Climate Adaptation analyses for industries in Great Lakes

A Business resilience report

Rahul Tapariya, Deepika Mutukuri

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1. Executive Summary

The Great Lakes region holds tremendous importance in the national and international communities. As it spans over a great part of Northern America and Canada, it is not surprising that it is an integral part of the lives of over 45 million people[i]. Rich ecological diversity, accessible terrains and ports have been significant contributors in making the region the hub of trillion dollar US economy (in excess of $4 trillion)[ii]. As the effects of climate change become increasingly severe in the world, the region does not remain unaffected. Rising temperatures and changes in precipitation patterns may have led to the loss of over 80% of the wetland regions (IL, IN, OH; Mitsch and Gosselink 2007)[iii].

Economic costs to businesses are huge due to disruption from climate events, ranging from $66M - $700M[iv], as they become aware of adaptation needs to changing weather patterns.

This project aims to initiate the debate and discussion about climate resilience/adaptation among industries operating in the Great Lakes region. Our goal is to analyze current awareness of businesses towards changing climate events and catalogue their responses and costs towards such physical changes in climate. This analyses would provide a starting point for further studies in future to identify best practices towards climate resilience as shown by pioneer industries in the region. We have combined and presented publicly available data for three such pioneer companies in form of case studies that eases understanding of business impact and actions by companies. As necessary, next phase of work could include taking the analyses a step further and involve these industries into dialogue through surveys and interviews to build a comprehensive understanding of climate resilience actions. We also declare that all opinions stated in this report are a result of our secondary research of companies through their publicly available reports and as such, these interpretations are subject to change from future research, surveys or interviews with these companies. Additionally, there could be additions to our findings through reporting of minor data that are otherwise not publicly quoted in disclosures or financial reports.

2. Introduction

2.1 Great lakes

The Great lakes region- encompassing the Great Lakes water shed basin, and its lake boundaries, spans the countries of North America and Canada. The US states of Michigan, Ohio, Pennsylvania, Illinois, Minnesota, New York and Wisconsin and the Canadian province of Ontario fall under the great lakes region[v]. A unique feature of the great lakes region is one of the largest reserve of surface fresh water- nearly one-fifth of the world's total reserve.[vi]

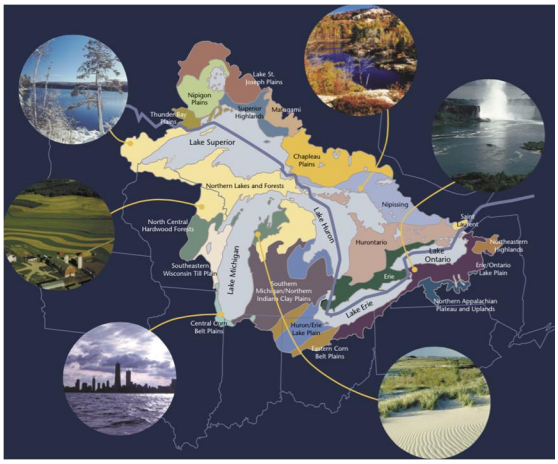


Figure 1: A pictorial representation of the diversity in and around the great lakes region. Source: Confronting Climate Change in the Great Lakes, Union of Concerned Scientists

Not only is the region the backbone of the nation's freshwater supply reserve, but it also is an area of continued economic growth. Great economic diversity, accessible terrains, navigation channels and waterways along with excellent port facilities have made the region home to some of the most diverse set of industries. As evident from figure 3, Great Lakes is home to a diverse range of industries with major contributions shared by Manufacturing, Services, Trade and Financial/Insurance/Real Estate sectors. Such is

the economic boom in the region that the according to the Brookings Institute, "if it stood alone as a country the Great Lakes region would be one of the largest economic units on the earth (with a $4.5-trillion gross regional product)."[vii]

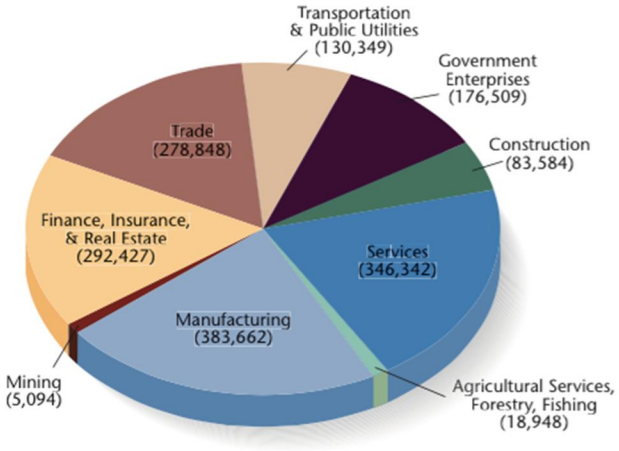


Figure 2: Great Lakes as the third largest Economy in the world (Million US dollar contributions per sector in the region) Source: Confronting Climate Change in the Great Lakes, Union of Concerned Scientists

As evident from figure 3, Great Lakes is home to a diverse range of industries with major contributions shared by Manufacturing, Services, Trade and Financial/Insurance/Real Estate sectors.

2.2 Climate Change and Great Lakes

The issue of climate change that was once widely contested has proven to hold true. The weather pattern of the world is slowly but surely shifting. The key player in this, among others, continues to be due the emission of "greenhouse gases (GHG)". As more and more greenhouse gases continue to accumulate in the atmosphere, temperatures, precipitation patterns and water chemistry in different regions of the world will be altered.[viii] These will in turn trickle down to effect geographical resources such as freshwater supply, ecology and even society and economy. Although, the importance of

this has now been understood and steps are being taken to reduce greenhouse emissions, fact remains that since the industrial era, there has been enough carbon dioxide emitted into the atmosphere that has already set the climate change wheels into motion. Any new steps, though effective, will have to face a period of inertia before their efficacy kicks in. Thus, climate change adaptation faces an urgency with which companies and governments need to respond with.

Climate change resilience and adaptation measures to be truly effective need to be considered not only at the global level, but also at the local level. Climate change for the great lakes region is already knocking at our doorsteps. Ample evidence suggests changing temperature conditions in the great lakes region, with winters becoming progressively shorter and decreasing ice cover.[ix] [x] On one hand warmer conditions would lead to productivity of crops and lesser energy utilization. But the positive effects are greatly undermined by the negative effects of climate change. The ecology of the great lakes rests on a delicate balance, which can be easily shifted, with changing weather conditions. Warmer climate causes an increased flux of invasive species that would threaten the aboriginal species and ecology of the region. [xixii]

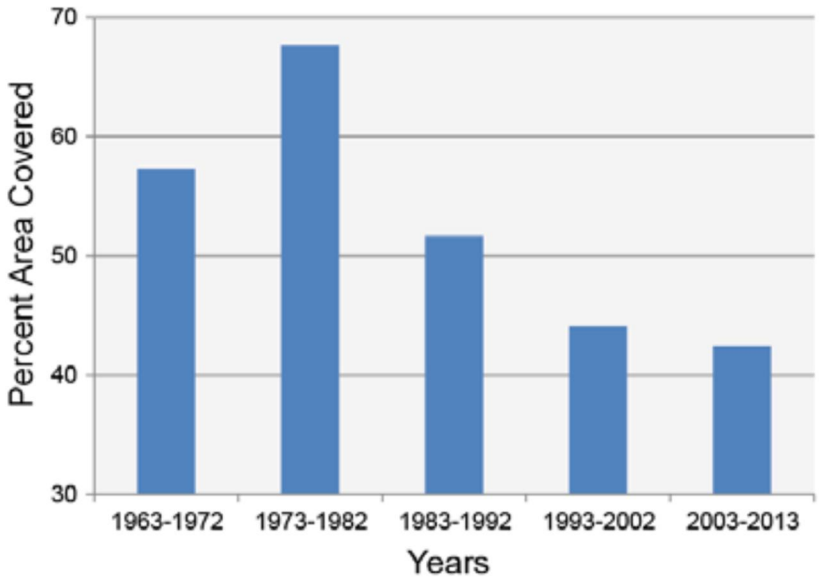


Figure 3: Average Ice Cover in the Great Lakes.
Source: National Climate Adaptability report, 2014

2.3 Business case for Adaptation

Great Lakes influence the climate of states adjacent to them to varying degrees. Taking an example of Michigan, 35% of US/Canada annual trade flows through it.[iv] Michigan's proximity to the Great Lakes has a profound influence on its weather and climate.[xiii] As reported in the Nature Conservancy article, future climate impacts and threats to Great Lakes include:

1. "Increase in annual average temperatures in the Great Lakes region – Great Lakes region experienced a 2.3°F (1.3°C) increase between 1968 and 2002. A 1.8 to 5.4°F (1 – 3°C) is projected by 2050"[xiv].
2. "Reducing duration of Great Lakes ice cover as air and water temperatures rise – Overall there has been a 71% reduction in the extent of Great Lakes ice cover between 1973 and 2010, led by losses by Lake Superior." [xiv]
3. "Heavy precipitation events becoming heavier – Between 1958 and 2007, the heaviest 1% of rain events increased by 31% in the MidWest resulting in more flooding, runoff, and sediment and nutrient loading impacts."[xiv]

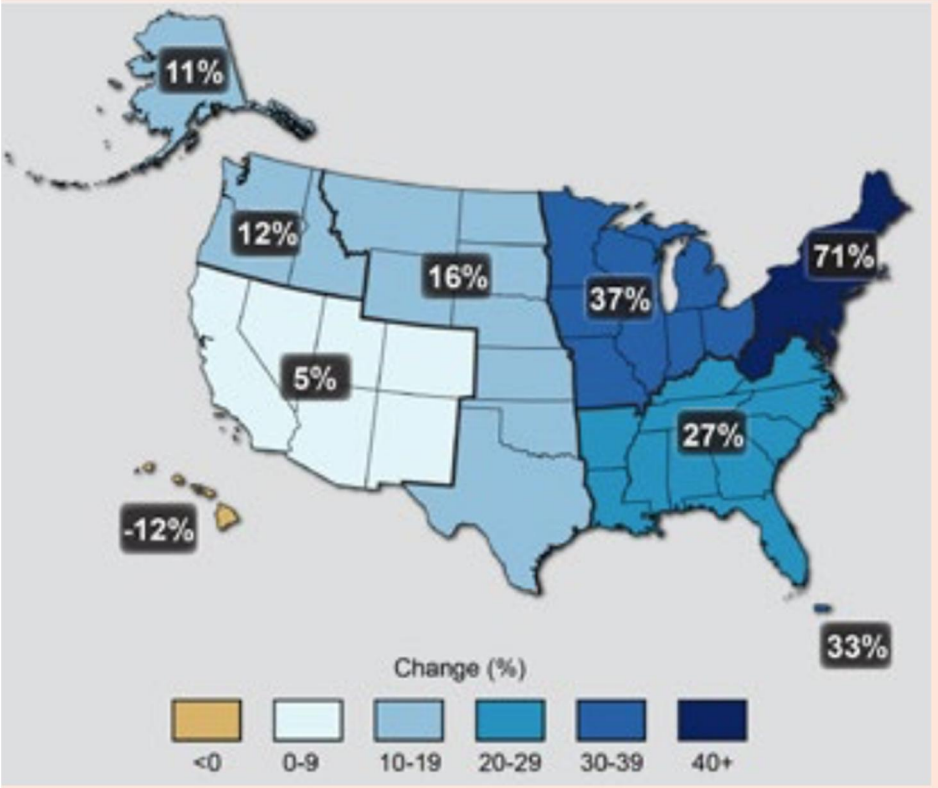


Figure 4: Graph representing the changes in precipitation in United States from 1958 to 2012.
Source: National Climate assessment Report, 2014: http://nca2014.globalchange.gov/report

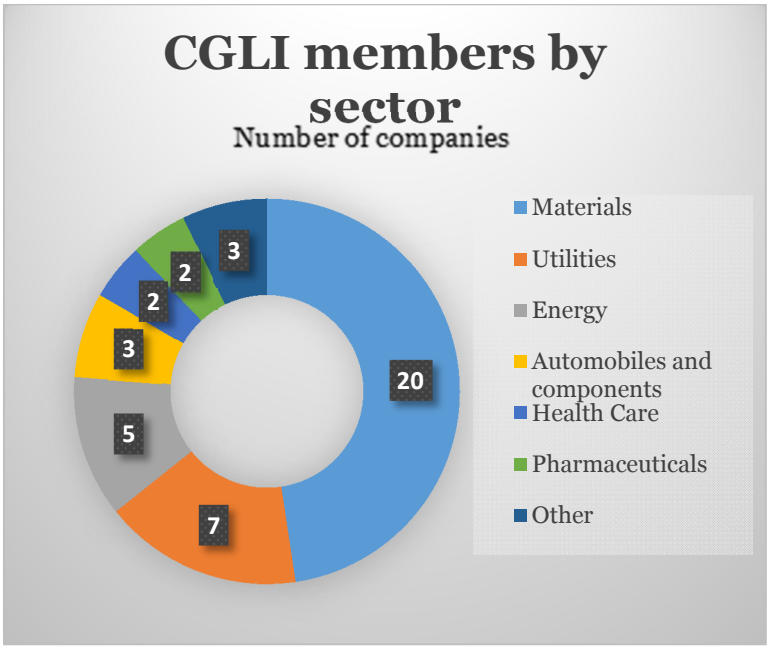
There is compelling evidence about increasing risks of these costly weather events. According to a study prepared by American Highway Users Alliance by IHS Global Insight, "economic costs of disruption from a snow storm is $66 - $700 million per day in some states - $251M for Michigan – for just a one day shutdown due to impassable roads"[iv]. The winter experienced in early 2014 is another example, which according to experts haven't been witnessed since the last three decades.

Based on our studies, we found that most companies are well aware of the risks that climate change poses on business opportunities. Companies also recognize the growing interest of shareholders, consumers and even governmental and regulatory bodies in reducing GHG emissions. Steps to mitigate if not nullify the impact of the risks are already in place[xv]. While climate resilience and mitigation is an important aspect, our study focuses on the climate adaptation practices that the companies are focusing on.

3. Methodology and approach

3.1 Industry classification

Our research started with the broad assessment of current member companies of CGLI. To begin with, we had to choose an industry classification to categorize member companies. Since Great Lakes houses large companies across multiple sectors, we needed a robust classification that would be universal (applicable to global companies), accurate (reflective of state of industries in equity investment space) and flexible (offers clear analyses from general sector to most specialized sub-industry). We selected Global Industry Classification Standard (GICS) as the standard to assign sectors to companies. Using GICS, we found that CGLI members represent a broad, cohort of S&P 500 companies (represented below)



Sectors (expanded into industry types)

Materials – Industrial manufacturing, Chemicals, Building materials and aggregates, Digital imaging, Papermaking

Utilities – Electric and Natural Gas utilities including coal

Energy – Oil and gas extraction, refining, renewables

Automobiles and components – Automotives and financial services

Health Care – Medical equipment manufacturing, healthcare

Pharmaceuticals – Pharmaceuticals, Biotechnology, Life Sciences

Other – Household and personal

Figure 5: CGLI member companies by sector

For the purpose of assessment in this report, we analyzed three sources of their public statements: their 2013 Sustainability reports submitted to Global Reporting Initiative (GRI), their 2014 climate change responses submitted to CDP and their 2012/2013 financial reports submitted to SEC (form 10-k).

We used two more criteria to derive the list of companies for deep dive – presence in Great Lakes basin and reporting abundance. As evident from chart below, we found that 38 out of total 42 member companies had offices/facilities in the GL basin region. Their grouping by sector has been provided below. Materials, Utilities and Energy form the three largest sectors, accounting for 74% of membership.

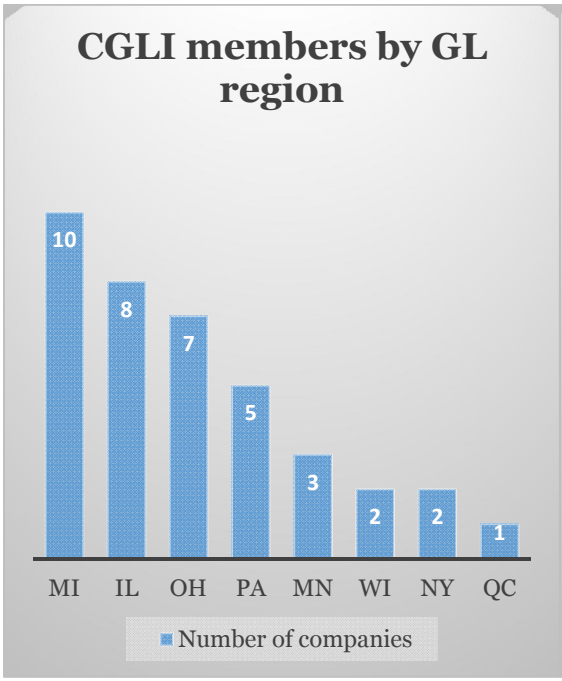


Figure 6: CGLI member companies by region

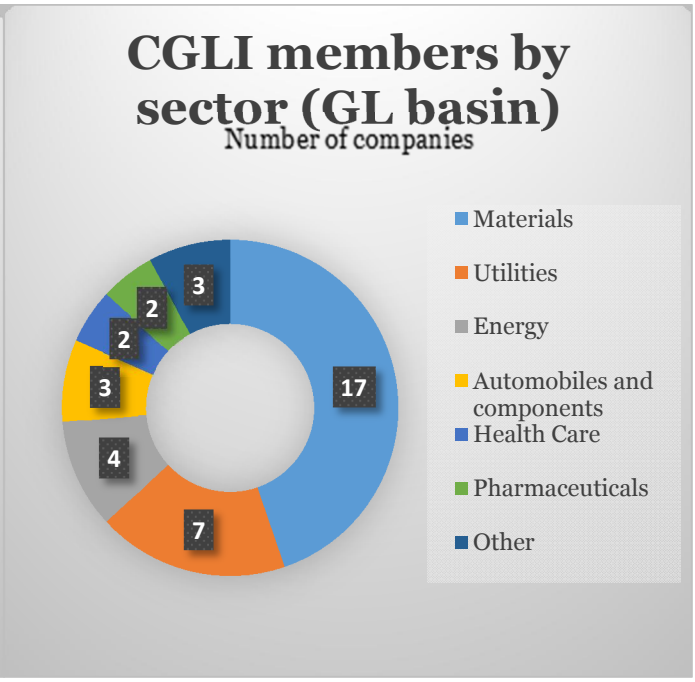
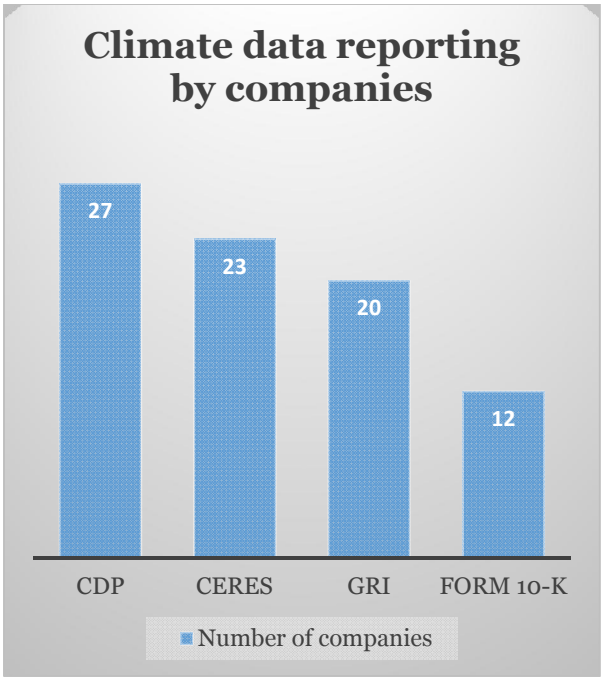


Figure 7: CGLI member companies by sector

We found that the CDP responses were the most exhaustive and had information about both mitigation and adaptation. Financial reports barely mentioned about business risks resulting from climate change, let alone estimates of implications and counter measures. The GRI report contained mitigation data and didn't include discussion on changing climate phenomena, thus making it difficult to glean any useful adaptation data. So, we further isolated companies that reported to CDP to do a deep dive on their reporting practices.



This represents an overlap of 38 companies with active operations in Great Lakes region that report to various climate databases. We find that companies are generally aware of risk related to climate change such as warmer temperatures, wetter climates or changes in precipitation levels. However, their degree of description varies across databases. For example, CDP disclosures contain extensive and detailed information on climate mitigation, adaptation and company's formal sustainability organizational structure. Of the companies that don't acknowledge climate change at all, they haven't provided any information on this factor in any of these databases.

Figure 8: Climate data reporting by companies in GL basin

The fact that limited number of companies have focused on adaptation issues in sustainability reports does indicate that the issue is not yet widely recognized among companies operating in Great Lakes basin. As quoted by Center of Climate and Energy Solutions (C2ES), "It may also be due to the fact that while sustainability reports tend to focus on the impacts of business on the environment, resilience is about the impact of the environment on the business."[xvi]

We took a deep dive into three member companies to understand their stand and response on adaptation to climate changes in Great Lakes region. We would like to highlight that the details mentioned below represent these companies' overall response towards adaptation at a company level and not necessarily constrained to the Great Lakes region. However, we have taken care to represent the adaptation actions to the typical climate change activities resembling to the Great Lakes climate activity and believe that the physical locations of presence for these companies in Great Lakes would be affected by similar climate phenomena (i.e. heavy precipitation, changes in temperature, snowfall) to elicit such response. This belief needs confirmation by contact with company representatives and would likely be taken up in next phase of research.

For ease of understanding, we divided the company analyses into five broad parts as listed below:

1. Background information
2. Acknowledgement of climate risk
3. Greatest concerns from climate risk
4. Climate risk management activities
5. Opportunities from managing climate risk

4. CDP Responses of Companies

4.1 Ecolab

Background info[xvii]

"Headquartered in St. Paul, Minnesota, Ecolab is a Global leader in water, hygiene and energy technologies and services that protect people and vital resources". [xvii] It's included in Materials sector in our industry classification. Ecolab is present in 44 countries across Europe, Americas, Middle East, Africa and Asia Pacific and generated annual revenues of $13.3B in 2013.[xvii]

Ecolab's core businesses are split into four major categories, of which Global Industrials (37%) and Global Institutional (32%) form the major business units by revenue share (2012). Global energy is the third largest unit with 26% revenues and others (5%) make up the rest of revenues generated in 2012. A brief description of each business unit is provided below:[xvii]

(a) Global industrial (37%) - consists of Global water, global food and beverage, global paper and global textile care operating units

(b) Global Institutional (32%) - consists of global institutional, global specialty and global healthvare operating units

(c) Global energy (26%) - consists of global energy operating unit

(d) Others (5%) - Global pest elimination and equipment care operating units

In Great Lakes, Ecolab has manufacturing presence in Illinois, Minnesota and Michigan.[xvii] However, we were unable to find the revenue breakdown for these regions from the available public data. We believe a further investigation with company executives/surveys would help provide that information.

Acknowledgement of climate risk[xviii]

Acknowledged in their financial report, they mention climate risk as **extraordinary events** (natural or manmade disasters, water shortages or severe weather conditions) that could indirectly impact their business by affecting their customers i.e. food, hospitality and travel industries. This could impact their supply chain operations and annual cash flows. They also mention about physical effects of climate change in their CDP disclosure.

Greatest concerns from climate risk

(a) Increased operational costs[xviii] - Changes in mean (average) temperature, precipitation pattern or in natural resources could increase cost of operations mostly through higher consumption of resources to maintain business-as-usual operations. A 3% increase in cost of electricity could result an operational cost increase of $1million across US facilities of Ecolab[xviii]. However, they don't consider this risk as financially material, based on their definition of materiality.[xvii]

(b) Reduction/disruption in production capacity[xviii] - Change in precipitation pattern could disrupt their production capacity. This includes the risk born by suppliers and customers of Ecolab whose supplies could be adversely affected by severe weather events. If raw material supplies are affected, short-term alternatives are usually more expensive and dent the bottomline profits.[xviii]

(c) Increased capital cost[xviii] – Capital costs, in form of contingency investments, also increase for suppliers due to extreme weather events or severe precipitation.

(d) Reduced demand of goods/services[xviii] - Negative effects of climate change could reduce tourism and lodging (A key market segment of their global business)

Climate risk management activities

(a) Create and Maintain Value (CMV) approach[xviii] – In Ecolab's words, "CMV is a continuous improvement process used by our sales engineers at customer locations to reduce energy and water use by installing state-of-the-art technology and improving the efficiency of existing equipment and systems"[xviii]. As reported in their 2014 climate change response to CDP, "we have completed more than 42 energy saving projects at multiple site locations. These projects included a variety of new, energy efficient equipment installations like higher efficiency boilers, air dryers and high efficiency building measures like HVAC units and improved lighting and insulation. These measures have reduced annual emissions by more than 1,862 tCO2e."[xviii]

Additionally, they also invest every year in operational improvements at some of their large projects. Historically, these investments have yielded significant cost savings ($1.8M in 2012 and $150,000 in 2013) with short payback periods averaging 2-5 years.[xviii]

(b) Active risk identification and budgeting for EHS expenses - As part of business-as-usual practice, they have developed an inventory of plants and locations to identify risks and management response, including a site selection process. They also maintain an annual budget expenditure for environmental, health and safety projects worldwide. An average $15M expenses (from years 2011-13) shows Ecolab's commitment towards continual measures to counter climate risks.[xix]

(c) Diversified supplier network and extensive database for material tracking – Ecolab has a two-step process for mitigating supply-related risks. First, they have a diversified supplier base spread across the globe to source raw materials needed for manufacturing. Diversification ensures that they are not critically dependent on a single supplier for sourcing needs. Second, they actively manage supplier contracts on an annual basis through a tracking database. This helps them predict volatility of supplies and annual contracts helps switch suppliers in case of prolonged issues. This cost is also included in their annual budget for environmental, health and safety budget.[xvii,xviii]

Opportunities from climate change

Increased demand of goods and services[xx] – Given Ecolab's business as a manufacturer of efficient water and hygiene technology products, they have used the resource conservation measures applied within industrial compounds to make even better energy and water saving products. This obviously increases their competitive advantage in the market. Some of their products that were modified for better resource savings include APEX TM warewashing system that helps restaurants save money through reduced washing costs,[xxi] 3D Trasar ™ technology that reduces maintenance costs of cooling towers through advance detection of issues and their mitigation through chemicals.[xxii]

4.2 General Motors

Background info[xxiii]

General Motors (GM) is a global Automotive and Components manufacturer, headquartered in Detroit, Michigan. They design, manufacture, market and distribute vehicles (cars, trucks and automobiles) and vehicle parts and also sell financial services. They are present in 157 countries across Europe, Americas, Middle East, Africa and Asia Pacific and generated annual revenues of $152.3 Billion in year 2012 ($6.2 Billion net profits).[xxiii]

GM is split into five business units based on geographical areas. GM North America accounts for their largest share of revenues (2012 numbers) at 58%. GM International Operations (17%), GM Europe (14%) and GM South America (10%) are the other three major business units across respective geographies. GM Financial (1%) is the growing financial arm of GM that sells insurance to consumers.[xxiii]

In Great Lakes, GM has manufacturing locations in Indiana, New York, Michigan and Ohio.[xxiii] They don't disclose the revenue share from these locations in their public disclosures. However, we believe this information could be gathered through in-person interviews.

Acknowledgement of climate risk[xxiv]

GM doesn't acknowledge any climate risk in their financial reports. However, they do mention risks due to changes in physical climate parameters under their annual CDP disclosures.

Greatest concerns from climate risk

Disruption in resource supplies – Although not specifically in the Great Lakes region, risk of water availability in water-stressed areas is a likely threat that could disrupt their operations in certain areas. Taking example of their production facility in Mexico that was hard hit by drought in 2012, such natural phenomena could recur within short time periods and cause difficulties in normal production routine. According to the estimate provided in their 2014 CDP disclosure, "one month disruption of GM's production in Mexico could result in loss of $27 Million in net income."[xxiv]

Climate risk management activities

(a) Investment for saving water - "GM has made a 2020 Manufacturing Commitment to reduce water use intensity by 15% (on a per vehicle basis) by 2020 (2010 baseline)". As shared in their CDP responses, they are consistently reducing their water usage despite growth in facilities and business (3.2% reduction in 2011, 7% reduction in 2013 both over 2010 baseline).[xxv]

Specific example: At their San Luis Potosi facility, GM has invested an additional $12M (over conventional water systems) to create a closed loop water system. Water extracted from underground water table, once used by plant, is sent to a Central Utilities Complex where it's treated for re-use. 90% of this treated water is re-used and remaining 10% is left off to evaporate.[xxv] As evident, the facility is able to reduce 90% of its water uptake by using the more resource efficient water system and also reduce wastewater emissions.

(b) Investment for saving energy – "GM implemented energy-saving initiatives in 2012 to comply with the 20% reduction in energy usage. The total estimated investment for the required generators is $4.4 Million."[xxv]

Opportunities from climate change

(a) Increased awareness and brand value in local community – Through their active water management at facilities located in water-stressed areas, GM has raised awareness in local community regarding efficient use of ground water. This has also increased their brand value for GM as a sustainability leader in the region (e.g. Mexico).

(b) Increased sales of goods/services – As the automotive world transitions to a more fuel efficient/hybrid/electric future, customers increasingly prefer such features in their vehicles. Car OEMs, thus benefit from their efficiency investments that boost brand image in eyes of a carbon-conscious consumer and increase sales. GM has made investments on similar grounds to increase their leadership in energy-efficiency. E.g. The Joinville Industrial Complex, in the state of Santa Catarina, Brazil is their new production facility that is LEED certified. Along with benefits of less energy consumption, it also has better wastewater treatment system that recycles water for industrial use and generates pure drinking water for household consumption.[xxvi]

4.3 American Electric Power

Background info[xxvii]

American Electric Power is a utilities company with its head quarters in Columbus, Ohio. It operates in different regions under different names- Appalachian Power (in Virginia, West Virginia), AEP Appalachian Power (in Tennessee), Indiana Michigan Power, Kentucky Power, Public Service Company of Oklahoma, and Southwestern Electric Power Company (in Arkansas, Louisiana and east Texas). It is one of the biggest players in the United states utilities sector owing to its 38 GW generating capacities. Its main sources for energy generation are coal, lignite, oil, and gas. A section of their energy demands are also met by renewables such as wind, solar, hydroelectric and biomass. In Great Lakes, AEP is present in Indiana and Ohio. From our research, we weren't able to get specific details about

revenues or operations of these locations and believe they could be addressed through in-person interviews or surveys at these plant locations.

Acknowledgement of climate risk[xxviii]

"Climate change has been one of the most significant sustainability issues facing AEP and influences both their short term and long term strategy".[xxix] Since energy industry is heavily regulated for generation, transmission and distribution of energy/electricity, any regulatory policy on climate change has a major influence on their business strategy.[xxviii] They term it as climate change in CDP disclosure but don't acknowledge it in their financial reports.

Greatest concerns from climate risk[xxviii]

(a) Reduced demand for goods/services[xxviii] – With temperature fluctuations and changing precipitation patterns, the demand for heating (and cooling) are bound to vary as per geographical location. As temperatures in the great lakes spike, the demand for power for heating reduces and consequently results in a loss for AEP. If past trends are any indication, mild weather has resulted in less power sales and lead to less income generation.

(b) Reduction/disruption in production capacity –Changes in precipitation patterns could have a tremendous impact on the production capacity of AEP. AEP supplies a part of their energy demands by using renewables as an energy source. It operates 16 hydroelectric power parts in various parts of the country , generating about 1,549 GW-hour annual power.[xxviii] Lesser precipitation has a domino effect in terms of lesser surface water flow and hence, lesser power generation. Reduced river flow also indirectly affects the thermal power generating units by affecting the cooling water supply. On the flipside, increased river flow could lead to transportation problems for resources (coal and other consumables).[xxviii]

(c) Increased capital costs – As per their CDP reports, changes in precipitation patterns would cost AEP $6 mm/year. - "Assuming a hypothetical $40/MWh incremental cost of replacement power if hydroelectric electricity needs to be replaced, a hypothetical 10%

reduction in hydro generation would cost AEP approximately $6 mm/year due to changes in precipitation events."[xxviii]

(d) Higher capital and O&M costs –

Precipitation pattern changes also could mean increased snow and rainfall. This could potentially cause damage to AEP equipment and problems in distribution and operations. This requires increased capital for management and repair.[xxviii]

Climate risk management activities[xxviii]

(a) Electricity loads are often volatile due to seasonality effect and personal preferences of customers and market prices fluctuate a lot depending on energy source and provider. Hence, AEP hedges itself against effect of such market and customer variability.[xxviii] Predicting temperature trends also allows AEP to be better prepared to expect increased demands, manufacturing and operational costs thereby taking measures to minimize the risk. As these measures are already a part of their management practices the expected costs are said to be minimal.[xxviii]

(b) The risks associated with climate change and weather variability are manifold. On one hand they affect AEP and their operations by increasing electricity demand, and enforcing higher grid reliability. On the other hand they can affect costumers by causing power outages and increased costs of utilities due to restoration charges.[xxviii]

(c) As AEP utilizes a variety of renewable energy sources to meet their energy demands, they predict that the effect of new restrictions on non-renewables, should they come into effect, would be minimal.[xxviii]

(d) Another way that AEP is incorporating climate change as a part of it business strategy is by implementing new design techniques and modifying their existing equipments to mitigate risks associated with climate change. For example, AEP has installed new replacement poles that would withstand higher wind speeds and higher ice

accumulations.[xxviii] This is particularly useful in the Great lakes where the ice cover has increased to a half inch from the previously reported quarter inch.

(e) Climate change impacts are not only short term but also have large implications for the long run. Taking these into account, AEP has taken measures to reduce their carbon footprint. As quoted in their CDP disclosure, "these measures include carbon pricing, greater dependence on renewable sources and building the first of its kind carbon storage and validation facility at Mountaineer Plant in West Virginia".[xxviii] They plan to decrease their coal dependence to 49% from the current 61% by 2026. As a result of these and other continued efforts their carbon dioxide emissions have reduced by 31% since 2000 and 21% since 2005.[xxviii]

Opportunities from climate change[xxviii]

Increased demand for services: Changes in temperature can lead to increased sales in regions with greatest demand. As temperature rises, the mean temperature peaks, cooling demands are bound to shoot up. Similarly in regions that suffer a temperature drop, demand for heating may increase. Either way, AEP's wholesale electric demand goes up and increases revenues.

5. Key findings

5.1 Risk identification from climate change

In our analyses, we found that companies in Utilities and Materials sector were most likely to acknowledge and understand the risks involved with changing physical climate parameters. This could be because of their nature of business that involves operations as one of the significant costs. Additionally, companies with facilities in coastal areas expressed concerns of tropical cyclones and storms that could disrupt their production capacity. We also found that companies in other sectors like Pharmaceuticals, Biotechnology and life sciences or Health care acknowledged climate risk but didn't factor it as a significant

disruption to their businesses. This could again be attributed to the lower cost of operations in their nature of business.

Companies were found to vary a lot in the manner of acknowledging climate risk. Terms like extraordinary events, climate change, business disruptions, and physical events were most frequently used to describe changes in climate parameters. This shows general tendency of businesses to acknowledge weather events by grouping these risks with other forms of unknown disruptions in their operations like storms, mechanical failures, IT system disruptions, war or terrorist actions.

When determining risks due to changing physical climate conditions, we found that disruption in production capacity, increase in operational costs and supply chain interruptions were the most frequently quoted risk types among all companies. Other risks like increase in capital costs to build better robust facilities or changing market conditions were less frequent.

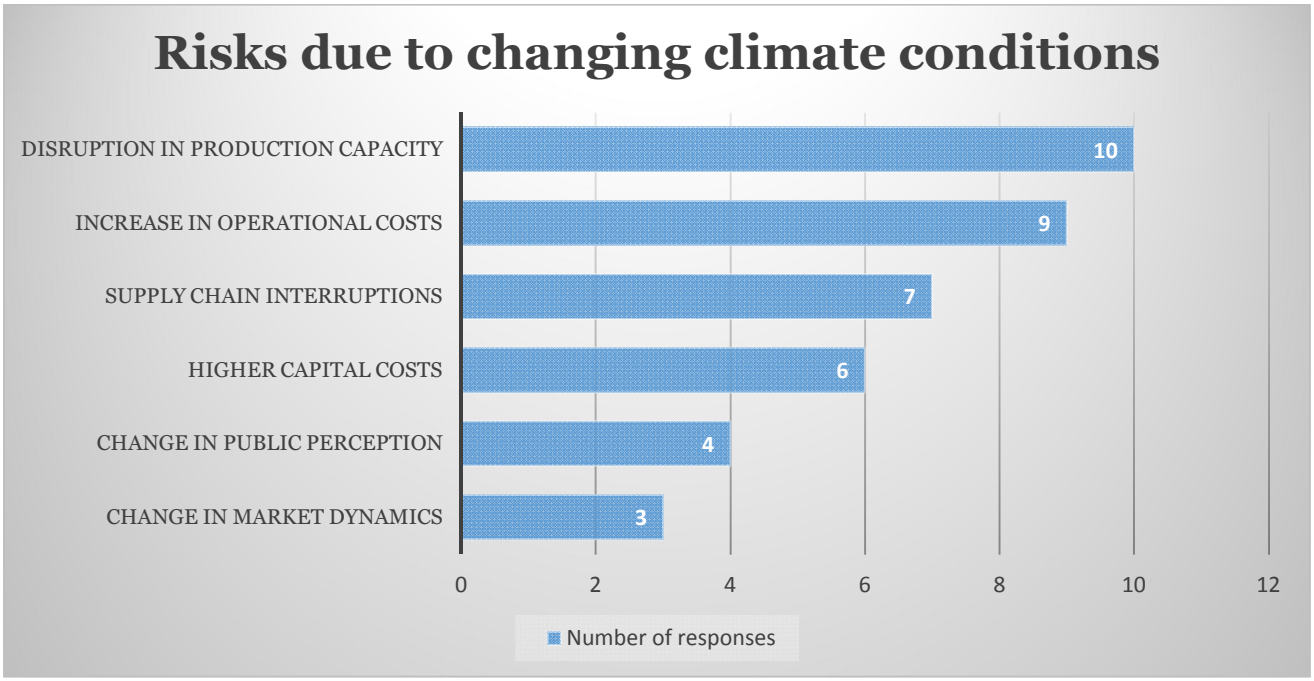


Figure 9: Risks acknowledged by companies due to changing climate conditions

As an example, "Baxter[xxx] recognizes a changing global climate due to global warming may cause changes in regional weather patterns (precipitation, droughts) and increased

frequency of extreme weather events (storms, hurricanes) may have adverse impacts on the total value chain (incl. acquisition of materials, supply chain, Baxter operations and logistics)." DuPont[xxxi] uses risk estimation measures to protect their agribusiness customers against changing precipitation patterns.

5.2 Timeframe of risk assessment

Majority of companies acknowledged some kind of risk associated with climate conditions. However, their estimates of risk impact varied widely. Companies were split evenly in their assessment of timeframe of risk impact. Very few companies noticed an immediate impact within less than 1 year, while larger number of companies responded with higher timelines (5 years or more). 3 companies didn't acknowledge a timespan and quoted lack of data availability and uncertainty of events as the prime reasons. We found that materials sector identified maximum number of risks that ranged from immediate impact to long-term impacts. Oil and Gas companies were on the other end of spectrum where they acknowledged risk but deemed it for impact in more than 5 years. Utilities sector, by virtue of their business cycle, identified risks that could impact their business in both short and long term horizons.

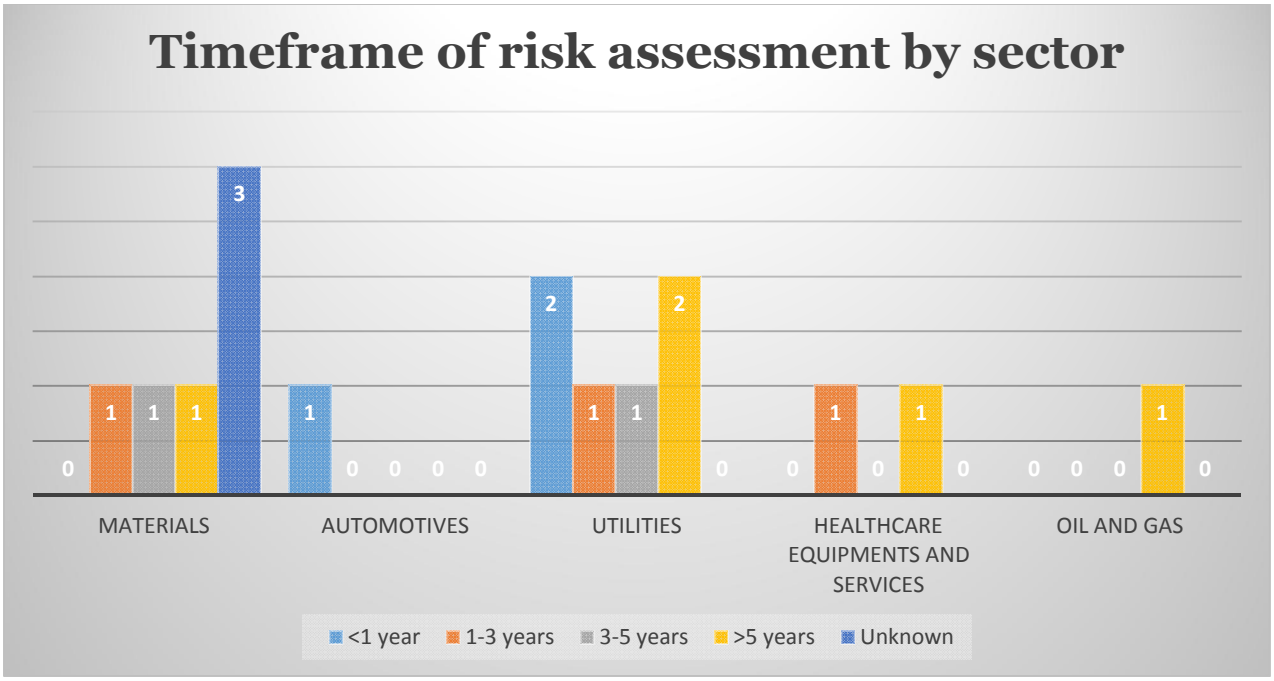


Figure 10: Time frame of risk assessment by companies across sectors

Quoting Du Pont, "we are unable to estimate the impact of any climate risk to their current business activities. Due to uncertainties regarding the type of climate risk, timing of occurrence and place, it's difficult to put a cost estimate for any contingency plan related to climate risks."[xxxi]

For Baxter,[xxx] the timeframe of induced changes in natural resources is more than 5 years. They acknowledge the risk of shortage for certain natural resources (water) and changes in land productivity as effects of climate change. However, it's not perceived as an immediate or instant threat.

5.3 Risk management actions

Across the board, companies tried to manage climate change risks as part of their conventional risk management. However, they also reported taking other actions specific to climate risk assessment and went as far as pre-emptively reducing their resource

consumption or building enhanced flexibility in supply chain to manage physical climate risks.

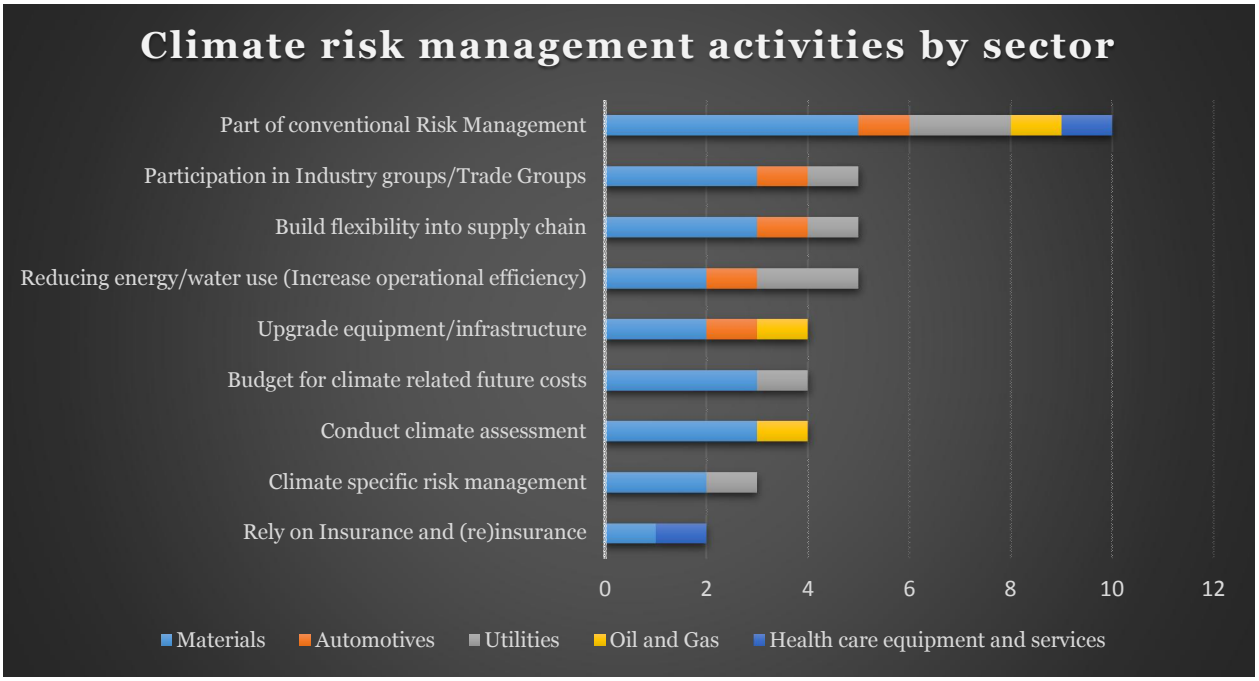


Figure 11: Climate risk management by companies across sectors

Our analyses suggests that all companies that acknowledge risks associate at least some of climate associated risks as part of their conventional risk management activities. Sector pioneers in Materials, Automotives and Utilities also participate in lots of industry groups to gain consensus and highlight their adaptation actions, along with building a flexible supply chain by reducing over-reliance on limited suppliers. Healthcare equipment and services sector relies primarily on insurance to cover their climate risk related costs.

5.4 Opportunities related to climate change

We found that a few companies not only acknowledged and actively managed risks, but actually took a step further to create business opportunities and emerge as winners in their sectors. The new opportunities created not only increased their demands for goods and

services but also helped them enter new markets and increase brand value as sustainability leaders.

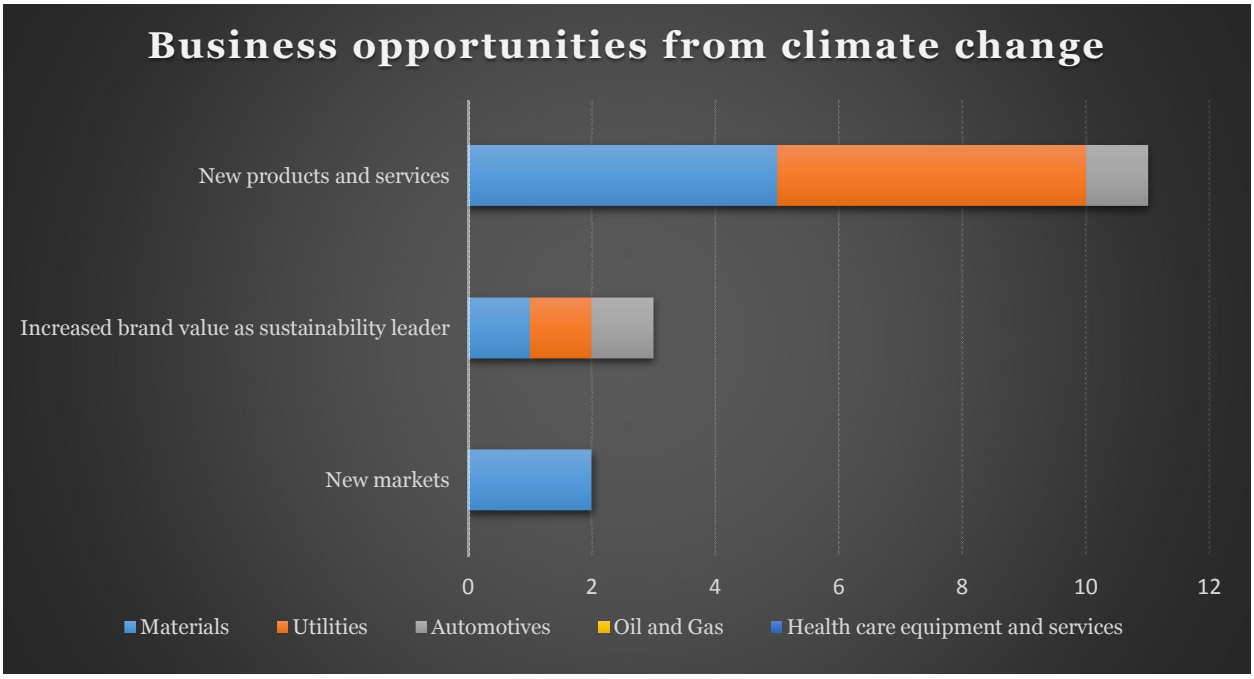


Figure 12: Business opportunities created from climate change across sectors

One of the best examples is chemicals company DuPont. In addition to their mitigation efforts, they see adaptation as an important precursor to new product opportunities.[xxxi]

Some examples of such modified products are Tyvek® Weatherization systems that provide excellent insulation for buildings[xxxii] or StormRoom® with Kevlar® (storm shelters reinforced with kevlar).[xxxiii]

5.5 Barriers to Climate change adaptability

Another aspect that we looked at was regarding what the companies understand to be the greatest barrier in tackling climate change. The uncertainty of weather events coupled with changing regulations and policies adds to the variability associated with climate change. This variability comes forth as the biggest problem when tackling climate change- across all sectors and size of companies. Other parameters include cost and lack of data availability. These factors though prevalent weren't identified as a serious concern.

5.6 Risks associated with climate change regulations

Apart from looking at the risks associated with climate change companies also tend to focus on the risks and opportunities driven by new and changing climate risks. It is interesting to note that companies identify this as more of a concern that changing physical parameters. This is evident from the time frame that regulatory factors were looked at- 1-3 years for most companies (physical risks associated with climate change ~ 6 years and greater). This includes companies like Dow, Baxter, American Electric Power and Ecolab. This shows that companies perceive this to be a more direct and certain driving force in their resilience and adaptability strategies. Some of the key factors that companies study are:

Carbon taxes
Regulations and taxes on fuel/energy
Cap trade and schemes
International agreement
Product efficiency regulations and standards

Each of the above risk is projected to increase operational costs for the companies. It is also important to note that potential cause of concern for each of the above factor varies from sector to sector. For example, as expected the energy and utilities sector is most affected by regulations on fuel and carbon taxes as compared to health and pharmaceuticals.

The method of management varies from company to company. For example, Ecolab identified that its fleet of vehicles would be affected by changing fuel regulations. For this reason, they are currently preparing for future increases in fuel costs by purchasing more hybrid cars and diesel engines, and smaller vehicles where they can still serve the necessary function. In the near term, they expect to pay higher prices for hybrid cars and diesel engines, but their hope is to offset all or part of that cost via reduced fuel costs.[xviii] For some other companies, like Baxter, the estimation of cost of management is much harder as these methods integrated into their overall strategy.[xxx]

5.7 Other factors

Some factors that every company looks at irrespective of the sector they belong to are:

i) Changing Consumer Behavior

As the issue of climate change becomes increasingly pervasive, more and more consumers are socially and economically aware of the fact. As a result, the demand for less energy intensive products is increasing. Another factor that plays a key role in changing consumer behavior is carbon taxes and fuel prices. As a method to reduce carbon footprint many countries are participating in CO2 pricing schemes. Thus it is expected that the demand for "greener" products will continue to increase in the markets.

ii) Reputation

As stakeholders become more aware and concerned about the implications of global warming and resulting climate change they will raise their expectations of company actions to responsibly address this issue. These stakeholders include customers, investors, suppliers, government agencies, NGOs, academic institutions and employees.

Most companies focus on providing "greener" services and products to show continued interest in building a clean tomorrow. American Electric Power does so by focusing and getting a part of its total energy supplied from renewable sources[xxviii]. General Motors, a automotive company invested approximately $7.2 billion in research and development activities in 2013 [xxiii]. They are actively looking at designing more fuel-efficient cars and vehicles. Another approach that companies take is to collaborate with leading organizations and academia across the country to develop better techniques and technologies.

6. Conclusion

From our research, we were able to analyze and adaptation responses of companies towards climate phenomena most observable in Great Lakes region. Hence, our findings should be treated as applicable for any region in US with similar climate conditions as Great Lakes. As mentioned earlier in the report, next phase of analyses involving interaction with company representatives would provide specific support to company response towards climate activity in Great Lakes region. Additionally, we analyzed a sub-set of companies present in

the region and hence, more insights could emerge with increasing the number of companies involved in the overall analyses.

That being said, we see from our analyses that companies across different sectors are aware of risks due to changing climate. However, the industries actively adopting adaptation measures are the ones being most affected in their business operations like utilities, materials or chemical manufacturers. Other sectors like Healthcare, oil and gas tend to rely on more traditional risk management approach and don't consider physical climate changes a discernible threat. The risk management activities undertaken by companies vary a lot across sectors and range from retrofitting existing facilities to changing engineering design for new buildings to finding new ways of reducing resource usage and so on. The cost for these activities are largely masked under their traditional enterprise risk management system and are not publicly acknowledged by companies. As a final piece, very few companies in Utilities/Materials sector have taken even a step further to not only mitigate risk but also create new business opportunities by either entering new markets, designing new products/services or diversifying their supplier base. In doing so, they have increased their overall brand value as a sustainability leader in their sector and are poised for long-term sustainable growth.

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