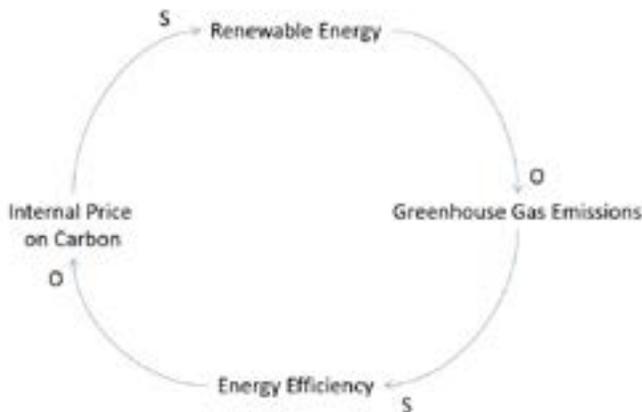


Exhibit 15: Internal Price on Carbon and Energy Loop

Sustainable supply chain strategy and operational risk loop

As demonstrated by our Evaluation Framework, one of the primary strengths of the Sustainable Supply Chain Strategy is its capacity to reduce Operational Risk, which results in fewer Supply Chain Disruptions (Exhibit XD). The more Supply Chain Disruptions GM experiences, the greater need for the recommendation. As this balancing loop perpetually decreases GM’s exposure to Operational Risk and the number of Supply Chain Disruptions, GM will be able to focus more directly on areas in their supply chain that are still at risk or experiencing disruptions.



Exhibit 16: Sustainable Supply Chain Strategy and Operational Risk Loop

Exhibit 16: Sustainable Supply Chain Strategy and Operational Risk Loop – A Sustainable Supply Chain Strategy serves to reduce both Operational Risk and Supply Chain Disruptions

Conclusion

Systems Thinking

Performing a Systems Thinking analysis has shown that the recommendations go beyond the direct benefits previously identified in the report. Implementing these recommendations will continually promote GM's brand value and revenue, while reducing the company's exposure to risk. Additionally, the systemic changes generated by the recommendations will perpetuate GM's energy efficiency and renewable energy sourcing to allow the company to meet and even exceed their sustainability goals. While the Systems Thinking analysis shows that each recommendation provides a range of benefits independently, the analysis also demonstrates the power of implementing the recommendations together and how the recommendations reinforce each other.

Recommendations

Ultimately, the team feels that recommendations of pricing carbon internally as well as implementing a sustainable supply chain strategy have been proven to have a potentially large impact on GM. As illustrated throughout this paper, both recommendations have benefits that GM could realize if only one was implemented. However, the most value is realized if both recommendations are executed in tandem.

Challenges

Estimating the cost of implementing these recommendations fell beyond the scope of this project and may be an area of potential challenge. While other companies have taken steps related to one recommendation or the other, now companies were found that are taking steps in both areas. GM would be the first OEM to take these steps. The team however feels that there is significant room for risk reduction and cutting costs that will make these commendations

worthwhile. The value will not only come from reducing risk and cutting cost, but adding value to the brand and attracting SRIs to GM stock.

In addition to the cost of implementation, the logistics may also pose additional challenges. These recommendations would require a shift in current strategies. Communications would be important across departments to make coordinated efforts to make these recommendations possible. In addition, continued collaboration will be needed in order for the internal carbon price and supply chain strategy to have the biggest impact possible.

Final Thoughts

The team recommends that GM begin to assess whether the costs of implementation are overcome by the benefits of internally pricing carbon and implementing a sustainable supply chain strategy. GM must not only consider the direct implications of these recommendations but the full value that will be realized over time.

As Millennials become more and more important in the market place and shift their focus from the value of individual automobiles, GM must consider the value in strategies, such as those in our recommendations, to increase their brand value to these key consumers. Automobile owners are no longer only looking for large, quality vehicles, they want vehicles that address current world issues and they want to know that they company they are supporting with their purchase is conscious of the world around it.

Appendix A

Conference Sessions

AIAG Sessions

Corporate Responsibility 201

Explored methods and case studies for integrating sustainability into business operations. Topics included supply chain sustainability, creating internal alignment with global teams, innovative stakeholder engagement, and effective transparency. The session identified and explored best practices and drew from the experiences and challenges of attendees.

Take-aways

1. Main challenges facing suppliers in sustainability

The main challenges facing suppliers in sustainability are integrating sustainability into the core function of the business, planning for the long-term, and convincing investors that sustainability enhances business value.

2. Key steps to becoming sustainability leader

Some key steps to becoming a sustainability leader are to set ambitious targets, to listen to outsider perspectives through external engagement, to invest in sustainable solutions within the supply chain, and to anticipate the future to make sure that organizational changes allow for and align with sustainability.

Influence on Research

Validated that overall project was current for the automotive industry in general and GM in particular. The purpose of the project follows in the vein of better integrating sustainability into the organizational structure of the company and enhancing value. The session also reinforced the concept of working sustainability into the supply chain.

Environmental Sustainability – Water

Covered the emerging environmental issues of water and data assurance. Water sustainability is a global water issue impacting local communities' living standards and has the potential for political and manufacturing issues. An overview of global water business risk, assessment processes, and technology related to manufacturing was covered along with overall environmental data assurance and verification process.

Take-aways

1. Key Performance Indicators (KPIs) – G4

The G4 Global Reporting Initiative KPIs help to identify risk and opportunity exposure in operations and the supply chain by linking water and carbon emissions. The KPIs also quantify the amount of water recycled and help companies understand the sources of its water and the associated vulnerabilities.

2. Relevance to automobile manufacturers

With 10 percent of automobile industry operations in water stressed areas, water is a major concern. Tools such as the World Water Assessment have been developed to help the industry deal with this issue. An example of GM's response to this issue is the assembly plant in San Luis Potosi, Mexico, where mitigation of the problem takes place through water recycling and reuse. This plant required a capital investment 3 percent higher than a conventional plant, showing that water availability can influence investment decisions. There has also been benchmarking that compares automotive companies against each other through BSR.

3. Importance of water to business risks

While the automobile industry uses a small percent of overall water use, this use competes with other sectors that hold more importance in countries around the world. Outside of water use, there is also a concern around sea level, as products come through ports. If infrastructure becomes damaged due to sea level rise, it could mean delays in the supply of parts. Water is a particular concern for the mining and minerals and energy sectors due to water rights restrictions, spurring conservation and recovery of mine water. If these issues continue, the industry could see increased costs for materials and electricity.

Water also poses a financial risk to companies through scarcity, surplus (e.g. flooding), and quality along with reputational and regulatory issues in various countries. By understanding its water footprint, a company can reduce its costs and resource use, manage its risk, prepare for legislation, and motivate and retain staff, in addition to mitigating climate change indirectly through reductions in energy associated with water pumping and treating.

4. Drivers for water projects

Water projects for companies are driven by a number of motivations, including compliance, business continuity, and sustainability.

5. Full cost accounting

When looking at full cost accounting, both direct and indirect costs are taken into account. Direct costs include water use and wastewater discharge fees, energy costs associated with water use, water management, and to a minimal degree, pretreatment technology and regulatory costs. Indirect costs include disruption to service and costs associated with a company's license to operate.

Influence on research

Initially validated the team's choice of water as a focus topic of the project. When the recommendations changed to pricing carbon internally and a sustainable supply chain strategy, this session helped prove the materiality of business risks associated with environmental issues, the overarching theme of topic areas connecting to carbon, and how costs could be passed through to automakers.

Environmental and Chemical Regulations

Shared key trends in global chemical and environmental regulations and highlighted best practices to assist companies in maintaining compliance in a global market.

Take-aways

1. Recycling and End of Life Regulations

Japan has put measures in place for end of life vehicles; manufacturers are required to recover and reuse materials. South Korea also implemented vehicle recycling in 2007; producers must support a certain recycling rate.

2. Global Regulations

While the global greenhouse gas regulatory market is fragmented, more regulations are being seen at the national and regional levels. China has set aggressive cuts to greenhouse gas intensity of 40-45 percent by 2020 over a 2005 baseline. Five cities and two provinces in China have instituted cap-and-trade pilot programs and a Chinese national program is expected around 2015. In North America, there has been some cross-border activity between Canada, in particular Quebec, and California.

Influence on Research

While there are very few functioning markets at the present time, especially in the U.S., this session made clear that there are some important regulations being tested in the Asian market. Understanding these markets will be important, as GM hopes to grow in this area and it will be beneficial to prepare for these policies in advance.

Environmental Metrics

Focused on collaborative efforts to address reduction strategies, benchmarking, and common definitions. External rankings and the Global Water Risk Analysis Model were discussed.

Take-aways

1. Ford's approach to internal sustainability reporting

This session introduced the general approach that Ford is taking to sustainability reporting. The company has introduced a global environmental operating system in every facility with weekly and monthly metric reporting. This system was largely a top-down approach and provides a closed loop system for the company, rather than the plant level. In addition, the company has a mobile source "path" to address emissions in the use phase of the vehicle. This also allowed the company to overlay water usage data with water costs and found that water prices have been increasing, keeping costs the same for less water.

2. Impact of environmental externalities

A representative from TruCost stated that 80 percent of automotive impacts are upstream in the supply chain and that environmental externalities could take away up to 50 percent of a company's profit. Sprint and Puma were given as examples of companies applying environmental economic techniques to find and reduce costs.

Influence on research

Demonstrated two things: 1) automotive companies are moving to sustainability reporting within the organization in order to better identify costs, savings, and meeting of goals and 2) environmental impacts have huge implications in the automotive industry through costs and understanding the supply chain. This validated the idea of pursuing a sustainable supply chain database and metric tracking system for GM.

Environmental Risk Management

Provided an overview of Life Cycle Analysis (LCA) use to quantify environmental risk in the supply chain and reviewed a tool to identify water risk globally for OEMs and supply chain.

Take-aways

1. Integration of natural accounting

Infrastructure for natural accounting and monetization of environmental impact needs to be put in context of operational management that is defined by each department.

2. Methods for monetizing environmental impacts

Four different Life Cycle Assessments (LCA) can help a company monetize its environmental impacts. Process LCA examines only critical parts, input/output LCA looks at the whole picture but has less detail, bottom-up hybrid LCA starts with the process model and fills in with the input/output model, and top-down hybrid LCA starts with the input/output model and defines further with the process model.

Influence on research

Demonstrated that there is a need to move forward with putting environmental impacts in traditional organizational terms.

Global Supply Chain Transparency Issues

Provided an overview of how organizations are tackling Corporate Social Responsibility (CSR) metrics and information internally and within their supply chains.

Take-aways

1. Benefits from improving supply chain transparency

Improving supply chain transparency provides many benefits to companies including improved vendor risk management, a focus on adequate information, and risk management for the company itself. Vendor risk management allows companies to collect and update data, correct points of contact, which eases communication, and provides knowledge on the maturity of each supplier, improving engagement, education, and relationship building and helping vendors push beyond compliance towards sustainable practices. Focusing on adequate information allows companies to set criteria for collected information and only collect the information that is needed. Internally, a company is able to manage risk through its visibility, resilience, knowledge sharing, aid to logistics, and reducing risk through centralized data, the potential of predicting rather than reacting to a crisis, and passing on lessons learned, reducing the chance of making the same mistakes twice.

Influence on Research

Helped validate the benefits that are realized from a sustainable supply chain strategy.

Conflict Minerals Sessions

The topic of conflict minerals was prevalent at the conference and spread over a number of sessions. Topics ranged from legal ramifications, IT support, and training. It was clear from the attendances of these breakout sessions how encompassing the endeavor is to report out conflict minerals.

Take-aways

1. Anticipation of an increase in the scope of conflict minerals legislation and place of origin

Currently, the conflict mineral legislation only applies to four minerals that come from the Democratic Republic of the Congo (DRC). It is expected that there may be other minerals and countries added in the future that companies should prepare for.^{132, 133}

Influence on Research

The themes throughout the conflict mineral sessions reassured the team that it was important to develop a more sustainable supply chain to mitigate risks.

Net Impact Sessions

Forward-Looking Finance: How to Make Capitalism More Sustainable

Focused on transforming conventional business models, economic frameworks, and financial practices to ensure that meaningful community and natural capital value is created along with financial returns in the short, medium, and long terms. Innovative approaches such as instituting an internal price on carbon, accounting for ecosystem services, and re-envisioning financial institutions were introduced.

Take-aways

1. Current status of finance

The dominant paradigm for the economy is focused on shareholder value, quarterly growth, and a market that operates on information and encourages transparency. Key missing pieces from this view are civic engagement, ecosystems, and the provisioning services of nature.

2. Case Study #1: Walt Disney Company – Internal Price on Carbon

The Walt Disney Company has a legacy of caring for the environment and a track record of environmental actions. In 2007, an Environmental Council of senior executives created environmental goals that intended to change the business model and spur innovation. One of those goals was to have zero net direct carbon emissions and by 2012, the company was about half way to this goal. In 2009, an internal price on carbon was implemented. In this scheme, each business unit pays for what it emits as part of capital planning. The generated funds go into a fund for carbon offsets, which not only increase carbon sequestration but also provide benefits to local communities and biodiversity. The approach to the pricing uses current market conditions for carbon. A major challenge to the system is how to get past hurdle rates for less carbon intensive technologies. An example was given of the new cruise ships where new fuels did not meet the hurdle rate. As emissions still needed to be reduced, efficiency needed to improve.

3. Case Study #2: One Pacific Coast Bank

One Pacific Coast Bank is a triple bottom line bank that is largely commercial, lending to non-profits and companies that are interested in positive impacts. The bank sees the need to account for financial actors in the supply chain. SASB reporting was given as a way to report the corporate value, performance quality, and sustainability for each product.

4. How to measure sustainability and work it into corporate strategy

Measurement of sustainability should be quantitative whenever possible and the life-cycle analysis and holistic view should be taken and brought into society. A major question is the role of measurement in moving value down the supply chain. In Europe, SRI is critical and moving forward it may become increasingly important in the U.S.

5. How to pursue integrated reporting

The presenter from SAP, a business software and cloud company, shared three lessons for pursuing integrated reporting: 1) using education to change the mindset towards collaboration and consensus building, 2) execution of the reporting by starting to quantify non-financial components and performance, and 3) the evolution of integrating business innovation and sustainability strategy. In terms of shareholder context around goal setting and getting shareholders to start asking sustainability questions, transparency is key, as is having a path or progression in place. Education of shareholders must take place and the company must start driving the change by talking the same language as the customers it is trying to reach.

Influence on Research

It directly addressed a company that has implemented one of the team's recommendations, placing an internal price on carbon. It also gave a sense of where the business community might be headed in terms of reporting and quantifying non-traditional resources and services.

When Nations Fail, States Prevail: Cutting-Edge Climate Legislation

Focused on how states are making strides in the battle against climate change while national energy policy has stalled. Presenters discussed if the state models, such as those in California and Colorado, that have led the country in legislative action to slow climate change could offer models that could catch on beyond state borders and if the models can overcome the political obstacles and implement change at the national and global level.

Take-aways

1. States are leading the charge on climate legislation

California and Colorado have been leading the country in climate legislation. California is pushing for 30 percent procurement of renewables and incentivizing storage by granting money strictly for this purpose. Colorado is also pursuing a 30 percent renewables policy not due to a renewable portfolio standard (RPS) but because it is economically logical. In addition, California and others have announced a plan to link California and Vermont with EV charging stations in order to reduce carbon and health impacts associated with car emissions and to pursue national energy independence.

2. Changes will come with different incentives for utilities, functional regional networks, and EPA legislation

Utilities need to be incentivized not on the number of kilowatt-hours sold, but on their investments in efficiency and clean technology. In addition, regional networks need to be strengthened. At the current time in the WCI, there is a disincentive to join, as there is no resistance for state governors that leave the group. Federal legislation is moving forward through the EPA capping emissions from coal plants.

3. The breakdown of utilities in the next 20 years will spur changes in the energy system and distributed generation will predominate

Influence on Research

As part of the justification for placing an internal price on carbon is due to regulatory risk, this session helped establish where regulations that affect companies might come from. Looking at states where GM is located can help give a better picture of what costs might be associated with its carbon footprint.

Driving Sustainability into Core Business Strategy

Discussed how Unilever, Autodesk, and Patagonia have led their industries in embedding sustainability throughout business operations to create long term value. Speakers shared advice on raising sustainability to a strategic level and driving growth and innovation as a result.

Take-aways

1. Building a sustainability culture needs to be championed at top levels for success, but it can be triggered by bottom-up motivation

Building a sustainability culture within an organization requires executive leadership, as what management says drives the business model. Without top-level interest, sustainability will not become a priority. However, bottom-up motivation can help to trigger this type of top-down vision. In addition, it is helpful to have both a sustainability team and also the integration of sustainability in other units of the company.

2. Consumer behavior change is vital to improving sustainability

70 percent of a product's impact is in the use phase. Without consumer behavior change, which is difficult to produce, sustainability will never reach its full potential.

3. Accelerating change is a growth issue

A major hurdle is how to be sustainable and not grow. The Responsible Economy Campaign addresses population growth and the growth of the middle class and demonstrates industry change so that everyone follows suit. In terms of the local movement, it is not scalable and it does not produce the large change seen in large companies.

Influence on Research

While not directly related to team research and recommendations, this session provided a better understanding of how sustainability might work within companies. It allowed team members to better understand how sustainability becomes part of the culture and validated the main purpose of presenting findings to top-level executives within the company.

Nature's Balance Sheet: Incorporating Natural Capital

Explored how private sector companies are developing approaches to understanding their impacts and dependencies on natural capital, including accounting for the natural resources consumed in the production of goods and services.

Take-aways

1. There is a business case for valuing natural capital

Valuing natural capital is an extremely new field and the reporting on it makes it a target for criticism. Valuing natural capital helps manage the unavoidable and helps avoid the unmanageable. In addition, the cost of managing natural systems is usually much less than managing constructed ones, for example maintaining wetlands rather than constructing a water filtration facility.

2. Reductions need to be put in terms of availability to better understand risk

Influence on Research

Helped the team gain a better sense of some of the risks valuing natural resources and impacts can help mitigate.

The Great Convergence: How Collaboration Can Transform Sustainability

Addressed how leading companies are creating new cross-sector collaboration and harnessing rapid technological transformation to drive mainstream sustainable behaviors.

Take-aways

1. Ford goals were based off of IPCC emission reduction targets

Ford used emission reduction targets set by the IPCC to determine long-term sustainability goals. These long-term plans were sold within the company by translating them into business terms, such as lowering the volatility in planning.

2. Potential technologies can help create new collaboration

An example of a potential collaboration is the use of EVS. It could be possible to use the charged car battery to run appliances, heating, air conditioning, and other functions within a house as well as charge during off-peak hours when energy is cheapest.

Influence on Research

Demonstrated how to pose long-term goals within a company as well as creative ways to work across sectors.

Exploring Sustainability at California's Energy Utilities

Devoted to the emerging sustainability issues and opportunities facing California's energy utilities and how utilities are collaborating to address these issues and embrace a sustainability mindset. The session led attendees through an exercise exploring these "material" issues in more depth.

Take-aways

1. Energy efficiency is a huge policy focus in California

In order to pursue the goal of reduce greenhouse gas emissions to 1990 levels by 2020, California has a RPS that mandates 33 percent renewables by 2020 for utilities.

2. Matrices are used to show what issues are important

Using a matrix to determine the materiality of sustainability issues that impact certain industries and companies helps focus on things that will have the largest impact. In order to determine the key issues affecting a business for long-term sustainability, a company should conduct a materiality assessment by asking stakeholders about issues and determining the biggest risks from the business side.

Influence on Research

The idea of using a matrix to determine issue importance reinforced the team's decision to use a criticality and viability framework to evaluate different recommendations and potential initiatives for GM.

Supply Chains of Scale: Creating Value Through Sustainability

Sprint, Starbucks, and UPS gave perspectives on what companies face when balancing environmental concerns with profits and quality in supply chains and how small decisions can have large effects.

Take-aways

1. Sustainability in the supply chain is important because more of the use of resources is embedded here

In addition to addressing the use of resources, the transparency and visibility that comes with sustainability helps create value in relationship between companies and their suppliers. It encourages long-term relationships and helps individual suppliers to see the value outside of the larger company. Where a company's money goes determines where to place focus on developing relationships.

2. It is important for companies to not only collect information but to also provide resources to answer questions from suppliers

Supplier surveys can be relatively simple, asking questions such as if the supplier calculates their carbon footprint and if they have an environmental management system, but help to show if a supplier is on the same path as the company. Companies try to get rid of suppliers that are continually not on the same path but are interested in helping suppliers see value and work through issues. By creating a supplier handbook that is easily accessible, a company is able to give feedback to suppliers on performance in comparison to others and share best practices. In addition, companies can put financing mechanisms in place to help their suppliers comply with new criteria set by the company.

Influence on Research

Validated the team's decision to look at creating a sustainable supply chain strategy. It gave an overview of what a company might gain from tracking its suppliers and how to make this type of program successful.

Appendix B

Initial Supporting Statements

Monetizing Carbon

- Make GM the leading American OEM in sustainability strategy and initiatives by leveraging lessons learned from other innovative companies
- Enhance its brand equity and marketplace success by supporting its pursuit of its five principles:
 - Safety and Quality First, e.g., will attract and retain the best employees given commitment to their workplace safety and their values
 - Create Lifelong Customers, e.g., GM shares their cost and environmental consciousness
 - Innovate, e.g., GM will be the first/leading American OEM to pursue such exciting goals; added metrics will foster innovation both within and between verticals
 - Deliver Long-Term Investment Value, e.g., GM is committed to minimizing idiosyncratic risk and costs while maximizing market access and penetration
 - Make a Positive Difference, e.g., GM will secure its reputation as a leader in social and environmental responsibility
- Mitigate financial risk associated with a) fluctuations in global oil prices and b) penalties for emitting more carbon than their credits allow (under cap-and-trade)
- Mitigate operational risk associated with license-to-operate in resource-constrained geographies (e.g., China)
- Support the expansion of GM's accounting scope and implementation of a supply chain sustainability strategy (per below)
- Opens up doors to other marketing opportunities (e.g., SmartWay Program Logo)
- Would help make the case for joining the SmartWay Program (logistics standpoint)
- Increase capacity to identify risk

Accounting Scope

- Enable GM to meet its target of generating 125 MW of renewable energy by 2020 by reducing the payback period, therefore increasing its prioritization vs. other projects competing for funds
- Allow GM to take a slightly longer-term view on maximizing value
- Unlock cost savings opportunities by sourcing renewable supply through PPAs
- Unlock cost savings opportunities by pursuing the “high-hanging fruit” energy efficiency projects

Supply Chain Sustainability Strategy

- Mitigate financial, operational, and reputational risk by increasing transparency along the supply chain about suppliers' practices and externalities
- Enhance brand equity with customers, NGOs, and SRIs by a) enabling the optimization of sourcing decisions around social/environmental impact, as well as by b) creating a channel for communicating successes in sustainability throughout GM's supply chain
- Mitigate operational risk associated with license-to-operate in resource-constrained geographies (e.g., China)
- Allow GM to be proactive in dealing with any issues in supply chain/helping suppliers make adjustments, e.g., avoid what happened with Conflict Minerals legislation
- Support the case for joining the SmartWay Program (logistics standpoint)

White Paper

See below

THE BUSINESS CASE FOR SUSTAINABILITY AT GM

IMPLEMENTING AN INTERNAL PRICE ON CARBON AND A SUSTAINABLE SUPPLY CHAIN SYSTEM



RECOMMENDATION	INTERNAL PRICE ON CARBON	SUSTAINABLE SUPPLY CHAIN STRATEGY
DESCRIPTION	A monetary value on carbon to serve as an internal tax or decision-making tool to identify the most cost-effective carbon reduction strategies	A strategy that uses a database to track performance metrics of suppliers in areas material to GM's sustainability efforts
BENEFITS FOR GM	<ul style="list-style-type: none"> · Achieving a smaller carbon footprint and energy efficiency gains at reduced costs · Reduced regulatory risk for carbon markets and taxes · Improved transparency in carbon mitigation metrics 	<ul style="list-style-type: none"> · Ability to track supplier performance over time · Reduced operational risk by identifying and sharing best practices · Reduced risk for supply chain disruptions

WHAT is a sustainability business case?

For the purpose of this report, a sustainability business case is defined as:

Justifying sustainability initiatives in terms of the business value that they will create –for example, through expected dollars saved or earned, or risks mitigated –thus making those initiatives attractive to profit-maximizing corporations.

WHY is sustainability important for the future of GM?

Beyond the social and environmental benefits generated from sustainability initiatives, these same metrics are becoming increasingly important for corporate reputations and bottom-lines. A number of green ranking systems, including the Dow Jones Sustainability Index and the Carbon Disclosure Project, assess companies on their sustainability performance, influencing consumer and investors, particularly the growing number of Socially Responsible Investors (SRIs). In addition to improved brand value, sustainability initiatives also serve to reduce long-term costs and mitigate significant operational, regulatory, and financial risk.

HOW can GM most effectively pursue sustainability?

To allow GM to continually achieve and even exceed their sustainability goals, the company should implement the following recommendations:

- An Internal Price on Carbon
- A Sustainable Supply Chain Strategy

IMPLEMENTING THESE RECOMMENDATIONS WILL ALLOW GM TO...

...REDUCE EMISSIONS COST-EFFECTIVELY

Within the last several years, the number of companies implementing an internal price on carbon as a means to achieve their sustainability goals has exploded. These companies cite the implemented the metric to achieve reduced costs, a more streamlined decision-making process, and a more effective comparison of between traditional projects and those that provide sustainability benefits.

...MITIGATE REGULATORY RISK

While reduced costs and improved decision-making serve as powerful incentives for any company to implement an internal price on carbon, the metric also serves to reduce a company's exposure to regulatory risks. Across the globe, we are witnessing carbon regulation becoming increasingly common throughout countries or across regions, particularly in Asia where carbon markets are emerging in South Korea and China. As an international company, an internal price on carbon can help a company prepare for these existing and upcoming regulations by valuing carbon internally.

...ADVANCE ITS POSITION AS AN INDUSTRY LEADER



Spanning industries, companies such as Shell, Disney, and Microsoft, have all announced their use of an internal carbon price, but the strategy has yet to be implemented in the automotive sector. Therefore, implementing an internal price on carbon would not only allow GM to actualize the many benefits discussed above, but this initiative would reinforce GM's role as an industry leader and further advance the company's brand value.

...STREAMLINE REGULATORY COMPLIANCE

GM, like all OEMs, recently had to develop a way of tracking conflict minerals throughout their supply chain as a result of legislation passed by the SEC. A database was created and distributed to suppliers to assess their use of conflict minerals and GM's subsequent exposure to operational risk. However, expanding this database to include other metrics, such as carbon, would allow GM to meet these compliance standards more quickly and at lower costs.

...EXCEED INDUSTRY STANDARDS

Recently, AIAG recently

developed a Supplier Sustainability Self-Assessment (SSSA)



tool to determine

whether suppliers had policies in place for a

range of subjects, including Human Rights, the Environment, and Ethics. While it is important to understand the policies regulating supplier performance, a Sustainable Supply Chain Strategy would go beyond just the policies and track issues that are material to GM's overall operations.

...REDUCE OPERATIONAL RISK

The SSCS could track issues, such as the carbon emissions, energy demands, and water use of GM's suppliers. This information can then be used by GM to pinpoint their most efficient suppliers, identify what policies are in place within these operations, and then share these best practices with less efficient suppliers. GM would also have the ability to classify suppliers as High, Medium, or Low risk based on other criteria. For instance, some regulations may be limiting the supplier's ability to obtain resources, like in water-stressed areas of China, which could threaten the supplier's ability to operate and create supply chain disruptions.

While an internal price on carbon has proven to be beneficial for other companies and supply chain strategies have been successfully implemented for parts of GM's operations (i.e. conflict minerals), it is necessary to determine how these recommendations would impact GM specifically and as a whole. To accomplish this, the recommendations were assessed in their ability to satisfy the following:

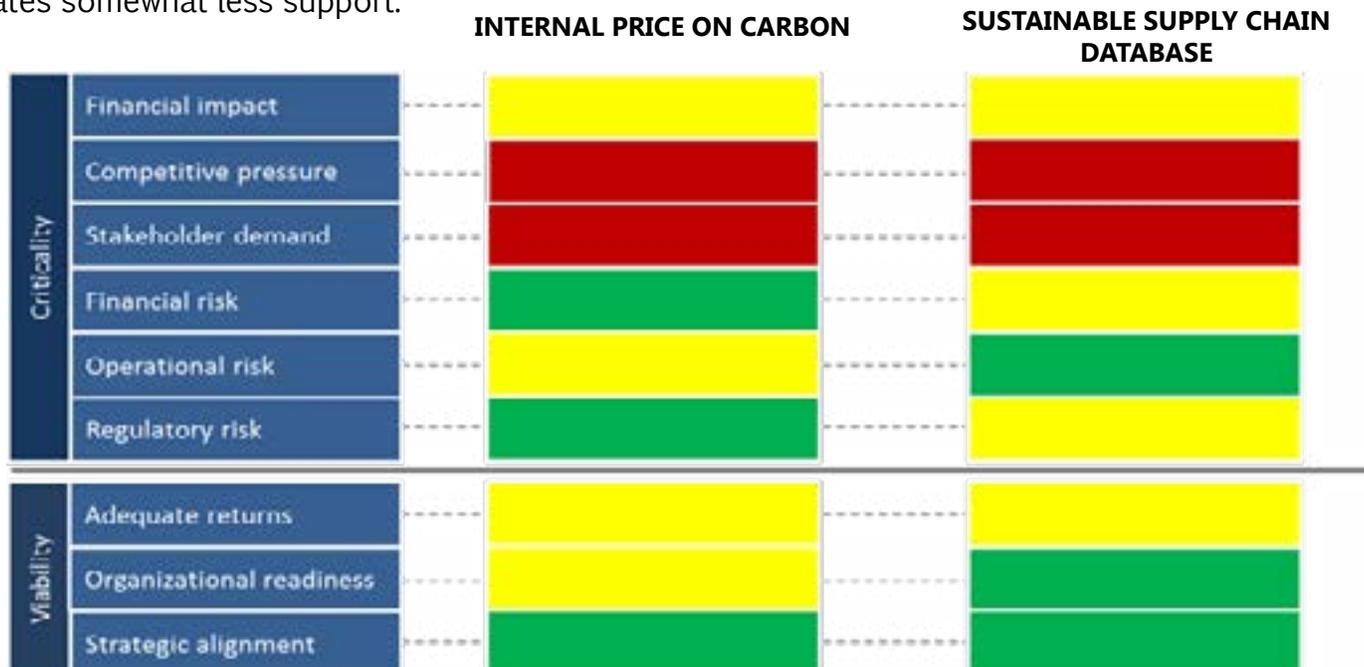
1. Enable GM to quantify the financial risk associated with carbon taxes and permits, domestically and internationally
2. Help GM to mitigate operational risk in resource-constrained and/or highly-polluted geographies
3. Unlock potential energy cost savings amidst rising usage and prices
4. Enable GM to quantify and mitigate financial risk surrounding suppliers' practices and externalities
5. Enable GM to mitigate operational risk associated with suppliers' practices and externalities

EVALUATING THE THE RECOMMENDATIONS IN TERMS OF THEIR CRITICALITY AND VIABILITY AT GM

Based on the results of the five analyses, each recommendation was scored based on two criteria:

- **Criticality** - how the recommendation impacts GM's operations (ex/ mitigating risk, satisfying stakeholder demands)
- **Viability** - how the recommendation fits within GM's corporate structure and policies (ex/ producing adequate financial returns, aligning with corporate strategies)

For each metric within Criticality and Viability, the scores for each recommendation were divided into three categories: Green indicates strong support, Yellow indicates moderate support, and Red indicates somewhat less support.



CONCLUSION

Implementing an internal price on carbon will allow GM to reduce its exposure to financial and regulatory risk, while a sustainable supply chain strategy will mitigate operational risk. As discussed previously, many other benefits exist for each recommendation independently and these are only amplified when the two are implemented jointly. While the metrics of competitive pressure and stakeholder demand are lower than other metrics, these pressures are expected to increase. However, GM could capitalize on the fact that their competitors are lacking these sustainability metrics and quickly advance their position as an industry leader for sustainability. An internal price on carbon and a sustainable supply chain strategy are both extremely viable options within GM and could have a tremendously positive impact on the company's performance and perception.

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