

Corporate carbon footprints: evaluating climate responsibility of six corporations

Abstract

The paper expounds the basic premise on the origins of climate science and the predictions of global warming followed by preceding events and studies and implementation of climate treaties. The purpose is to set a foundation for evaluating the progress made by major corporations in conforming to these climate treaties both in their letter and spirit. In the realm of carbon trading and environmentalism today, there are many companies making bold strides toward sustainable business models. This paper reviews the measures taken by five large corporations that profoundly affect the world economy and the environment and examines the goals of each organization, how their methods have yielded results, and whether or not these results have met the aspirations or fallen short. The exploration of how carbon trading markets and the carbon-footprint-reduction efforts of major corporations are implemented to maintain local economies and support small communities is discussed. Integration of greater sustainability and biodiversity in the future carbon trading is an important component to create a low carbon economy.

Keywords: carbon trading, sustainable business, sustainability, biodiversity

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Introduction

The theory of climate change was first proposed in the 19th century when studies of ice ages and greenhouse gases were expanded upon; scientists began to propose the idea of anthropogenic climate change through greenhouse gas emissions. In 1896, an American scientist Samuel Pierpoint Langley measured the infrared radiation coming from the Moon to Earth. His measurements were weaker when the moon was lower in the sky, due to the water vapor and CO₂ that the Moon rays had to pass through.¹ These findings were used by a Swedish scientist, Svante Arrhenius in his calculations of temperature change in relation to CO₂ and water vapor in the atmosphere. He predicted that a 50% reduction in CO₂ would cause an ice age, whereas a 100% increase in CO₂ would raise global average temperatures by 6 degrees Celsius. In 1896 Arrhenius's research paper "On the Influence of Carbonic Acid in the Air upon the Temperature of the Earth" concluded that industrial sources were comparable to natural sources of carbon emissions.² It was estimated that the potential atmospheric change caused by industrial carbon emissions would take thousands of years to produce profound results, and the resulting changes would be positive for humanity and life on earth.³ In 1899 Thomas Chrowder Chamberlin's book, titled "An Attempt to Frame a Working Hypothesis of the Cause of Glacial Periods on an Atmospheric Basis" postulated the changes in climate would accompany a change in atmospheric CO₂ levels.⁴ These early theories met with much contention and ultimately did not find mainstream acceptance. Only in the 1950's with improved spectrography and in the 1960's with more sophisticated computer modeling scientists began to become alarmed of Arrhenius' calculations. Further adding to their suspicions was the effect of smog on urban areas in the developed world. Soon they began to theorize that aerosols and carbon emissions might influence temperatures on a global scale. Measurements of Arctic sea ice decline and glacial melting also contributed to the alarm of many researchers. During 1960's and 70's, scientists began to embrace the theory of global warming due to man-made emissions of CO₂. Climate change was defined as the significant and lasting change of

weather patterns in a statistically measurable way. In 1988 after an assessment authored by James E. Hansen a "World Conference on the Changing Atmosphere: Implications for Global Security"⁵ in Toronto agreed that anthropogenic climate change existed and constituted a significant threat to the international community and the populations of the world. World Meteorological Organization in 1988 established the Intergovernmental Panel on Climate Change in order to issue assessment reports on the state of scientific discourse on the subject of climate change, updated every 5 to 6 years. In 1992, the United Nations held a convention for establishing an international treaty of goals and regulations regarding climate change. This meeting was called the United Nations Framework Convention on Climate Change (UNFCCC). The purpose of the convention was to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".⁶ On December 11th, 1997, another convention was held in Kyoto, Japan led to the development of international treaty, the Kyoto Protocol. This convention was an extension of the UNFCCC, and it obligated the governments of the world to reduce their greenhouse gas emissions. The justifications for this obligation are the apparent occurrence of global warming, and the supposition that man-made carbon emissions are the primary cause of it. This treaty was adopted in Kyoto in 1997 and took legal effect in 2005. There were successive stages of commitment periods, the first of which started in 2008 and ended in 2012. In 2012 the second stage of commitments was agreed to and implemented. The Doha Amendment was added to the Kyoto Protocol and it assigned serious emissions-reduction objectives to 37 member countries. By July of 2016, the Kyoto Protocol had 192 participant countries, and 66 countries agreed to the Doha Amendment. However, in order to take force, the amendment would require the acceptance of at least 144 countries. Out of the 37 countries selected for emission-reduction quotas, only 7 have ratified the treaty. Some countries that have withdrawn from or declined to ratify the treaty include Canada and the United States. Japan, Russia and New Zealand have participated in the first stage of commitments to reduce their emissions, but have not accepted new quotas for the second stage.

The second stage of commitments will end in 2020. Also of note is the Paris Climate Accord is not an amendment to the Kyoto Protocol itself, but rather is an agreement within the UNFCCC will take effect in 2020.

Under the Kyoto Protocol, there are various measures for implementing emissions reduction, and also “flexibility mechanisms” to alleviate the burden on governments and corporations attempting to comply with their assigned commitments, since the cost of reducing or otherwise alleviating carbon emissions may vary across countries. These “flexibility mechanisms” include International Emissions Trading (IET), the Clean Development Mechanism (CDM), and Joint Implementation (JI). These mechanisms are the basis for a multitude of programs and for the carbon trading market itself. The IET permits the Annex I parties of the treaty to trade carbon credits, also called Assigned Amount Units (AAU’s). The mechanisms for CDM and JI, are focused on projects that generate emission reductions. These emission reduction projects are measured by Certified Emission Reductions (CER’s) and Emission Reduction Units (ERU’s). These units are referred to as “credits” because they are credited against a hypothetical sum or baseline of greenhouse gas emissions produced by a particular country or entity. Therefore, these credits could also be traded on the carbon market. Annex I countries are required to submit annual reports on carbon sources and carbon sinks and the balance of their overall greenhouse gas inventory.

The Kyoto Protocol has implemented many emissions trading schemes for various regions and countries. The Tokyo Metropolitan Government took charge of Japan’s emissions trading in 2010. In the European Union Emission Trading Scheme was started by the European Commission in 2005. In North America there are several trading centers managed by separate coalitions of US states and Canadian Provinces, starting up between 2009 and 2013. Australia and New Zealand each have their own trading schemes. Although intergovernmental emissions trading are permitted, in 2009 a company in the United Kingdom called Carbon Trust, found that no such international trading had taken place other than within the member states of the European Union Emission Trading Scheme. Also in 2010, it was found that 97% of the international carbon trade was driven by the European Union.⁷ Another issue with international emissions trading schemes is that certain countries have a surplus of AAU’s that they can trade, due to their less developed industrial base. Developed nations also suffer a deficit in AAU’s. This gave rise to another mechanism called the “Green Investment Scheme” (GIS). The GIS is designed to provide greater flexibility to developed nations trying to meet their commitments under the Kyoto Protocol, by allowing them to buy credits or subsidize green projects in countries that have a surplus of AAU’s, and which do not expect that their economic development will surpass their emission-reduction commitments. A mechanism has been developed to aid in emission reductions that can be invested in by large companies or governmental organizations to provide them with credits for economic production. This mechanism is called a Clean Development Mechanism (CDM). The CDM’s consist of the commercialization of renewable energy and energy efficiency, or switching to more renewable fuel sources. This mechanism gives corporations and governments a clear avenue toward reducing their carbon footprint or at least neutralizing it with carbon sinks and projects designed to foster clean development and carbon sequestration. The Kyoto Protocol continues the established principle of the UNFCCC, that wealthy modern countries must invest billions of dollars into climate studies and sequestration projects, as well

as providing green technologies to less developed countries. The Adaptation Fund is a product of this principle of the treaty.

Methodology

This paper examines the recent activities of six major companies from two different angles: the self-representation given by each company, and the media coverage of their activities. The information is matched based on its relevance to the business model and overall impact of each company, to evaluate how close each company has come to true sustainability and mitigating their effects on the environment.

Mechanisms

IET market and units of exchange

The first of the practical mechanisms in the repertoire of the treaty is the IET market. Carbon AAU’s have become commodities for trade in the global marketplace. Other units for trade have also arisen, including Removal Units (RMU) based on activities such as reforestation, ERU’s and CER’s.⁸ Each of these units represents one ton of CO₂. The Kyoto Protocol’s registry system is used to track the trade of these units. An International Transaction Log is used to link registries for emissions trading. The International Transaction Log (ITL) works by receiving transaction proposals from various registries and evaluating these by the standards of the Kyoto Protocol and Doha Amendment, and any other pertaining agreements or treaty amendments. The ITL either rejects or approves the transactions for further processing. If approved, the registry can carry out the transaction, but if denied, it will receive an error code from the ITL which describes the failed checks on the list of Kyoto Protocol standards. The standards followed by the ITL are provided by Data Exchange Standards (DES).

Each party in the trading schemes is required to maintain a reserve of carbon trading units, to avoid an outcome in which they might oversell their AAU’s and fail to meet their carbon reduction quotas.

Clean development mechanism, CDM

The CDM is a program for facilitating emissions reductions and supplying green technologies to developing countries.⁹ These projects are funded by corporations and developed nations in order to earn CER credits. A single CER credit is equal to a ton of CO₂ and can be traded between companies and countries. CDM is the primary source of revenue for the Adaptation Fund that was established in 2001 to help developing nations adapt to climate change and potential crises caused by it. The CDM’s exist mostly in the developing world, and China and India hold the majority of current projects. CDM has created a marketplace worth billions of dollars, with contributions from major countries and private investors.¹⁰ The CDM is regulated by an executive board of 10 members who are elected by the parties to the Kyoto Protocol. This board evaluates projects and awards CER credits. In order for projects to be considered by the board, a Project Design Document must be drafted and submitted for evaluation. The proponents of a given project may choose from 140 recognized methodologies for sustainable development and acquiring CER’s, or they may choose to propose an entirely new methodology for running a new project. The board can either approve or deny registration for these projects. Once a PDD has been finished it is sent to the Designated National Authority (DNA) of the host country, responsible for evaluating the project in terms of the sustainability objectives of

their country. If the projects are registered, then every year following the beginning of operation, the developer of the project must hire an accredited auditor to evaluate the progress of the project and submit monitoring reports to the board. The lifespan of an approved project is 7 to 10 years, with an option to renew a 7 year period once.

Joint implementation

Developed nations that are parties to the Kyoto Protocols are given emission reduction quotas, which they must meet by cutting their carbon footprint or by purchasing AAU's or carbon credits. Joint Implementation benefits developed countries and corporations by allowing them to buy permissions to continue production, and it also benefits developing countries by giving them access to funding for renewable energy projects and access to green technologies.¹¹ Any JI project proposed must be either an emission reducing measure at an existing site, or a carbon sequestering project that increases carbon absorption by the environment beyond what it otherwise would have been. Such projects must be verified by the Joint Implementation Supervisory Committee (JISC). The JISC also grants accreditation to designated operational entities, allowing them to operate independently on carbon offsetting projects.

Cost of carbon credits

The price of carbon credits has fluctuated over the years since the trading schemes began. In 2008, prices went down when the housing bubble burst and the global economy at large was decimated. Afterward, the value of carbon credits began to rise again. In California, the price of one ton of CO₂ is \$15.10.¹² The cost of one ton of carbon is higher by a factor of 3.67 than the cost of one ton of CO₂. Therefore, a price of \$30 per ton of CO₂ would equal \$110 for a ton of carbon.¹³ Albert Bates in *The Biochar Solution*,¹⁴ stated that in 2009 by the time that the UN held its Conference on Climate Change in Copenhagen, the international market for carbon trading was growing faster than any other commodities market in the world. Bates claims that over \$300 billion dollars' worth of emissions reductions were sold. Major Banks such as Goldman Sachs, Barclays and Citibank were speculating on prices anywhere from \$25 to \$100 dollars per ton of carbon sequestered. With this in mind, these financial institutions began opening carbon trading desks in London. Speculators from around the globe anticipated that the global carbon trading markets could be valued at as much as \$3 trillion dollars per year. According to Kristin Olson's "The Soil Will Save Us",¹⁵ in 2012 the government of Australia passed a plan known as the Clean Energy Future. Through this plan the government established a \$23 carbon tax per ton of carbon, levied against energy producers, transportation companies and various other industries. The Australian government also planned to use \$1.7 billion from the profits of this tax, to fund its Carbon Farming Initiative. Also in 2012, the voluntary carbon trading market in the United States had created over \$100 million dollars of carbon credits. The carbon trade has grown fast, and become a large industry across the globe. This paper examines and compares different companies and the measures they have taken to achieve sustainability. The conclusion evaluates the progress made by each company and discusses future options they may pursue, as well as potential projects for the sustainability movement.

Unilever

Unilever produces and distributes over 400 brands of products. Some notable names produced by Unilever include Lipton, Dove,

Axe, Hellmann's and Suave. In 2010, Unilever was out-competing all of its rivals in terms of implementing carbon footprint reduction measures and green development¹⁶ and improved its energy efficiency by 20%. By the declarations by the company, from 2010 to 2017, Unilever reduced its CO₂ output by 31%.¹⁷ This was achieved by cutting mileage, reducing the number of trips taken, and switching transportation methods. Other measures taken include the reduction of waste sent to landfills by 85%.¹⁸ It is worth noting that 27% of Unilever's carbon footprint comes from the acquisition of raw materials, and 63% comes from the consumer's use of their products. One reason for this is that their bathing products are used with hot showers. Because of this, their carbon footprint per consumer has increased by 9%. Unilever's total greenhouse gas footprint is approximately 61 tons of CO₂. Unilever also focused on conversion of their supply of soybean oil to sustainable sources. Unilever developed a program to induct the farmers from whom they purchase their soybean oil. Notionally this was a step forward, however there was no serious standard applied to farmers or any way of disqualifying them from the program for lapses in their sustainability measures.¹⁸ Unilever had to set up a system for evaluating and encouraging sustainable soybean production in the United States. The company collaborated with Archer Daniels Midland (ADM), a very large commodities trader and purchaser of soybeans from hundreds of American farms. ADM processes the soybeans into soy oil. With the assistance of ADM, Unilever created their sustainable soybean program. The World Wildlife Fund, Practical Farmers of Iowa, United Soybean Board, Field to Market and Iowa Soybean Association have contributed to Unilever's program. Field to Market was the group responsible for developing software to evaluate soybean farming practices. ADM agreed to pay an extra 10 cents per bushel to farmers who grew soybeans using sustainable practices, as defined by the software application of the program and evaluated by Unilever's auditors. There were also state subsidies offered for "eco-friendly" farming programs.¹⁸ In 3 years, over 250 farmers signed onto the program, responsible for a total land area of 285,000 acres. Some activities encouraged by the program include the planting of cover crops during the winter, such as cereal rye, intended to prevent soil erosion and enhance the nutrient content of the land. Contour strips were implemented to prevent water loss on the fields. However, not all of the farmers enrolled in the program are implementing such practices; rather, what is required of them is to use the Field to Market software to calculate their water usage, soil carbon levels and emissions levels. A few minimum requirements are all that need to be met in order for a farmer to be retained in the program.¹⁸

Microsoft

The prominent software company and well-established philanthropic giant Microsoft has set ambitious goals for implementing sustainability. The corporation has the stated goal of reducing their carbon footprint by 75% by 2030.¹⁹ From the implementation of its carbon reduction plan in 2012 up to 2018,²⁰ Microsoft has cut over 9.6 million tons of CO₂ from its carbon footprint and invested in over 21 million megawatt hours of green energy.²¹ Microsoft shows initiative and enthusiasm for using the carbon market to subsidize preservation of natural environments and carbon sequestering resources. During 2015, Microsoft purchased 520 acres of forest at the base of Mount Rainier in Washington State. The carbon credit transfer for this purchase was approved by the California carbon market, as Washington has no trading scheme in the carbon market. This forest lies in the Nisqually watershed and is valued at 37,000 credits.²² Microsoft has also intervened in the rainforests of Indonesia,

saving 100,000 acres of natural forest from conversion to palm oil production.²³ This area serves as a refuge for Borneo orangutans, and so the project is also an effort to conserve wildlife. The locals in the area have been given new, more energy efficient charcoal stoves for cooking.²³ The program also instructs and encourages the locals to plant trees and maintain their native environment. For \$20million annually, Microsoft can offset 100% of its carbon emissions.²² According to their impact reports, the company has offset 7.5million metric tons of CO₂ from 2013 to 2015, has a much deeper and more holistic comprehension of the nature of sustainability.²⁰

Apple

Apple is one of the largest producers of consumer electronics in the world. Their products include the iPhone, watches, iPads, MacBooks and more. Much of their production takes place in factories in East Asia. About 77% of the carbon footprint of Apple products is generated by their production and 17% by the consumers' use of the products.²⁴ Apple takes into consideration many facets of its carbon footprint, including consumer use, factory production, the footprints of its suppliers, and more. Although the company reported 100% of its facilities in the U.S. were running completely on renewable energy, it still produced 34.2 metric tons of carbon emissions in 2014, up from 33.8million metric tons in 2013.²⁵ However, recent data indicates that Apple reduced its carbon footprint from 29.5million metric tons in 2016, to 27.5million metric tons in 2017.²⁴ The company accomplished this reduction by cutting the emissions of their aluminum production and by improving the energy efficiency of their facilities and also the facilities and transportation of their suppliers. Apple in 2018 achieved 100% renewable energy sourcing for all of its facilities.²⁶ Since 2011, the company has reduced its emissions by 54%. In 2016 Apple issued the largest green bond in history, pledging \$1.5billion worth of funding for green projects.²⁷ In 2017, as a response to the United States' withdrawal from the Paris Climate Accord, Apple issued another green bond worth \$1billion dollars, totaling 2.5billion dollars in green investments. According to green impact reports that Apple has issued to disseminate information concerning these projects, the company has so far allocated all of the 2016 green bond, and \$168million of the 2017 bond.

The breakdown of the 2016 bond for green projects included \$194.2million for renewable energy, \$495.9million for green buildings, \$665.9million for energy efficiency measures, \$98.5million for water efficiency, \$36.3million for material conservation and \$3.6million for developing greener materials. The bond for 2017 has so far allocated \$9.8million for renewable energy, \$105.9million for green buildings, \$38.1million for energy efficiency, \$8.7million for material conservation and \$.3million for waste diversion.²⁷

Bank of America

Bank of America (BoA) is one of the largest multinational financial institutions in the world, headquarters in Charlotte, North Carolina, and it is the 26th largest company in America in terms of revenue. It serves over 47million people in more than 35 countries. Since 2007, Bank of America provided \$70billion to green projects, and as of 2015 they have pledged an additional \$125billion.²⁸ According to the economic impact report published by the company, BoA spent \$1.9billion on residential building energy efficiency, \$366million on renewable energy, \$2.3billion on photovoltaic cell research, \$3.7billion on wind power projects, \$2billion on energy efficient installations, \$1.1billion

on low-carbon emission vehicles, and \$1.3billion on commercial building energy efficiency. BoA has proclaimed their sustainability goals publicly, including their ambition of using 100% renewable electricity for all of their facilities, and to reduce emissions by 50%, water use by 45% and overall energy use by 40% in all of their operations worldwide.²⁹ The company boasts that from 2010 to 2015 it managed to reduce its greenhouse gas emissions by 37% through increased efficiency measures. BoA plans to become carbon neutral by procuring 100% renewable energy and by purchasing carbon offsets.

Some other sustainability measures listed by BoA in their agenda include:

- i. Maintain LEED certification (Leadership in Energy and Environmental Design) in at least 20% of the company's owned and leased space. LEED Certification is an internationally recognized green building certification system. It provides third-party verification of a building or community assuring that it was designed and built using strategies aimed at improving performance across all the metrics like energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.
- ii. Reduce waste sent to landfills by 35%
- iii. Reduce paper use by 30%
- iv. Maintain an average of 10% recycled content in paper purchased
- v. Purchase 100% of paper from certified sources
- vi. Dispose of 100% of e-waste through certified responsible vendors

From 2013-2016, BoA had created 39,728 jobs related to their green projects funding. Wind energy and energy efficient buildings comprised the bulk of the projects' job creation. Bank of America though has generated funding and job creation for green projects it has been criticized for its continued financial support for fossil fuels. From 2013 to 2015, BoA invested \$3.9billion in coal mining, and also invested more than \$10billion into the 20 biggest coal-fired power companies across 4 different continents.³⁰ BoA loaned over \$24billion to companies building liquid natural gas terminals in America. BoA also funded extreme-location oil drilling to the tune of \$29billion.³⁰ BoA is also the primary funder of the Dakota Access Pipeline (DAP) project, a much loathed and fiercely opposed oil conduit. The DAP is a \$3.8billion dollar project, yet it was put on hold because of concerns that its construction may violate federal regulations. A political battlefield surrounds the Dakota Access Pipeline, and many environmentalists strongly rebuke BoA for financing it.

Phillip morris

Philip Morris (PM), also known as Altria, is a corporation with branches that produce wine, alcohol, cigarettes and other tobacco products. Altria's total greenhouse gas production in 2016 was 391,809 metric tons.³¹ Altria has implemented an 'Environmental Framework' for assessing the business plans of all their companies. Also in 2016, Altria established a new set of environmental goals for their corporation that include reduction of their emissions by 20%, reduction of energy use by 18%, reduction of waste sent to landfills by 25%, and the attainment of 50% water neutrality.³² These goals are to be achieved by 2025 according to Altria's new agenda. In 2014, PM and U.S. Smokeless Tobacco Company, one of their producers, switched from coal to natural gas to power their boilers, and

significantly reduced their carbon emissions. Philip Morris has also begun implementing LED lighting in their facilities, and has so far saved 3.5million Kilowatt-hours annually. Philip Morris has endorsed agricultural sustainability guides for its producers and suppliers, such as Vine Wise and the Good Agricultural Practices handbook for farmers. It has also worked with the National Fish and Wildlife Foundation to reduce its water usage and protect watersheds such as the Green River and Chesapeake Bay. The company is introducing pilot programs to test no-till systems for tobacco production and drip-irrigation systems for their vineyards. Tobacco curing requires heat to enhance the flavor of the leaves and prepare products for storage. Tobacco producers in US often use propane to fuel the curing process, but in countries like Brazil, producers often use firewood. Universal Leaf, one of the suppliers, reported that it has provided millions of eucalyptus seedlings to tobacco producers over the past 12years, to replant the wood they have cut down. The number of seedlings distributed would cover about 88,000 acres of land. These are described as “woodlots” or production fields for firewood and building materials. The company has an installation on the side of the James River, called the Park 500 Facility. This facility alone uses 1.8million gallons of water from the river every day.³³ In 2008, the company created a 48 acre wetland to help cleanse the wastewater of the facility before sending it back into the James River. This project included more than 150,000 plants of 22 different species, from varieties such as water lilies, bulrush and pickerelweed. The wetlands are currently used as a research and observation area for students of sustainability. The facility is also part of the Virginia Nutrient Credit Exchange, an organization whose goal is to improve the water quality of the Chesapeake Bay. In 2017, PM was paid \$75,800 by the Virginia Nutrient Credit Exchange for nitrogen credits.

Marks and spencer

Marks and Spencer (M&S) is a large grocery and retail company based in the United Kingdom. It has 1,000 locations and employs 85,000 people. Across the world, from all of its operations, M&S produces approximately 8million tons of emissions.³⁴ Conducting a study into its energy use and carbon emissions, M&S discovered that 336,224tons of emissions were produced by the logistics operations of the company. To minimize the energy and emissions devoted to transportation, M&S began using double-decker trailers for hauling loads 50% to 70% larger. The company also implemented driver performance software to improve fuel economy.³⁴ To reduce energy spent on warehouses and storage, M&S began investing in passive infrared lighting, operated by motion sensors, to install in its warehouses, as well as investing in the largest solar panel in the world. The supply chain of M&S incorporates 20,000 farms and 2,000 factories. Over 2million people visit M&S stores every week, and the company controls 3.9% of the food market share in the United Kingdom. It is also the largest clothing retailer in Britain.³⁵ The Company was the first in the UK to boast of achieving carbon neutrality in 2012 and of recycling 100% of its waste. This plan even affects executive pay rates, based on their performance at meeting sustainability goals set by the company.

Discussion

The concept of “sustainability” (avoidance of the depletion of natural resources in order to maintain an ecological balance) needs to be adopted as a system that can evoke a desire to mimic the state of nature and its processes. A genuine pursuit of sustainability will

seek to replenish, proliferate and possibly even enhance the processes of nature to their fullest and most lively potential. What may seem acceptable to us in our lifestyle today can have dire ramifications in the future. During the century between 1750 and 1850, much of the natural forest of Europe was cut down. In modern times the forests were replaced mostly with coniferous trees such as spruce and pine. It was assumed that this reforestation would be a net benefit to the environment and the process of carbon sequestration. However, it has recently been found that coniferous trees absorb much more heat than broadleaf trees, and hence these managed forest may have actually raised temperatures in the region by 0.12 degrees Centigrade.³⁶ Similar stumbling toward perceived sustainability can be seen in China, with the Great Green Wall project to halt the expansion of the Gobi Desert. The project has created a monoculture forest. In 2008 the artificial forest in the northern region of China was the largest in the world, yet it lost 10% of its trees that winter and the World Bank was prompted to advise pursuing quality rather than quantity in the project’s future. In 2009 alone 53,000 hectares of trees were planted, but no less than a quarter of them died.³⁷ The artificial “forest” is virtually devoid of bird and animal life, and susceptible to disease, and incredibly vulnerable to the elements. It is also costly to the groundwater resources of the region. True sustainability is the replenishment of nature and its renewable resources in a holistic way. With this objective in mind, the corporations presented in this paper is evaluated on their sustainability projects their business structure, approach to sustainability and their needs as economic entities.

Unilever assembled many organizations into a coalition to achieve a single sustainability goal; to produce sustainable soybean oil. Although many of its products use this resource as an ingredient merely addressing the matter of sustainable soil will not by itself render any of the company’s products wholly sustainable. The company has ambitious goals but appears to be in the proselytizing phase of their campaign to convert their suppliers to sustainable practices. It seems that the primary focus of Unilever is on reforming their supply chain and business model, rather than on purchasing carbon credits or funding sequestration projects. Unilever needs a solid farming model to follow and implement, that can meet their supply needs and also to reduce their carbon footprint and mitigate their environmental impact. The attempts to produce sustainable soybeans are resulting in reduction of water use and introduce cover crops. Practices like silvipastoral agro forestry, a system of farming that incorporates trees with annual crops, using strips or alley cropping would mitigate soil erosion, prevent nitrogen leaching and sequester carbon all at once.³⁸ There is a great potential to understand deep sustainability than promote monocultures, as eucalyptus seedlings were distributed by PM. The company claims of being able to cover 88,000 acres with eucalyptus trees. This would of course be an unnatural environment created by the company’s consumption of firewood and subsequent shallow attempt at sustainability. These trees are intended for the future use of the company and not an environmental replacement or sustainability measure. The company has created wetlands projects in 48 acre wetlands by James River facility. This area has been turned into a habitat for wildlife and restores the water used in the company’s facility. It is serving as an example and also as a teaching resource for students of sustainability to observe how the wetlands operate and how they can be used to mitigate the pollution of modern factories and industrial activities. It appears that Philip Morris is orienting itself toward creating projects to mitigate its environmental impact and replace the resources it has consumed. For

Philip Morris it is more difficult to suggest sustainable amendments to their operations, because of the particular nature of their business model and the requirements of preparing their products. Some of the practices that the company could adopt to mitigate its carbon footprint and environmental impact are carbon offsetting, purchasing carbon credits, funding carbon sinks and preservation of natural resources.¹⁴ Biochar is a viable option for sequestering carbon from the woods that they burn in Brazil. As much as 12% of the annual carbon emissions of the world could be offset by burying the smoldering remnants of biomass that is subjected to “slash-and-burn” techniques practiced in tropical areas today. The practice of coppicing, or periodically trimming trees down to stimulate more growth, could also be used to produce more firewood without cutting further into natural forests. Crystalline carbon found in biochar can be buried and stored under the soil indefinitely. The company’s operations in Brazil could also switch to using pyrolytic stoves, which burn the gases of biomass that are clean-burning with an efficiency rate of 93% as opposed to the 7-12% efficiency of open fires.¹⁴ By separating biomass from the actual flame it is fueling, a clean burn is produced and the byproducts are a significantly reduced emission of CO₂, water vapor and biocharred materials. Biochar stoves can be as simple as inserting a cylindrical container that releases the vapors of the biomass placed inside it, which then feed the flame of the stove with a much more powerful and efficient fuel. These metal boxes or cylinders are known as stove inserts. The gases escape from these inserts and ignite, and after use the biomass inside the insert can be quenched and yields biochar.

Biochar stoves come in varying types and levels of sophistication. A very simple and low-tech model, called the “Holon Stove” was developed by Folke Gunther. The Holon Stove was developed with the goal of creating a more efficient and clean method of making biochar. A biochar stove can be something as simple as a steel barrel inside of a concrete box, and thus it is also scalable for higher rates of production. It requires an inner chamber to hold the biomass for conversion to biochar, and an outer chamber for kindling to start the fires. There are also models in which the outer chamber is filled with biomass and the inner chamber is the source of the flame. One model, developed by Biochar Engineering Company (BEC) is a mobile reactor unit that can be carried on a trailer or placed upon skids. This reactor can convert 1000 pounds of biomass into 250 pounds of biochar in just one hour. BEC is also conducting development of attachments to the reactor that could produce liquid fuels such as methanol and dimethyl ether, as well as process heat and hot water, and even steam power. Microsoft has been using a more inclusive approach. It has not only made efforts to cut its footprint, but also uses the carbon trading market and financially supports carbon sinks and natural preservation projects. The company leadership seems to understand and appreciate the qualities of naturalness, diversity and sustainability. Microsoft would seem like the ideal sponsor to approach with suggestions for new sustainability projects with a holistic approach to their methods. Knowing that Microsoft has already funded a program to preserve natural forests in Indonesia, perhaps they could also be convinced to fund a hypothetical project related to the Great Green Wall of China to combat desertification, or to fund projects planting bamboo forests, since bamboo has an extremely high potential for carbon sequestration.³⁸ Due to their appreciation for biodiversity and natural preservation, their counsel could be of great use in reforming the monoculture created by the Green Wall project. Microsoft has taken the route to sustainability using the carbon market to purchase offsets. This is a good way to preserve existing natural carbon sinks, but in

the future it could create new carbon sinks and the creation of natural habitats similar to the wetlands area built by Philip Morris by the James River. The carbon trading schemes could be used in such a way that Microsoft would receive credits for funding such a project even for another company’s use. Microsoft has opportunities to have a broader range of options since it is engaged in the carbon trade. For Apple, the vast majority of the carbon footprint of their products is generated by their production. Therefore, reductions in their emissions and pollution would require an ever-expanding evaluation of the efficiency of their factories and production processes, and implementing efficiency measures or innovations relies on a comprehensive knowledge of the production process, which the company possesses. The company produces its products in Asia, where the need for carbon sinks and natural preservation is very dire. Apple could do much for the region by providing funds and advisors to environmental protection and reforestation projects. Apple products are very popular and undergo a rapid turnover rate, as new editions and models are released and older models are replaced. Only 17% of the carbon footprint of each Apple product is generated from customer use of the item. If the lifetime, durability and adaptability of each product were increased, then the impact of production would decrease. It was noted above that in spite of Apple’s efficiency measures, the overall carbon footprint of the company increased in 2014 by virtue of the increased sales of Apple products.²⁶ Bank of America has provided funding for sustainable development and green projects around the world, but this is counterbalanced by their financing of carbon-intensive activities. As a financial institution, BoA must show their commitment to sustainability in their decisions as to where they direct their investment capital. The energy efficiency and sustainability of their own installations is merely a token gesture compared to the impact of their investments. Of course, much good can be accomplished with the billions of dollars that BoA has pledged to green projects. Therefore it is critical that wise counsel is employed in the allocation and management of those funds, to see that they are invested in deep sustainability projects undertaken by persons and organizations with extensive knowledge in sustainable practices, carbon sequestration, the integrity of natural ecosystems and how to restore them. Marks and Spencer has great potential for creating deep and profound social change with regards to sustainable living. By virtue of its business as a food and retail store, how the company produces and transports its products is key to its approach to sustainability. M&S has already taken measures to improve the efficiency of its transportation in terms of increasing load size and reducing trips. If the miles traveled could also be reduced by subsidizing local production, especially of perishable food items, the effect could not only reduce the carbon footprint of the company, but also stimulate local economies. The potential to influence suppliers and farmers to adopt practices to replenish the soil, sequester carbon, and produce sustainable organic goods, is fully within the company’s reach. For a company that expends 85% of its carbon footprint on transportation, of which more than half is by trucks, it only makes sense to invest in local production of goods.

The realm of food production and distribution can affect the culture and economy of an area and an entire society. It is here that the green development funds and sustainability commitments could be focused to great benefit. Farms can be structured in such a way that they sequester large amounts of carbon. A study conducted in the Philippines discovered that multi-strata agro forests and vegetable gardens can sequester more carbon than even natural forests. Agro forests consist of timber, nuts and fruits, and various native trees.

Perennial crops are most effective at carbon sequestration.³⁸ Integration of livestock grazing areas with tree lines or sparse woods is known as silvopasture. The addition of trees to livestock pastures has been shown to increase carbon sequestration, and depending upon the type of trees used and the intensity of the implementation, sequestration can be increased dramatically.³⁸ Conventional understanding of environmentalism and animal husbandry has long held that grazing is potentially deleterious to natural resources, however Judith Schwartz in “Cows Save the Planet” published in 2013 suggests that there is just as much potential for environmental maintenance and improvement with the help of livestock. If managed correctly, herds of grazing animals, especially cattle, can improve the nutrient content and water absorption of a tract of land. If held in a single area for a prolonged period of time, livestock can selectively graze all of the tender plants and they mow the grass down to the ground. However, if rotated systematically, the plants and the soil have time to recover and in fact the grazing stimulates the plants’ vegetative growth.³⁹ Allan Savory has been working on the problem of desertification in Africa and across the world for decades. He had once thought that livestock and grazing animals were the source of the diminishing grasslands and spreading deserts. However, he observed that once livestock were removed and grazing animals had been subjected to population reduction, the lands they had subsisted on became much worse rather than showing any improvement. The reason for this was that dried out and dead groundcovers left over after winter, and smothered out the new growth in spring. To correct this, some farmers or land managers would burn off the dead grass from the previous year, but this process releases a large amount of carbon and can also lead to desertification. Therefore Mr. Savory began experimenting with systematic rotation of grazing herds of cattle or other livestock, to trim the grasses and plants without excessively damaging them, and to add manure to the fields. The cattle also trample the ground and break the surface of the soil with their hooves, allowing it to absorb more water and thus alleviating runoff and evaporation.³⁹ Marks and Spencer largely deals in food distribution has a responsibility to encourage food production methods that can halt or reverse desertification in Southern Europe and North Africa, regions neighboring its home base and likely to be involved in its supply chain. Desertification already affects Spain and many other Mediterranean states. At least one third of Spain is in danger of transforming into a desert.⁴⁰ About 45% of European soils contain low level of organic matter and are subject to erosion, primarily so in Southern Europe. This is largely due to overgrazing of livestock and water erosion, both of which could be mitigated if large companies pressured farmers to practice techniques which have already been found to produce results.

Conclusion

There seems to be a lack of understanding or a shortage of effective and practical counsel in the realm of sustainability today, because the world community has been insistent upon combating climate change and establishing carbon credit markets, cap-and-trade and so on for many decades now. Indeed, many of the companies reviewed above, such as Microsoft, have been encouraging the global effort to achieve sustainability. While Microsoft has perhaps done the most with regards to preserving existing natural areas, those sites can receive legal protection from governmental agencies and the priority of corporations who have pledged to support sustainable development must be to create new habitats and carbon sinks as well as fund and facilitate the transfer from high-emission activities to more carbon neutral activities.⁴¹ It seems only reasonable to explore and

experiment with carbon farming practices. Such projects would not only sequester carbon and generate carbon credits, but they could also be profitable to the companies that own or sponsor them. We live in an era of food shortages for an increasing number of populations around the world, rapid desertification and deforestation, overpopulation, mass-migration and rising unemployment. Surely there has never been a better opportunity for a conglomerate of wealthy and powerful organizations to pursue an environmentalist agenda. There are more than enough workers available and more than enough resources to spare for such a program. The methods for achieving carbon sequestration could be implemented virtually anywhere and by anyone; far from requiring some new invention or sophisticated technique, quite literally gardening and agro forestry are among the most effective means of carbon sequestration and soil replenishment. Farm hands and peasants with a few qualified advisers would be the ideal task force for such a movement. The program would be perfectly self-sustaining in that it feeds and provides for the people who operate it. The world can look forward to a magnificent blossoming of sustainable culture and infrastructure in the decades to come. A growing number of young people in America especially Millennial are leaving conventional careers and jobs in favor of small farms.⁴² The number of farmers under the age of 35 has been increasing, something that has only happened once before in the past century. About 69% of these young farmers have college degrees, according to a survey conducted by the U.S. Department of Agriculture.⁴² Millennial have brought with them an arsenal of new technologies into the field of agriculture, including robots, drones, and self-driving tractors.⁴³ Perhaps this generation will see a true fusion of technology with natural resource management and food production, in which an efficient method of production can be achieved while biodiversity is preserved and ecosystems are replenished.⁴⁴ A new era of sustainability revolution could be the solution for a myriad of social, economic and environmental problems in the world today. The question is whether or not the organizations and companies with the ability to pursue green development and the implementation of sustainability truly have the commitment and the wisdom to see it through properly. A generous social program, either publicly or privately funded or organized, to put capable and dedicated people to work with the resources and access to the land in need of rehabilitation, would do much to repair the environment and meet the goals of the modern climate treaties.

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Conflict of interest

Author declares that there is no conflict of interest.

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