5-2015

Environmental Impact of Conference Realignment

Bradley Farley

ENVIRONMENTAL IMPACT OF CONFERENCE REALIGNMENT

by

Bradley Farley

A thesis submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Master of Arts
Geography
Western Michigan University
May 2015

Thesis Committee:

Lisa DeChano-Cook, Ph.D., Chair
Gregory Veeck, Ph.D.
Lucius Hallett IV, Ph.D.

ENVIRONMENTAL IMPACT OF CONFERENCE REALIGNMENT

Bradley Farley, M.A.

Western Michigan University, 2015

Sports have a large impact on the environment. While leagues and teams are looking at improving their sustainability at stadiums, they also have increased their travel distances. NCAA Division I athletic conferences have recently endured conference realignments. This expanding geographic footprint of these conferences has led to teams having an increased travel distances for all sports. This research investigates the environmental impact of travel distances that conference realignment has had in NCAA Division I athletics, particularly regarding the Power 5 conferences carbon footprint. The research question examined is, based on travel distances, has the carbon footprint of the conferences changed dramatically, from pre-realignment to post-realignment? In order to answer this question, I examined the changes in mean center and average travel distances for each conference pre- and post-alignment. The carbon footprints were then calculated for 2010 and 2014 and the total emission and average emission changes were investigated.

ACKNOWLEDGMENTS

I would first like to thank my family for all their support, especially my mom and dad. They have always supported me through my academic career. I also want to thank my thesis advisor Dr. DeChano-Cook for helping me with the general research idea and for taking me on as a second year student. I also need to thank my committee members Dr. Greg Veeck and Dr. Lucius Hallett for agreeing to be a part of my research so late in the process. I also want to thank my classmates Alex Ebenstein and Rudy Bartels who made going through this process so much easier. I want to thank the department chair Dr. Benjamin Ofari-Amoah for giving me the opportunity to work as a teaching and research assistant at Western. I want to thank Mary Lou Brooks for the support and always making sure I was signed up for classes on time and having all the answers. Lastly, I want to thank Rebecca Luchies for her support when I was writing and for helping me with edits.

Bradley Farley

TABLE OF CONTENTS

Table of Contents-continued

CHAPTER

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Professional sports can have large environmental impacts on areas surrounding venues. Sports venues in particular degrade local environments through construction and maintenance. Events at these venues generate large amounts of waste products, which end up in landfills, incinerators, or sewage plants (DeChano & Hruska, 2006). In addition to these on-site issues, professional sports contribute to pollution levels through the transport of fans and teams to the venues.

Professional sports leagues across the U.S. have started working on improving the environmental impact of sports. Major League Baseball (MLB) partnered with the National Resource Defense Council (NRDC) in 2005 to establish several environmental initiatives, aimed at improving environmental quality in and around stadiums. MLB also employs software in order to track the success of NRDC programs, monitoring levels of energy use, waste management, recycling, water use and paper purchasing. The Seattle Mariners baseball team saved one million dollars over a three year period from 2006 to 2009 through retrofits such as waterless urinals, a new power-saving scoreboard and other efficiency improvements for electricity, natural gas, water and sewer usage (Henly, Hershkowitz, & Hoover, 2012).

Environmental protection and impact mitigation efforts are not limited to MLB. The National Football League (NFL) has also made significant strides to reduce its environmental footprint. For instance, the Philadelphia Eagles have saved over $3 million since 2005 simply through energy, waste, and water reductions (Henly, Hershkowitz, & Hoover, 2012). The Staples Center in Los Angeles, an arena hosting two teams in the

National Basketball Association (NBA) and one team in the National Hockey League (NHL), replaced all of their urinals with waterless versions after an audit from the NRDC. This in turn led to an annual savings of $28,200 in direct water costs by saving seven million gallons of water (Henly, Hershkowitz, & Hoover, 2012.).

In 2011, the NRDC joined the National Collegiate Athletics Association (NCAA) Final Four Sustainability Committee to strategize various initiatives to reduce environmental impacts. At the 2014 NCAA Basketball Final Four, activities included planting 1,014 trees in Arlington, Texas, unveiling a public transportation system for ticket holders to get to the stadium, and a recycling and composting program which managed venue waste during the tournament (Hubbard & Durant, 2014.).

While efforts to reduce environmental impacts in and around stadiums and events have been increasing, the added travel by fans and teams due to recent conference expansion and realignments, add to a team's carbon footprint. Recent changes to some conferences have made them more geographically distributed, increasing distances between schools for all sports. This has led to fiscal budget cuts at some schools in non-revenue sports. For instance, gymnastics at Temple, located in Philadelphia, was cut even though the gymnastics team won many conference titles. Travel costs for all of Temple's teams have increased dramatically due to league member teams being located from Texas to Connecticut in the American Athletic Conference (Graves, 2013).

Until the late 1950s, team travel was not an issue for schools or conferences. Conferences were based upon ease of travel, as teams were geographically closer to each other and traveled by road and rail networks for football and other sports (Abbott, 1990). Conferences defined the region with which they were associated. For example, the Big

Ten represented the American Middle West (Abbott, 1990). The popularization of commercial air travel in the 1960s allowed teams to cover greater distances for competitions, since they were no longer limited by road and rail networks (Abbott, 1990). However, the most recent NCAA realignments require some schools to travel multiple time zones, for not only football but multiple other sports (Weaver, 2013). In addition, conference regulations require schools to have teams in men's football, women's volleyball, and men's and women's basketball. Still, football and the potential revenue seems to remain the principal driver in the recent NCAA realignments.

Original regional conferences such as the Big Ten created natural rivalries between schools and their fans, especially between bordering states. As Weaver (2013, p. 20) states, "residents in one state felt themselves to be engaged in 'border battles' with their neighboring states, like conflicts in the Roman Empire between warring city-states." Conferences in the past were generally composed of similar sized schools with similar athletic goals within a single geographic region. The increasing travel distances alters how conferences are traditionally viewed.

With realignment, the geographic and environmental footprint of these conferences has expanded, causing travel distances for athletics to increase. Transporting teams and equipment farther distances significantly increases carbon emissions. Since 1990, the fastest growing source of greenhouse gases in the United States has been from transportation. In 2012, transportation of all types of vehicles for all purposes accounted for 28% of greenhouse gas emissions in the U.S. Of these greenhouse gas emissions, carbon dioxide accounts for 82%. Between the years of 1990 and 2012, the average number of miles traveled for vehicles rose by 35%. This increase has been attributed to

economic growth, low fuel prices, population growth, and urban sprawl. A report to Congress in 2010 emphasized that one of the U.S. Department of Transportation's strategies for reducing these emissions is the reduction of carbon-intensive traveling (U.S. Environmental Protection Agency [U.S. EPA], 2014a).

Reducing overall trip length is a way of reducing emissions. As college sports teams increase travel distances, the travel distances for devoted fans also increases. Revenues have dramatically increased for NCAA conferences along with expenses, but what about the carbon emissions based on the increase in travel times and distances? Have carbon emissions also dramatically increased with the spatially expanded new conferences, or has the use of divisions in these conferences helped to cut down on some of the travel?

Current college conferences span vast regions and do not seem to fit the traditional view of an athletic conference as discussed previously. While conference realignments obviously impacted institutions in terms of requiring greater investment for travel, the need to study the environmental impact of the new spatial networks is apparent. The purpose of this thesis is to determine if carbon footprints have changed due to conference realignments and if so by how much.

This thesis is ordered in the following way. The next chapter reviews literature with three distinct sections. The first discusses conference realignment history and the 2010-2014 realignment period. The second reviews literature on carbon emissions and ways to calculate carbon emissions. The last section of Chapter 2 provides a review on sports and the environment. Chapter three will introduce the methodology of the study. Chapter four covers the results and discussion of the study. Finally the last chapter

provides the conclusions related to the research and offers suggestions for how carbon emissions may be reduced by these conferences and schools.

CHAPTER II

LITERATURE REVIEW

As noted in Chapter 1, this chapter is divided into three sections. The first is a discussion on conference realignment, discussing history of conference realignment, the actual realignment that occurred after 2010, reasons for switching conferences, and turmoil that happened in the Big 12 conference. The next section is on carbon emissions where the carbon footprint calculator used in the research is discussed. In this last section the Olympics, professional sports, and collegiate athletics are all discussed in regards to environmental impact.

Conference Realignment History

Between 1990 and 2008, 30 schools changed conference affiliations with most of the shifts occurring in 2003 (Leibovitz, 2011). The 2003 movement was a ripple effect that began with the move of teams from the Big East Conference to the Atlantic Coast Conference (ACC). As a consequence, the Big East Conference invited teams from less popular conferences to join which forced further realignments in the conferences (Leibovitz, 2011). At the individual school level, there are a variety of reasons why a school would switch conferences, but the primary factor often revolves around potential increases in revenues. By moving to a more popular conference, such as the teams from the Big East Conference moving to the ACC in 2003, schools are in position to receive more television revenue, receive invitations to better or more prestigious bowl games, and participate in conference championship games. All of these factors can increase revenue for the conference and individual schools (Leibovitz, 2011).

When looking at realignment from a conference perspective, the addition of new teams can increase revenue for the conference. This benefits all member schools of the conferences as well. With new members, TV contracts for conferences can be renegotiated predicated on an increase in viewers from new television markets (Leibovitz, 2011). When the ACC expanded in 2003-2005, the conference went from nine schools to 12 with the addition of University of Miami (Miami) in Florida, Boston College, and Virginia Polytechnic Institute and State University (Virginia Tech). This increase to 12 teams allowed the conference to host a championship game. A conference championship game means more money for the conference. It also allowed the conference to secure a more lucrative TV contract and increase ticket sales (Katz, 2005).

A historical conference that was a part of the realignment in the 1990s was the Southwest Conference (SWC). The SWC was a premier football conference featuring all Texas based schools and the University of Arkansas (Arkansas) until the conference broke up in 1996. Some reasons for the break up and subsequent realignment are similar to those that emerged during recent realignments. Arkansas was the only school not located in Texas and left for the Southeastern Conference (SEC) in 1992 making the 1996 breakup inevitable. The SWC breakup was impacted heavily by television revenue. The SWC was unable to secure a lucrative TV contract to meet the demands of the multi-million dollar budgets of its schools. The conference's geographic footprint only included access to 6.7% of the nation's TV viewership. This situation can be compared to the SEC, which accessed 18% of the nation's TV viewers. While some of the SWC teams, Southern Methodist University (SMU) and Rice, were located in major TV markets including Dallas and Houston, the support for these schools dwindled as professional

football grew in popularity in those cities. This led to the top four teams - University of Texas (Texas), Texas A&M, Texas Tech University (Texas Tech), and Baylor University (Baylor) - joining the Big 8 Conference to form the Big 12 Conference in the fall of 1996. The remaining private schools of Rice, SMU, and Texas Christian University (TCU) joined the Western Athletic Conference, while the University of Houston joined Conference-USA which at the time placed greater emphasis on basketball than on football (Writes, 2010).

The 2010-2014 Realignment

The NCAA now is a much larger business than it was previously, with more individual colleges having expansive athletic budgets. The NCAA itself generated $913 million in total revenue in 2013 (Berkowitz, 2014). With larger budgets, colleges and athletic departments are always looking for ways to increase revenue. The 2010-2014 realignment started in December 2009 when the Big Ten announced that it was interested in possible conference expansion. Following the announcement by officials in the Big Ten, Southeastern Conference (SEC) commissioner Mike Silve contacted the Big 12 about its intent to contact Texas A&M and the University of Oklahoma (Oklahoma) to gage interest in possibly joining the SEC (Dennie, 2011).

The realignment started when the University of Nebraska (Nebraska) joined the Big Ten conference for the 2011 football season. Nebraska is one of the most successful programs in college football history in terms of win-loss record. Before Nebraska's departure, the Big 12 conference was becoming more unstable based upon reports that multiple schools were looking to leave for new conferences. Based upon these reports,

the Big 12 conference leadership asked all member universities for a commitment to stay in the conference for the foreseeable future with a deadline of June 11, 2010. This led to the Chancellor of Nebraska contacting Big Ten Commissioner Jim Delaney saying something would need to occur fast. On June 11, 2010, Nebraska applied for and was accepted for membership into the Big Ten Conference. The University of Colorado (Colorado) left the Big 12 at the same time to join the Pac-12 Conference (Leibovitz, 2011). In total, 12 teams moved from one power conference to another, or joined from a lower ranked conference between 2010 and 2014 (Table 1).

Table 1: Teams that changed conferences to one of the Power 5 conferences and when the move occurred (Peloquin, 2015).

Team	Old Conference	New Conference	First Year in New Conference
Colorado	Big 12	Pac-12	2011
Nebraska	Big 12	Big Ten	2011
Utah	Mountain West	Pac-12	2011
Missouri	Big 12	SEC	2012
Texas A&M	Big 12	SEC	2012
Texas Christian University	Mountain West	Big 12	2012
West Virginia	Big East	Big 12	2012
Pittsburgh	Big East	ACC	2013
Syracuse	Big East	ACC	2013
Louisville	AAC	ACC	2014
Maryland	ACC	Big Ten	2014
Rutgers	AAC	Big Ten	2014

Nebraska and Colorado were the first “dominoes” in the 2010 realignment that affected the five power conferences of the SEC, Pac-12, Big Ten, Big 12, and ACC. These conferences generate the most money. The realignment did eliminate some of college sports’ biggest rivalries, or at least put them on hiatus for a long period. When the University of Missouri (Missouri) left the Big 12 to join the SEC, their rival, the

University of Kansas (Kansas), indicated they would no longer compete against Missouri. The Border Showdown, as this game was known, started in the 1890s and ended after over 100 years of competition. Texas A&M moved to the SEC from the Big 12 at the same time as Missouri. Texas A&M's departure led to the cancelation of the Lone Star Showdown rivalry with the University of Texas. The Lone Star Showdown began in 1894, and because the two schools have so much animosity for each other, both schools fight songs reference the opposing school (Dennie, 2011). Realignment did bring back some old rivalries however. This was demonstrated when TCU joined the Big 12 Conference in 2012. TCU fans were ecstatic with the opportunity to revive old rivalries that were established during the time of the Southwest Conference, with teams that include Baylor, Texas Tech, and Texas (Havard & Eddy, 2013).

Reasons for Switching Conferences and the Impacts of These Shifts

Schools often want to align with schools that are viewed as being in an equivalent 'peer group', with similar athletic and academic traditions. This played a role in Nebraska choosing to move to the Big Ten Conference, as the Big Ten Conference has a very strong academic and athletic tradition (Leibovitz, 2011). Although Nebraska was brought in on a graduated payment scale for revenue with the Big Ten Conference, it was a better situation than Nebraska had in the Big 12 Conference. In the Big 12 Conference, revenue was not divided evenly among the schools. Instead, revenue was distributed in what was called an "eat what you kill" mentality where a schools revenue depended upon television ratings (Lavigne, 2014).

Some conferences now have dedicated television networks including the Big Ten Network and the Pac-12 Network, which generate large revenues. Media and television rights played a major role in the realignment. According to Notre Dame Athletic Director Jack Swarbrick, the 2006 formation of the Big Ten Network was the biggest development since the 1984 Supreme Court decision to take the control of television rights away from the NCAA and give them to the schools. The Big Ten addition of Rutgers University (Rutgers) and the University of Maryland (Maryland) in 2014, not only brought strong academic schools to the conference, the move also brought the television markets of Washington D.C., Baltimore, and New York City to the Big Ten Network. The money in television media rights is vast and will continue to grow, as live sport is one of the remaining programs on television that is considered "DVR-proof" (Pointer, 2014).

With the evolution of the new conferences, the spatial characteristics of these conferences has changed immensely in terms of absolute and relative travel distances. The biggest impact on team expenses for those that switched conferences has been travel-related with more teams flying to games rather than being bussed (Lavigne, 2014). For instance, the University of Utah (Utah) moved from the Mountain West Conference to the Pac-12 Conference in 2011 and travel expenses have doubled since entering the Pac-12 Conference. This occurred even though the spatial distribution of their opponents did not change much. However, due to multiple trips to cities that are more expensive, such as Seattle where they play the University of Washington, and TV scheduling based on new contracts that require the team to travel during the middle of the week, the school must provide more time-efficient transportation (air). Mean travel cost related to the conference change from the Big East Conference to the Big 12 Conference has been an

increase of $2 million for travel for West Virginia University (West Virginia). West Virginia is the team that reported the biggest average increase in travel associated with a conference change as the closest conference foe is over 800 miles away. Oliver Luck, the West Virginia Athletic Director, stated that the huge increase in conference payouts received has dwarfed the increased travel expenses essentially making travel costs a non-issue (Lavigne, 2014). However, increased travel has also placed an increased demand on student athletes. Teams that play during the week, including basketball teams, can be at a disadvantage when it comes to student athlete coursework. Sometimes West Virginia is forced to play a late weekday game in the Midwest for TV purposes which can result in the team not returning to campus until around 5 a.m. This puts student athletes with morning classes at a marked disadvantage due to the travel times (Grayson, 2013).

Payouts from conferences are not the only thing that increased for many of the schools that changed conferences. Donations and alumni support for some schools has also increased tremendously. Colorado's switch to the Pac-12 Conference resulted in increased private donations. In previous years the school averaged $10 million in donations, however $22 million in private donations were made in 2012-2013 (Lavigne, 2014). For Utah and TCU, schools that moved into power conferences from the Mountain West Conference, the financial impact has been vast. TCU earned roughly $2 million from the Mountain West in its last year in the conference. TCU now has been brought in on a graduated plan to the Big 12 Conference, TCU is expected to receive $18 million in 2014-2015. TCU has also benefitted from large increases in season-ticket sales, merchandise sales, and donations. TCU Athletic Director Chris Del Conte says all of this has "been through the roof". Season ticket sales increased from 13,000 for the last year

the school was a member of the Mountain West Conference to 32,000 tickets. Utah's athletic director says that if the school had stayed in the Mountain West Conference, Utah would have earned approximately $4 million annually compared to the roughly $23 million the school will receive from the Pac-12 Conference in 2014-2015 (Lavigne, 2014). These huge financial gains have justified these schools' decisions to switch conferences.

Turmoil in the Big 12

The Big 12 conference is the only remaining conference that had the most turnover of teams between 2010 and 2014. The other conference with large turnover during this period was the Big East, which collapsed, causing the remaining schools to form the American Athletic Conference, with the basketball-only schools taking the Big East name and forming a new football-less conference. In 2010, Nebraska and Colorado announced they would leave the Big 12 Conference. This was followed by Missouri and Texas A&M announcing in 2011 that they would leave for the SEC. With the Missouri and Texas A&M departures, the Big 12 added TCU from the Mountain West Conference and West Virginia from the Big East for the 2012 season. During the first wave of departures, many teams were considering leaving due to low conference payouts, which left the conference on the verge of implosion. Some partially blamed Texas, as the school created their own television network, the Longhorn Network, though ESPN. This unilateral move furthered the idea of the 'eat what you kill' mentality. However, other schools including Nebraska were looking into the possibility of getting their own networks but the opportunity was never realized (Lavigne, 2014). The Longhorn

Network's creation was partially blamed for helping push Texas A&M to finally join the SEC. Texas A&M had previously flirted with joining the SEC a few times. With the perceived advantage Texas would have in recruiting due to the network, while not the main reason Texas A&M left, it helped push Texas A&M away. Texas A&M left the conference mainly for the national exposure that membership in the SEC provided as well as the increased revenue believed to be associated with it. Being the only SEC school in the state of Texas should also give the school a recruiting advantage to allow Texas A&M to compete against Texas and other Big 12 schools. The state is a major recruiting hotbed and Texas A&M will give these recruits a chance to stay close to home while playing in what is believed to the best conference in college football (Sandhop, 2011).

Recently, Big 12 officials adjusted the conference payout schemes so that current payouts rival, or are higher, than the revenues for schools that left the conference. Nebraska is a good example. The school will not receive a full share of conference payouts until 2017, only receiving $16 million in 2013. This is compared to Big 12 payouts which were around $21 million. This is reasonable because after the 2017 season, the Big Ten will reopen media rights negotiations. The expected payouts with the new deal are expected to rise from an average $27.5 million in 2013 per school for full members to an estimated $40-50 million per school in 2018. Missouri and Texas A&M were not on graduated payment plans and received payouts that are thought to be approximately equal to current Big 12 payouts. Missouri and Texas A&M also are expected to see significant increase in revenues in the future, possibly as much as $40

million per school from the SEC network which has only recently been established (Lavigne, 2014).

Conference realignment is something that has occurred throughout time, and will likely continue to occur in the future. The 2010-2014 realignment started when Nebraska and Colorado left the Big 12 to join the Big Ten and Pac-12. When all was settled, 12 schools joined power conferences, or switched from one power conference to another during this period. As noted, schools change conferences for a variety of reasons. Often, it is to be in a more stable conference for the future and to secure more revenue. This was demonstrated by West Virginia leaving for the Big 12 where the closest opponent was over 800 miles away, but ultimately the move made the school financially more secure. The realignment led to the elimination of one of the previous power conferences, the Big East Conference, leaving only five power football conferences in the NCAA, the ACC, Big Ten, Big 12, Pac-12, and SEC.

Carbon Emissions

To this point, this chapter summarizes the conference realignments, and some of the reasons that dictate a team changing conference affiliations or conferences expanding with new members. The next section of Chapter 2 details carbon emissions and ways of calculating carbon footprints. Carbon footprints will later be used as a focal point of the analysis for the new conferences resulting from realignment.

Carbon emissions are an important consideration when discussing global climate change. Carbon dioxide is a greenhouse gas and is considered a major contributor to global climate change. Combustion of a fossil fuel always results in a release of carbon dioxide. This gas remains in the atmosphere for approximately 100 years once it is

emitted (Brief & Clark, 2012). Greenhouse gases including carbon dioxide are naturally emitted to the atmosphere. These natural emissions however are dwarfed by anthropogenic emissions caused by the combustion of fossil fuels (USGS, 2012).

Carbon dioxide as a greenhouse gas can contribute in several ways to climate change. Greenhouse gases absorb infrared heat radiated from the earth and radiate it back to the surface as longwave radiation to warm the earth. This longwave radiation cannot escape out to space and the energy is trapped. Without this greenhouse effect, the earth would not be at a livable temperature, as 90% of infrared radiation is absorbed by these gasses in the atmosphere (NASA, n.d.).

The most recent Intergovernmental Panel on Climate Change (IPCC) report states with high confidence that if carbon dioxide emissions continue to increase, marine ecosystems will be negatively affected. These ecosystems will be affected by the acidification of the ocean (Field, Barros, & Mastrandrea, 2014). Acidification of the ocean occurs when carbon dioxide dissolves into the ocean forming carbonic acid. Oceans absorb approximately one-third of the carbon that is emitted by humans. Through this absorption, less carbon dioxide remains as a gas in the atmosphere. However, the more carbon that is absorbed, the less capacity the ocean has to store future carbon emissions. This means that more carbon dioxide will be left in the atmosphere to work as a greenhouse gas. The continued acidification of the ocean inhibits shell growth and is believed to cause reproductive disorders in fish. In the past two centuries, oceans have had a 25% increase in acidity from 8.2 to 8.1 on the pH scale (National Geographic, 1996-2015). While the numbers do not indicate a large change, this 0.1 acidity change is enough to significantly impact ocean ecosystems. Ocean acidification and warming ocean

temperatures from greenhouse gas emissions are particularly devastating to the world's coral reefs. Coral bleaching, the process of corals expelling their nutrient supplying algae and resulting in death, has been occurring more rapidly as ocean temperatures rise with climate change. Studies have shown that coral grown in a more acidic environment had reduced growth rates by 59% and had abnormal skeletal structures (Christopherson & Birkeland, 2016).

Effects of higher carbon dioxide concentrations in ocean water continues to happen because emissions have continued to rise since 1970, with the largest absolute increase occurring from 2000-2010. The time period of this largest increase occurred while there were more climate mitigation policies than ever before (Field, Barros, & Mastrandrea, 2014). Since the Industrial Revolution, carbon dioxide concentrations have risen sharply. In the 800,000 years prior to the start of the Industrial Revolution, carbon dioxide concentrations ranged between 100ppm (parts per million) and 300ppm. Since, the Industrial Revolution however, they have risen above 300ppm, to 402 ppm as of May 2014. Between May of 2000 and May of 2014, the concentration rose by 30ppm, which before the Industrial Revolution had never occurred in a time span less than 1000 years (Christopherson & Birkeland, 2016).

While electricity production is the largest emitter of greenhouse gases with 32%, the transportation sector comes in a close second with 28% of emissions in the US (U.S. EPA, 2014a). Over time, there has been an increase in the number of cars on the road, while there has only been a limited increase in fuel efficiency. For the entire US fleet of vehicles between 1990 and 2004, average fuel economy declined due to increased truck

sales, but after 2005 there have been higher fuel efficiency standards for vehicles (U.S. EPA, 2014b).

Depending on if emissions are from surface vehicles or from aircrafts up in the atmosphere the impact on the environment differs. In theory, air travel is particularly harmful when it comes to negative environmental impacts. However, the exact impact is not actually known because emissions at a higher altitude can start various chemical reactions that both warm and cool the environment. This leads to uncertainty when calculating carbon emissions (Jardine, 2009). Airline emissions are difficult to estimate. Unlike cars where the industry protocol measures miles per gallon, statistics on fuel efficiency for air travel measure how far a "seat" can travel on a gallon of jet fuel whether it is occupied or not (McCartney, 2010). According to the Department of Transportation as cited by McCartney (2010), in 2009, airlines averaged 64 miles per seat per gallon of jet fuel.

The idea of a carbon footprint was originally based on the idea of an ecological footprint. An ecological footprint refers to the biologically productive land and sea area that is required in order to sustain a given human population expressed through global hectares (Pandey, Agrawal & Pandey, 2010). While carbon calculators are often used to measure carbon footprints, an actual definition of a carbon footprint is something that is hard to discern. While it is a very popular term in climate change discussions, depending on who is asked, it will mean different things. It is often assumed that a carbon footprint is the certain amount of gaseous emissions that are associated with human activity or consumption of a resource that are relevant to climate change. Knowing how the carbon footprint is defined is important when it comes to purchasing offsets. Many definitions of

carbon footprints use a generic definition for the emissions of carbon dioxide or greenhouse gases expressed in the equivalents of carbon dioxide (Wiedmann & Minx, 2008). This is how the concept of the carbon footprint will be used in this study.

While all types of emissions are generally difficult to measure, recently there has been a large increase in the use of carbon calculators to measure the impact of individuals and groups of individuals on Earth's climate. There are numerous options when it comes to using an online carbon calculator and each vary in the way carbon emissions are calculated. Various groups including governments, businesses, environmental groups, carbon offset companies, and environmental non-governmental organizations have designed carbon footprint calculators for their own purposes (Jardine, 2009).

For airline carbon emissions, a few carbon calculators and formulas can be used to determine an individual's impact. One is the CoolClimate Carbon Footprint Calculator [http://coolclimate.berkeley.edu/carboncalculator] created by researchers at the CoolClimate Network of the University of California Berkeley. In addition to airline carbon calculations, this calculator allows other forms of transportation emissions to be calculated along with housing, food, and shopping. For air travel emissions there are two options for entering data. The first is based on total miles flown per year. The second has the user classify all trips per year as either short, medium, or long-one way trips (U.C. Berkeley CoolClimate Network, 2013). A second user-friendly carbon calculator for air travel is provided by the company Native Energy [http://www.nativeenergy.com/travel.html]. This also classifies flights into short, medium or long for applying various emission factors. This calculator has a map and allows users

to input the cities they are flying between and allows them to select how many times the flight takes place either by week, month, or year (Native Energy, 2015).

The previous calculators were shown to demonstrate how useful the one used in the research was. The carbon calculator used in this research to calculate air travel was the Atmosfair calculator [https://www.atmosfair.de/en/kompensieren/flug]. This calculator is from a carbon offset retailer which allows the user to input the airports between which travel has occurred. This calculator also allows the user to choose the type of plane, number of people traveling and whether the flight is a normal flight or a charter flight. Choosing between normal and charter flights is important because different percentages for seat occupancy are used in the calculator, assuming that a charter flight will have more seats occupied than a regular flight. The calculator uses fuel consumption figures for 43 different aircrafts that covers approximately 95% of worldwide air traffic. Atmosfair calculates the great circle route and takes into account the flight distance along with the flight profile for calculating fuel consumption (Kollmuss & Lane, 2009). This calculator is also more transparent than others, as many carbon calculators do not show the steps used to derive final estimates.

When using a carbon calculator, it is important to realize that the actual emissions and those that are calculated will often vary for a number of reasons. Climatic conditions will always differ with various headwinds and tailwinds. In the case of inclement weather a flight may be diverted, adding to the actual distance imputed for the calculation between departure and destination cities. A plane also may end up in a holding pattern waiting to land. Finally, the actual mass of the aircraft may vary from flight to flight especially due to passenger and cargo contents (Jardine, 2009).

Sports and the Environment

As the previous section noted, carbon emissions are important when discussing environmental impact of travel. The travel associated with college conferences impact the environment through the release of emissions due to travel. However, sports as a whole can have a huge environmental impact both negative and positive. This section will discuss the environmental impact of sports.

International Sports

Sports and the environment are intertwined. This connectedness is most obvious when looking at the Olympic Games. The Olympic Games had two pillars, sport and culture, until 1994 when the environment was added as a third pillar (Chappelet, 2008; DeChano & Hruska, 2006). The addition of the third pillar occurred after the International Olympic Committee (IOC) signed a cooperation agreement with the United Nations Environment Programme (UNEP) (Schmidt, 2006). UNEP promotes the sustainable development of the environment on the global scale through the United Nations (UNEP, 2003). The environment being added as the third pillar is significant as the Olympics are one of the largest international sporting events, occurring every two years with summer and winter games alternating. The 2012 London summer games had 10,500 athletes participating from all over the world and over 500,000 people traveling to watch the games (Pfahl, 2013).

Cities that wish to bid for hosting the Olympic Games must include an environmental assessment (Schmidt, 2006). This requirement emerged from what came

to be called Agenda 21 for the Olympic Movement, adopted by the IOC in 1999. These adoptions came after the 1994 Winter Olympics in Lillehammer, Norway, which was considered by many to be the first attempt at a "green" Olympics (DeChano & Hruska, 2006). These games followed the 1992 Albertville, France, Winter Games which were a catalyst for the Olympic environmental movement. During the lead up to the 1992 games, environmental concerns were being raised by environmental groups and others (Samuel & Stubbs, 2012). This resulted in some efforts to protect the environment, but they were very limited. For example, residents in the city were given gasmasks because of the risk associated with the storage of 40 tons of ammonia for the freezing of bobsled runs. Environmental groups also raised issues associated with an easily dismantled ski jump tower, which was rejected in favor of a concrete one that was extremely bulky (Terret, 2008). The IOC and the Olympic Games Organizing Committee (OGOC) were unfazed by these concerns. When damage occurred seemingly unimpeded by the IOC and OGOC, there was quite an outcry and a lot of negative publicity for the Olympics. The alpine wilderness at the games was greatly damaged. The tree line was scarred and plant and animal habitats were devastated, all occurring on an already shrinking environment (Samuel & Stubbs, 2012).

The 2012 games were awarded to London, England, on July 5, 2005 (O'Brien, 2012). After the announcement, the IOC made sure to draw attention to the centerpiece of London's bid, which incorporated many environmental aspects (Roper, 2006). The London Games had five themes related to the environment: climate change, biodiversity and ecology, inclusion, waste and healthy living (Samuel & Stubbs, 2012). The plan called for the development of an urban park while featuring things such as natural

corridors, waste water and energy management, wetland and waterway restoration, and sustainable building development (Roper, 2006). The sustainability criteria that was included in the bid was something that had previously not been seen. The people behind the organizing of the London bid had completed full environmental impact statements for the venues relatively early, which put London ahead of other bidding cities (Samuel & Stubbs, 2012).

Major events such as the Olympic Games can cause vast environmental damage, which is why the environmental portion of the London bid was the centerpiece. These events can be harmful through many ways. Physical development required of these events, such as building construction, transportation and other ways, all can change the land use in these areas causing irreparable harm to the environment. Large sporting events such as the Olympics consume large amounts of non-renewable resources, release emissions to the air, soil, and water, and generate large amounts of waste. These events also contribute to global climate change, biodiversity depletion, and air pollution (Roper, 2006).

Attempting to manage global climate change is a major focus for everyone, and often when discussing climate change, carbon emissions are a main point. The first major event that attempted to deal with carbon emissions was the Salt Lake City Winter Olympics in 2002. While these games were highlighted by a corruption scandal, much was done in terms of environmental management not previously seen. The Salt Lake City Games encouraged US companies to purchase emission credits to donate as an offset for the estimated 180,000 tons of carbon dioxide that were emitted during the games (Roper, 2006). From the start the Salt Lake Organizing Committee (SLOC) was keen on

implementing an environmental management system for all aspects of the winter games. This plan included water and energy conservation measures, site construction, transport and accommodation systems, and education programming. The successes of the games in the environmental perspective can be seen through the over 95% of waste that was recycled or composted, along with 100,000 trees planted by primary school classes with the cooperation of the US Forest Service in areas around the venues (Chappelet, 2008).

Another major international organization that is addressing environmental concerns is the Federation Internationale de Football Association (FIFA), the governing body of international soccer. The headquarters of FIFA were built as a zero-emission building and they developed guidelines similar to the IOC for host countries to follow when bidding to host the World Cup (Pfahl, 2013). The Green Goal program has been developed with the goal of having the World Cup be more climate-neutral (Trendafilova, Pfahl, & Casper, 2013). The World Cup is played every four years and is the biggest competition for a single-event sport in the world (FIFA, 1994-2015). Individual soccer clubs within FIFA, such as Manchester United of the English Premier League, have been working on environmental impact for quite some time. The club has been reducing energy consumption for a while, starting before the United Kingdom government introduced the Carbon Reduction Commitment Energy Reduction Scheme. Manchester United currently is looking at furthering energy savings by reviewing the latest technology for renewable energy (Trendafilova et al, 2014).

Professional Sports

In recent years there has been growing environmental awareness among the leadership of many professional teams in the United States. This started about 11 years ago with the Philadelphia Eagles being considered the leader (Trendafilova, Pfahl, & Casper, 2013). The Eagles have saved over $3 million through reductions in waste, water, and energy use (Henly, Hershkowitz, & Hoover, 2012). Of the 122 teams in the four major sports leagues (MLB, NBA, NFL, NHL), over 30 report using renewable energy for at least some portion of their operations. More than double that number have implemented energy efficiency programs (Trendafilova, Pfahl, & Casper, 2013). The four major sports leagues and other similar organization all strive to minimize negative environmental impacts as will be discussed below.

Stock car racing has become very popular over the years and this has put increasing pressure on the sport for their resource consumption, as cars are an obvious example of a polluting entity. NASCAR has what is called the 'Race to Green' initiative. This initiative was dedicated to making the sport more environmentally friendly and calls upon teams, fans, tracks, and corporate sponsors to be as environmentally friendly as possible. NASCAR cooperated with the Arbor Day Foundation and planted trees across the country in places around the tracks where the trees were needed. NASCAR is also home to the most diverse and largest recycling program in professional sports along with the world's largest solar powered sports facility (Trendafilova, Pfahl, & Casper, 2013). Pocono Raceway in Pennsylvania has a 3-MW solar farm which is twice the size of the next largest one for a renewable energy stadium project. The solar farm here not only

powers the track, it also powers 250 homes on the local power grid (NASCAR Green, 2014).

The NBA has been partners with the National Resource Defense Council (NRDC) since 2007 and has implemented a variety of environmental initiatives. One of the events they promote to highlight the environment is NBA's Green Week. This involves a week of activities with community action and fan engagement while highlighting environmental awareness (Casper, Pfahl & McCullough, 2014). Through the NBA Green program, many teams work on environmental initiatives at the stadiums where they play. Currently six teams have achieved some level of Leadership in Energy and Environmental Design (LEED) certification for their arena complexes. These are the Portland Trailblazers' Modo Center, the Atlanta Hawks' Philips Arena, the Miami Heat's American Airlines Arena, the Orlando Magic's Amway Center, the Houston Rockets' Toyota Center, and the Brooklyn Nets Barclays Center (NBA Green, 2014). The first arena to achieve any level of LEED was Philips Arena in Atlanta in 2009 for existing building operations, with improvements reducing the energy consumption by 2 million kilowatt-hours annually (Henly, Hershkowitz, & Hoover, 2012). Other teams, while not completing full LEED certification, have made stadium improvements including solar panel installation for five other teams, and an 115,000 square foot green roof on the Target Center in Minneapolis. During the 2013 Green Week, the NBA offset the electricity used for the games that week. This resulted in more than ten million pounds of carbon being offset (Hershkowitz, 2013). This offset was done through a partnership with Sterling Planet which is a leading supplier of renewable energy (Crandall and Sterling, 2013).

The NBA's Portland Trailblazers are one of the leaders when it comes to environmental stewardship. Not only were they the first NBA team to have their arena LEED gold certified in 2010, the team plays in the first professional sports arena worldwide to achieve "gold". In the Portland region, the Modo Center became the largest, single, electric vehicle charging station when ten charging stations were revealed as a part of NBA Green Week in 2012. At the stadium, there is also an interactive display called the Corix Living Wall designed to educate fans on the development of EcoDistricts in the city of Portland. This is through a partnership with the City of Portland and Corix Utilities allowing the Trailblazers to pledge their commitment to sustainability (NBA Green, 2014). At the arena, more than 800 tons of waste per year are diverted from local landfills, achieved through an aggressive waste diversion program. Over two million kilowatt-hours of energy is saved through energy efficient lighting along with low flow plumbing fixtures. For the actual energy purchased for the arena, the team purchases 100% renewable energy through a partnership with Pacific Power and NW Natural (Henly, Hershkowitz, & Hoover, 2012). Currently, after recovering their up-front green investment costs, they have saved approximately $500,000 (NBA Green, 2014).

The NRDC has been mentioned previously as a key collaborator with numerous sports teams and organizations addressing environmental impact. An organization similar to this is the Green Sports Alliance. The Green Sports Alliance assists professional sports teams with enhancing their environmental performance (Trendafilova, Pfahl, & Casper, 2013). This nonprofit organization was started in February 2010 at a workshop about Sustainability Issues in Sports. The founding members were the Seattle Seahawks (football), Portland Trailblazers (basketball), Seattle Sounders FC (soccer), Seattle

Mariners (baseball), Seattle Storm (women's basketball), Vancouver Canucks (hockey), Milepost Consulting, Bonneville Environmental Foundation and the US Environmental Protection Agency (Pfahl, 2013). This alliance now includes over 20 different sports leagues, venues, and teams from 14 countries (Green Sports Alliance, 2015).

The Green Sports Alliance was launched nationally in March 2011, after the benefits of such an alliance were realized. The goal is to bring together sport personnel from around the world in order to share information and ideas for ways to improve environmental performance throughout the sports industry. Membership is open to any sports team, league, collegiate program, or venue as long as they are committed to improving environmental performance. This alliance offers a variety of ways for members to reach their environmental goals. Direct support, focused research, assisted networking with recognized leaders in the industry, gathering and sharing of best practices for venue operations and team communications, monthly webinars, and workshops are ways they help achieve these goals. The organization does not prescribe actions or even monitor the actions of members. Instead, it focuses on the sharing of information and bringing people together for the discussion of all issues related to sports and the environment, and ways to address these issues. There is room for expansion with more members, as currently most members are professional sport organizations in North America, not many collegiate and smaller professional sports organizations are involved (Pfahl, 2013).

College Athletics

At the collegiate level, more and more colleges are promoting sustainability and being more eco-friendly and, university athletic departments are slowly increasing sustainability efforts. Colleges and universities are often central to the local community giving them the ability to spread the environmental message. Colleges and universities can help facilitate change through the ability to engage the community, but also in the ability to amass research talent with resources. Athletic department sustainability efforts not only provide an educational opportunity for fans and students, they impact the bottom line through cost savings and revenue generation (Casper, Pfahl, & McCullough, 2014).

When it comes to college athletic department's sustainability and colleges, there seems to be disconnect with some between environmental strategies. This was discovered through a study that interviewed 97 key administrators at various Football Bowl Subdivision universities. While the majority of respondents believed that at the university level, environmental and sustainability initiatives were high priorities, only 43% of the respondents believed these to be a high priority within the athletic department. This study suggested a lack of clarity and understanding between the athletic departments and the university-wide role in sustainable initiatives. It is clear that athletic departments need to foster relationships with university sustainability office personnel because without a solid relationship it will be difficult for the department to develop, administer and evaluate sustainability efforts (Trendafilova, Pfahl, & Casper, 2013).

There are quite a few universities working on improving the sports operations impact on the environment. When it comes to LEED building practices, 41 athletic departments and 47 recreation departments have built to LEED standards for new

facilities, existing facilities, and major renovations. Some conferences even have their own environmental initiatives with the Ivy League considered to have the best, but the Big Ten Conference, Southeastern Conference, and Pacific-12 have noteworthy ones as well (Henly, 2013).

Many high profile schools have implemented more environmentally friendly practices, but some smaller schools have also followed suit. The University of North Texas (UNT) does not have well-known sports program, but are making efforts to improve sustainability. These efforts include the first sports venue to be LEED platinum certified in the United States for Apogee Stadium. This stadium allows the athletic department and UNT to give tours and educate people on the value of green innovation. The location of the stadium's LEED Platinum plaque along with wind turbines that provide 30% of the stadium's energy needs are visible to an estimated 24,000 people every day (Henly, 2013).

Among the larger, more prominent schools, the University of Florida is a leader for LEED certified buildings. The university has five LEED-certified athletics facilities along with a LEED gold certified recreation center. The university has a minimum LEED certification for any new buildings or construction and has continued to raise standards. They now require a minimum of LEED gold for new projects. Arizona State University (ASU) is also committed to sustainability, mostly through harnessing of solar energy. They have the largest solar portfolio of any university in the US, taking advantage of the 300 days of annual sunshine Phoenix receives. The solar panels are able to meet almost 40% of the university's peak demand during the day. ASU has constructed new basketball facilities that meet LEED gold standards, and receive 45% of its energy from a

photovoltaic system on the roof (Henly, 2013). The University of Colorado does Sustainability Gamedays for their basketball teams. The University gets a corporate partner, which helps highlight sustainability efforts during men's and women's basketball games through various activities (Casper, Pfahl, & McCullough, 2014).

Overall, the sporting world's impact on the environment has continued to be lessened over time. Large sports governing bodies such as the IOC and FIFA have taken steps towards reducing environmental impact through city event selection requirements. Other professional sports leagues like the NBA have put the environment at the center of events like "Green Weeks". At the collegiate level, some schools are using their high profiles in the community to raise environmental awareness. Many schools are using LEED certified building practices as a way of achieving this. People often recognize what LEED certified buildings are, and several universities are using LEED certified athletic facilities to boost their environmental reputation. As the center of a community, it is important that universities use their ability to reach a wide range of people who might not give the environment the proper thought, through their athletic teams.

CHAPTER III

METHODOLOGY

Study Site

The focus of this study will be the Power 5 conferences (Atlantic Coast Conference [ACC], Big12, Big Ten, Pacific-12 [Pac-12], and the Southeastern Conference [SEC]) locations across the continental U.S. The years included in the study were 2010 and 2014. The year 2010 was the starting point, as it was the year prior to the most recent major change in the college football conference landscape. Only conference games were included for analysis, as teams play a variety of teams out of conference and these non-conference games change significantly from year to year. After email and phone calls with the Director of Football Operations at the University of Michigan, Michigan State University, Purdue University, Stanford University, University of Miami (Florida), and Oregon State University, it was determined that most schools use a three- to five-hour time period for travel when choosing between bussing or flying to games. The three- and five-hour drive times were both used for calculating carbon footprints.

Data Collection

Travel distances between schools were collected using Google Maps to determine the approximate miles and travel time between football stadiums. Distances between football stadiums and airports were also collected through Google Maps. Airports were chosen based on the likelihood of the team being able to schedule a charter flight, as some close airports had an inadequate level of service and did not offer charter flights. The three digit airport codes for airport designations were collected for all relevant

departure and arrival airports. Once collected, variables were entered into the Atmosfair calculator: departure and arrival airports, the flight class, type of flight (charter), aircraft type (Boeing 757-300, 767-300, and 777-300), and round trip for one passenger, as emissions are calculated per person for flights. These types of planes were chosen because the Boeing 757, 767, and 777 are common charter planes for football teams (McCartney, 2012). The -300 version of the planes were chosen due to the -300 versions are slightly longer, and allow more cargo capacity (Boeing, 1995-2015). For the mapping component, the latitude and longitude coordinates of stadiums were collected in order to compute geographic centroids.

Data Analysis

Geographic centroids were determined for each conference in 2010 and 2014. Geographic centroids were used to determine the "as the crow flies" distance between schools and the geographic center of the conference. This was done in ArcGIS ArcMap 10.2 (ESRI, 2014). A simple contiguous United States map was acquired from ESRI in the NAD_1983_Contiguous_USA_Albers projection. The latitude and longitude of the school's football stadiums were imported using the display xy data function to create a feature class of each conference in 2010 and also in 2014. Using the mean center tool, the geographic mean center (geographic centroid) was calculated and saved as a separate feature class for each of the two years. To determine the distance of each school from the geographic centroid, the point distance tool in ArcMap was used to create a table of all distances. To determine the average driving distances, distances from Google Maps were used.

The Atmosfair carbon calculator was used for the airline carbon emissions calculations. This calculator was discussed in Chapter 2. Carbon emissions were calculated for busses and airplanes, along with the two different travel times of three and five hours. There were three different planes used (Boeing 757-300, 767-300, and 777-300) and two different numbers of busses (either four or five as busses typically seat between 50 and 60 people), as well as three different sizes of travel parties (140, 160, and 180 people). The travel parties were based on viewing and counting flight manifests from the University of Oregon and Oregon State University as high and low numbers, 140 and 180, since 160 was the average (Iboshi, 2014). Four and five busses were used based on the assumption that teams would not fill every seat with a player as football players are larger than average people, and also due to equipment and luggage that travels with teams. Each plane, travel party, and possible number of busses were calculated. As an example, one combination was a 757 plane, with a travel party of 140, using four buses to get to and from the airport. Eighteen combinations for 2010 and 2014 was calculated.

Airplane emissions were calculated for one person, as airplane emissions are calculated per person, and then multiplied by either 140, 160, 180 for each plane. The bus emissions were calculated on a per bus basis. Using data from the Motorcoach Census (2011) from the American Bus Association, the average miles per gallon (mpg) for buses was determined to be six mpg (Dunham & Associates, 2012). The mpg was divided by the total miles traveled (airport to schools, or school to school) in order to determine the fuel consumption. Fuel consumption was multiplied by an emissions factor of 10.21 kg of carbon dioxide per gallon (Federal Register, 2009) to determine the carbon dioxide emissions released per bus. In order to calculate the emissions for the travel using a 757

airplane, four busses, and 140 people the following steps were taken. First, the emissions for a 757 between the two airports were calculated, which gave the emissions of one person traveling round trip. This number was multiplied by 140 for the number of people traveling. Next, the bus emissions were calculated for one bus traveling from the school to the departure airport and from the arrival airport to the host school. This emission value was then doubled to account for round trip travel, and then multiplied by four to get the total emissions for four busses traveling. Airplane and bus emissions were summed to get a total for any given trip. These flying emission values were calculated for every game, however, if the travel time by driving was under the three- or five-hour drive window, the bus emissions between the two schools were used for the footprint instead of flying. The results of the 18 combinations for both periods of travel along with the geographic centroid changes are discussed in the next chapter.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents results from the analysis of data, relating to changes in conference geographic centroids and carbon emissions occurring after the recent wave of realignment in college sports conferences for football. Discussion of what these results mean for the environment and the conference themselves is discussed accordingly.

It is important to remember that during the recent realignment of schools in the Power 5 conferences that two conferences (ACC and Big 12) both lost schools and added new ones. This is contrasted with three conferences (Big Ten, Pac-12, and SEC) that only added new schools. There was also variation in the number of conference games played by teams in each of the five conferences. Sometimes this variation occurred year-by-year. Both of these aspects are important to keep in mind when investigating the differences in conference geographic centroid as well as changes in carbon emissions due to team travel. A listing of the city locations of schools is listed in Appendix A.

Geographic Centroid Movements

As noted in the methodology, geographic centroids were calculated for both 2010 and 2014. Each conference is discussed in detail separately with figures and tables showing results of the analysis. Each of the five conferences experienced shifts in the geographic centroid.

The ACC was a 12-member conference in 2010, and became a 14-member conference in 2014. In both years, the conference was split into two divisions, with a conference championship game played after each team played eight- conference games.

The conference added Syracuse University (Syracuse) and the University of Pittsburgh (Pittsburgh) from the Big East for the 2013 season, and the University of Louisville (Louisville) for the 2014 season. The only school to leave the conference was the University of Maryland (Maryland), which left after 2013 for the Big Ten Conference. Syracuse and Pittsburgh were moved to into different divisions in order to keep the numbers even, and Louisville was added as a replacement for Maryland, also to keep the numbers even.

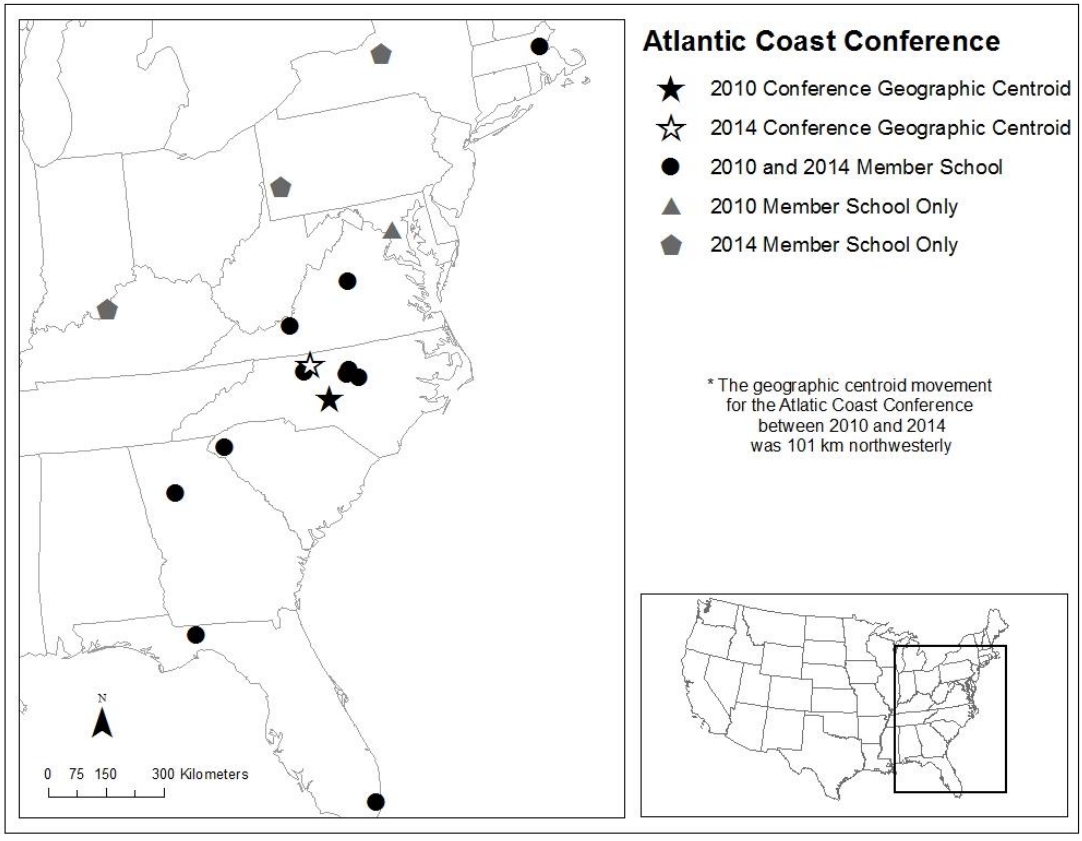

Figure 1: The location of the ACC schools along with the geographic centroid of the conference. (Source: Author)

The geographic centroid of the conference as shown in Figure 1 moved northwestward between 2010 and 2014. This movement in straight line distance is 101

km. All three teams that joined the conference were north of the 2010 geographic centroid of the ACC. The teams (Louisville, Pittsburgh, and Syracuse) all formerly belonged to the Big East football conference before the Big East collapsed, while Louisville was in the American Athletic Conference (Big East replacement) for one season before joining the ACC. In terms of the average distance from the geographic centroid, in 2010 the distance was 410 km. This can be compared to 2014 results where the average distance to the geographic centroid was 447 km, a 9% increase in distance (Table 2). None of the additions were located farthest from the geographic centroid. In 2010, Boston College was the farthest from the geographic centroid at 1061 km, but the added schools pulled the geographic centroid north. In 2014, Miami was the farthest at 1147 km.

The Big 12 was the only conference with fewer teams in 2014 than in 2010. The University of Nebraska (Nebraska) and the University of Colorado (Colorado) parted ways with the Big 12 after the 2010 season for the Big Ten and Pac-12 respectively. After the 2011 season, Texas A&M and the University of Missouri (Missouri) both left to join the SEC. This departure left the conference with only eight members, resulting in Texas Christian University (TCU) and West Virginia University (West Virginia) joining to once again increase member teams to ten. There were no subsequent changes occurring between 2012 and 2014. In 2010, the Big 12 had two divisions and a conference title game after eight- conference games. In 2014, the conference no longer had two divisions or even a conference title game but played a nine- game schedule where every team played every other team in the conference. Now, there is no longer a conference title

Table 2: Distances to geographic centroid in a straight line (kilometers)

		Average Distance to Geographic centroid	Max Distance to Geographic centroid
ACC	2010	411	1061
	2014	447	1147
	Difference	36	85
	% Change	9%	8%
Big Ten	2010	328	732
	2014	453	947
	Difference	125	215
	% Change	38%	29%
Big12	2010	479	799
	2014	540	1409
	Difference	61	610
	% Change	13%	76%
Pac-12	2010	694	1060
	2014	728	1017
	Difference	34	-43
	% Change	5%	-4%
SEC	2010	382	727
	2014	447	899
	Difference	65	172
	% Change	17%	24%

Source: Author

game, as NCAA rules require a conference to have 12 teams and two divisions if the conference wishes to hold one (Dodd, 2014).

The geographic centroid for the Big 12 exhibited the greatest spatial shift in Euclidean distance of all the conference between 2010 and 2014, moving 176 km to the southeast (Figure 2). In 2010, the average distance from all schools to the geographic

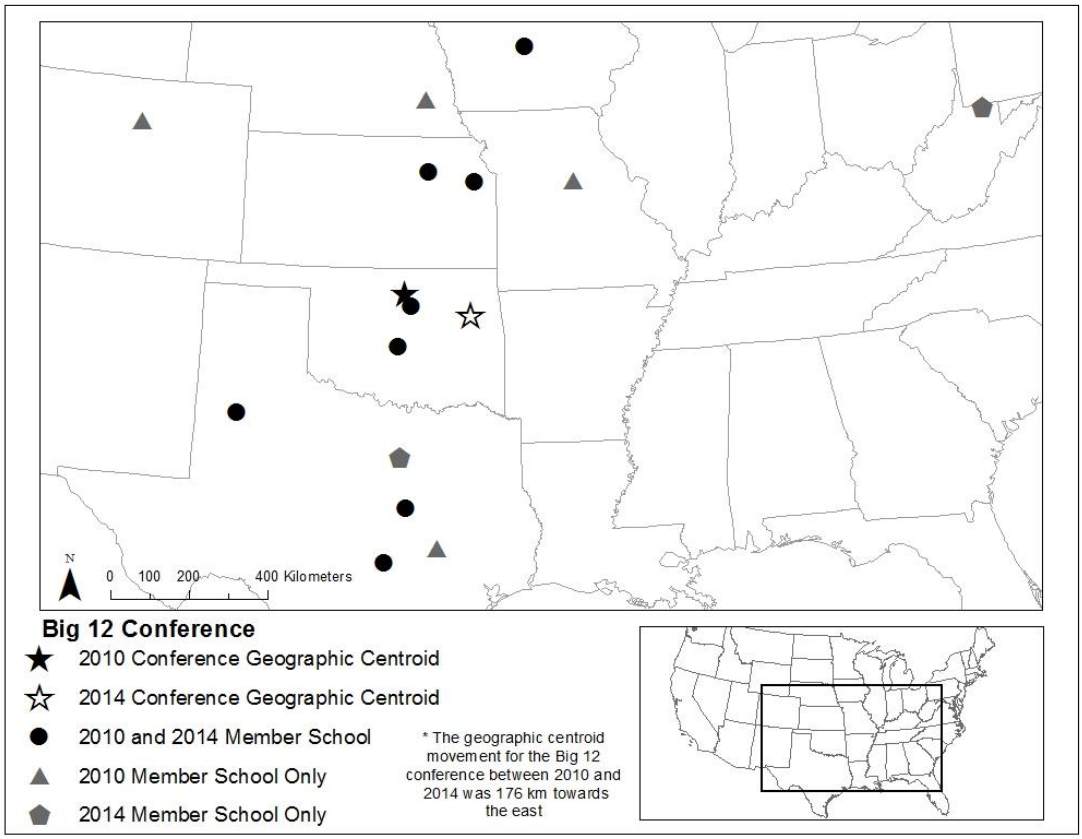

Figure 2: Showing the spatial distribution and geographic centroids of the Big 12 conference (Source: Author)

centroid was 479 km, compared to the 2014 distance of 540 km, which was an increase of 13%. The maximum distance to the geographic centroid between these years is the largest change for all five conferences. As shown in Table 2, the maximum distance from the geographic centroid was 799 km in 2010, but increased to 1409 km in 2014. West Virginia University is the school located 1409 km from the geographic centroid, and is located a considerable distance from any other conference opponent with the closest being Iowa State located 1179 km in a straight line, and 1400 km of driving distance.

The Big Ten Conference did not lose any members and, in fact, added three new member schools. Nebraska joined in 2011 as did Maryland, and Rutgers University (Rutgers) in 2014. The Big Ten Conference went from 11 member schools in 2010 to 14 in 2014; resulting in the creation of the "leaders" and "legends" divisions in 2011. Then in 2014, these divisions were realigned to become the East and West Divisions. With addition of the new teams, a conference championship game was created after the eight game conference schedule. Each team plays each division opponent and two additional teams from the other division.

The Big Ten Conference had the smallest shift in geographic centroid (Figure 3) as it only moved southeast by 77 km due to the additions of Rutgers and Maryland. The conference reported the largest increase in the average distance to the geographic centroid at 38% (Table 2). However, the actual distance was only 6 km farther than the lowest for 2014 at 453 km (ACC and SEC at 447 km) and was the lowest in 2010 at 328 km. The Big Ten Conference had the second largest increase in the maximum distance to geographic centroid (behind only the Big 12) with an increase of 29% going from 732 km to 947 km.

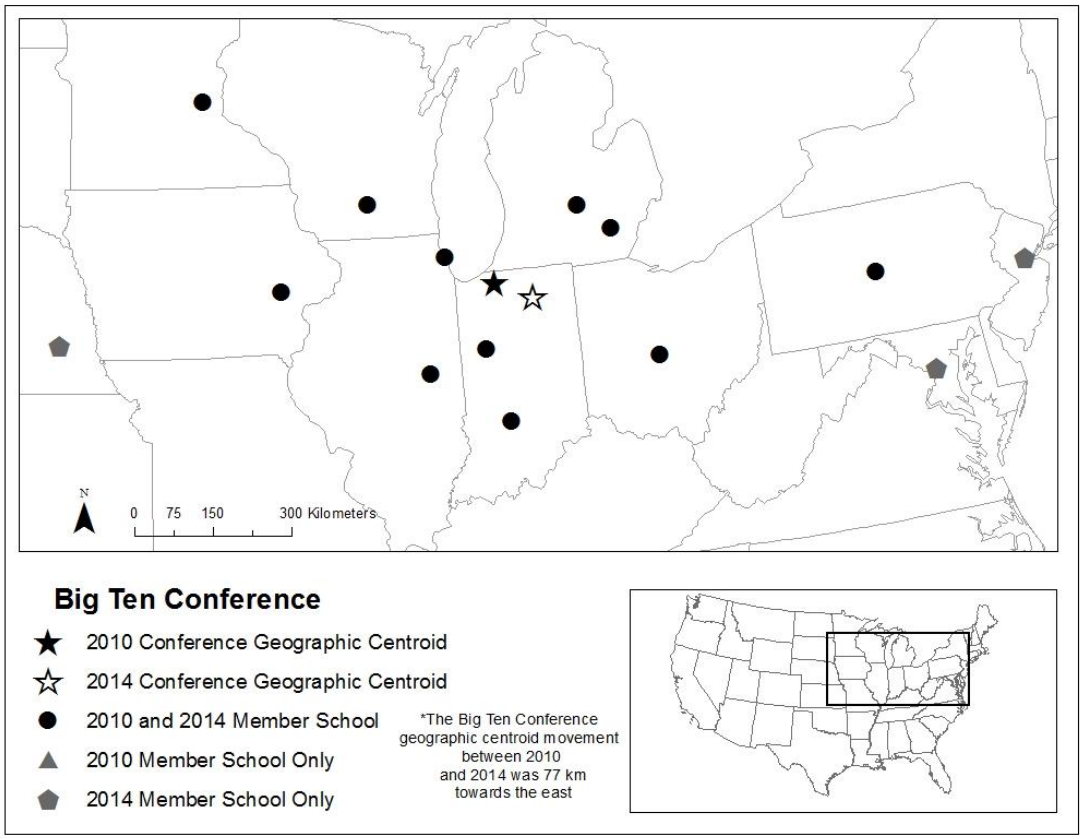

Figure 3: Showing the spatial distribution and geographic centroids of the Big Ten Conference (Source: Author)

The Pac-12 Conference did not lose any member institutions, but gained two new members in Colorado and University of Utah (Utah). Colorado transferred from the Big 12 and Utah came from the Mountain West Conference. The Pac-12 Conference changed the conference name from the Pacific-10 (Pac-10) to the Pacific-12 (Pac-12) after the addition of these teams to reflect the number of schools in the conference. The addition meant that the conference could create a conference title game. In both 2010 and 2014, the conference played a nine- game schedule. In 2010 every team played every other team, but now teams play all five division opponents, and then four teams from the other division.

The Pac-12 Conference geographic centroid movement between 2010 and 2014 is shown in Figure 4. The geographic centroid moved nearly due east by 149 km. The average straight-line distance between the schools and geographic centroid (Table 2) in 2010 was 694 km, while in 2014 it was 728 km, which is an increase of 5%. The

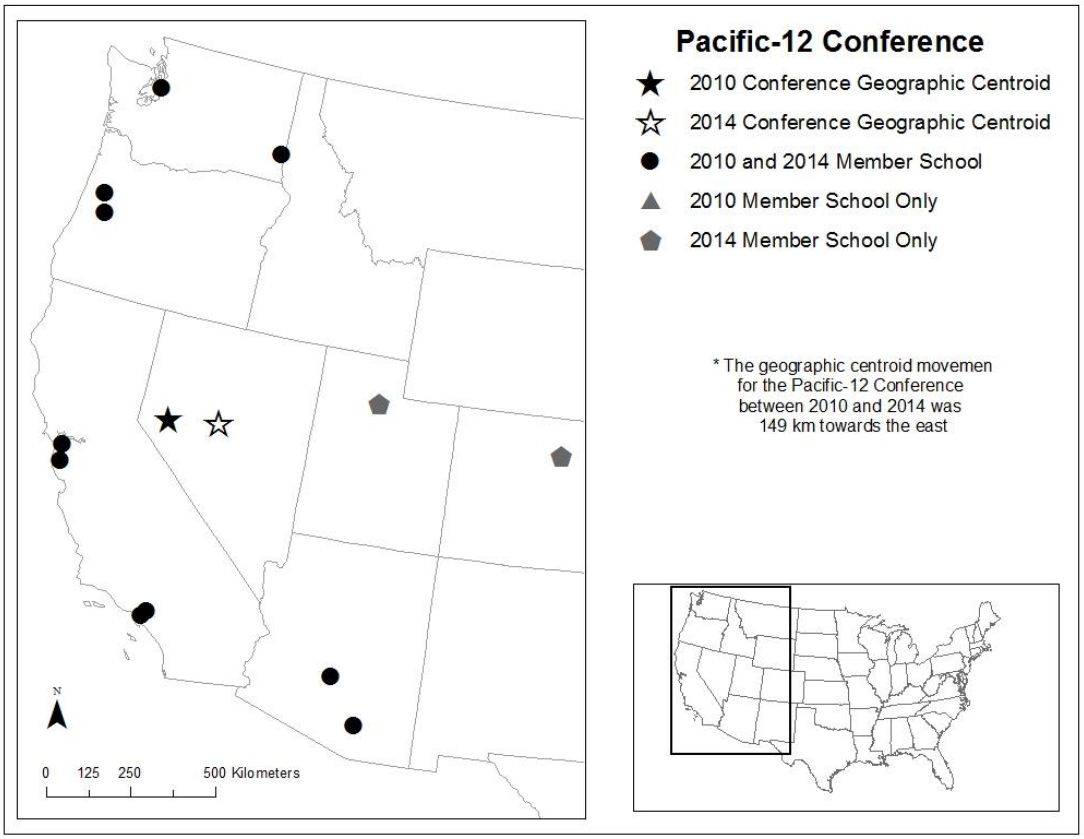

Figure 4: Showing the spatial distribution and geographic centroids of the Pac-12 Conference (Source: Author).

maximum straight-line distance between a school and the geographic centroid actually decreased between the two periods by -4%. This decrease made the geographic centroid more of a geographic fit for the center of the conference compared to the previous which had schools located farther away. The distance between Utah and the geographic centroid in 2014 was 478 km, which was the second closest distance behind the University of

California-Berkeley, which was 466 km from the geographic centroid. The other addition was Colorado located 1,017 km away from the geographic centroid, which is the farthest of any schools. However, it is barely farther than the University of Washington, which is located 1,005 km from the geographic centroid and has always been a member of the Pac-12 conference.

The SEC Conference was a 12-team conference in 2010, and did not lose any members. However, the conference added Missouri and Texas A&M from the Big 12, to their already existing East and West divisions. This makes less sense spatially however, as only two schools are west of Missouri. One is Texas A&M and the other is the University of Arkansas.

The geographic centroid shift as shown in Figure 5 moved 102 km westward between 2010 and 2014. The average distance from schools to the geographic centroid in a straight line went from 382 km in 2010 to 447 km in 2014, which is an increase of 17%. The maximum distance a school is from the geographic centroid changed from 727 km in 2010 to 889 km in 2014.

These changes in geographic centroid distance may not seem very far in some cases. Remembering that these are Euclidean distances, the actual travel time for a fan traveling may be much greater. This increase may be an extra 45 minutes, but this may be on top of a one- or two-hour drive. This might make some fans less likely to travel to away games. As shown in previous figures, all conferences exhibited an increase in average distance to the geographic centroid and all but one conference (Pac-12) increased the maximum distance to the geographic centroid. Because these conferences are more spatially dispersed, it is logical to believe that the carbon emissions from team travel also

increased due to these realignments. This portion of the research is addressed in the next section of chapter four.

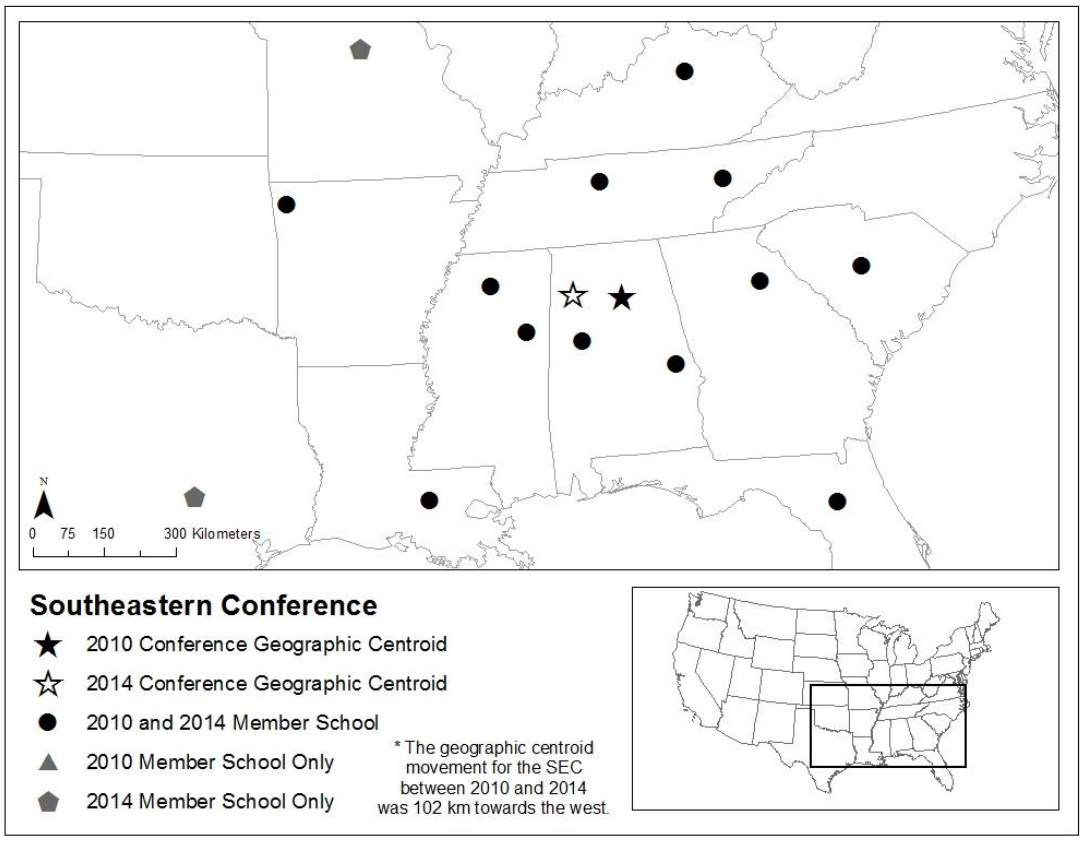

Figure 5: Showing the spatial distribution and geographic centroid of the SEC. (Source: Author)

Three- and Five-Hour Drive Times between Games Emissions

To this point, the analysis has focused on the Euclidean distances from the center of conferences to each school along with other aspects of spatial dispersion between 2010 and 2014. The rest of the analysis will focus on the carbon emissions that were associated with the realignments.

When looking at the overall average of all combinations for a three-hour driving window (Table 3), the conference with the lowest percentage total increase in emissions

was the Pac-12 Conference at a 16% increase, while the largest was the Big Ten Conference with a 54% increase in total emissions (Table 3). Consequently, the Pac-12

Table 3: Showing the overall averages for total emissions (Kg of CO_2) and percent change per conference

			Overall average 3 hour	Overall average 5 hour
ACC	2010	Total Emissions:	3464558	3212919
	2014	Total Emissions:	4499147	4230239
		% Change	30%	32%
Big12	2010	Total Emissions:	3306887	2983735
	2014	Total Emissions:	3957214	3620950
		% Change	20%	21%
Big 10	2010	Total Emissions:	2497212	1996618
	2014	Total Emissions:	3840257	3104675
		% Change	54%	55%
Pac-12	2010	Total Emissions:	4993232	4881705
	2014	Total Emissions:	5812257	5700730
		% Change	16%	17%
SEC	2010	Total Emissions:	2868129	2422336
	2014	Total Emissions:	3752251	3237815
		% Change	31%	34%

Source: Author

was also the only conference with a decrease in average emissions per game with a -1% change from 2010 to 2014. The conference with the largest increase in average emissions per game was the Big 12 Conference with an average increase of 28% from 2010 to 2014 (Table 4). The percentages for five-hour driving times are all similar to the three-hour driving times as the Pac-12 Conference had the lowest increase in total emissions at 17%, while the Big Ten was the largest at 55% (Table 3). These emissions number increases fit with the increase in the average distance to geographic centroids increasing for all conferences, while the maximum distance to the geographic centroid increased in every

conference except the Pac-12 which was the only conference with a decrease in average

Table 4: Showing the overall averages for average emissions (Kg CO2) and percent change per conference

			Overall average 3 hour	Overall average 5 hour
ACC	2010	Average Emissions:	72178	66935
	2014	Average Emissions:	80341	75539
		% Change	11%	13%
Big12	2010	Average Emissions:	68893	62161
	2014	Average Emissions:	87938	80465
		% Change	28%	29%
Big 10	2010	Average Emissions:	56754	45377
	2014	Average Emissions:	68576	55440
		% Change	21%	22%
Pac-12	2010	Average Emissions:	110960	108482
	2014	Average Emissions:	109665	107560
		% Change	-1%	-1%
SEC	2010	Average Emissions:	59752	50465
	2014	Average Emissions:	67004	57818
		% Change	12%	15%

Source: Author

emissions per game. A full list of all individual school results can be found in the appendix.

When comparing the three-hour and five-hour emission numbers, the five-hour emissions were lower than the three-hour emissions when looking at the same category. When comparing driving between two schools and flying, driving had lower emissions than flying between the schools. This explains why the five-hour drive time combinations had lower emissions as more games were drivable at five-hours compared to three-hour time frames. The smaller the travel party, the lower the emissions numbers also. With the airplane emissions being multiplied by the travel party, the larger the party the more

emissions. The emissions were also smaller when the combination involved a 757 airplane, the 767 was the next, and the 777 was the largest emitter.

The Big 12 Conference had the largest increase in average emissions, likely due to the change in conference scheduling, and the inclusion of West Virginia. Three of the four schools (Colorado, Nebraska, and Missouri) that departed the conference were on the northern edge of the conference (Figure 2). TCU's location was central to the Big 12's other schools in Texas, and is more centrally located than any of the four schools that departed. However, the addition of West Virginia, which was located at a greater distance than schools that departed, made a huge impact on the emissions numbers. Even though all four schools that left were on the edge of the conference, and West Virginia was also on the edge, the departed schools were still located in states bordering other conference states. If a straight line is placed between West Virginia and the nearest opponent (Iowa State), the line has to cross Ohio, Indiana, and Illinois. If you divide the 2010 total emissions number by eight, and the 2014 total emissions numbers by 9, to get the total emissions per week for an eight- and nine- game schedule, the 2014 emission totals are still higher than 2010. This shows that even though each team played more games in 2014, if evened out against the 2010 season with more total teams, the emissions numbers are higher in 2014. This is likely the primary reason that the total emissions and average emissions numbers jumped for the Big 12 Conference, even while having two less teams in 2014 than in 2010.

Table 3 shows that the Big Ten was last in total emissions in 2010 for both three-hour and five-hour driving. The Big Ten ranked 4th in total emissions in 2014 for three

hours, and ranked 5th in 2014 for five hours for both total and average. The SEC was 5th for total emissions and average for three hours, and 4th for the five hour.

The Big Ten had the largest percentage increase for total emissions. In 2010, the Big Ten had 11 teams, only bigger than the Pacific-10 with ten teams. By 2014, the Big Ten Conference added three additional teams bringing it to 14 teams, which is the largest size of any conference (ACC and SEC are also 14 teams). The Pac-12 conference only added two teams making it a 12-team league. The Big Ten also had the smallest geographic centroid movement (77 km) which may help explain the low average and total emissions.

For total and average emissions, the Pac-12 had the highest numbers. This conference is spread out across the West Coast. The conference had the lowest number of drivable games with four in the three-hour and five-hour period of 2010, and seven for both in 2014 (Table 5). The Big Ten had the lowest total emissions for the five-hour window for 2010 and 2014, which made sense as they had the most games that are drivable at 21 and 25 games. The SEC had the second lowest total emissions for those same years and the five-hour drive time, at 19 and 21 games.

Table 5: Number of games that were drivable

	3 hours 2010	3 hours 2014	5 hours 2010	5 hours 2014
ACC	8	8	17	16
Big 12	7	6	16	14
Big Ten	7	6	21	25
Pac-12	4	4	7	7
SEC	8	8	19	21

Source: Author

Teams that were added into the Big Ten (Maryland, Rutgers, Nebraska) were all within a five-hour driving time of at least one opponent. Nebraska was within five hours of the University of Iowa. Rutgers and Maryland were within five hours of Penn State University, and each other. Every team that was added to the Big Ten had a conference opponent that was within the five-hour drive time. The ACC additions of Syracuse and Pittsburgh had opponents within five hours but Louisville did not. Syracuse was within five hours of Boston College, and Pittsburgh was within five hours of the University of Virginia. The Big 12 conference added TCU that was within three and five hours of a conference school. TCU was within a five-hour drive of Oklahoma State University and Texas Tech University and within three hours of Baylor University, University of Oklahoma, and the University of Texas. The SEC also had one of its two additions within a five-hour drive time of an opponent. Missouri was within five hours of Arkansas, however, these two teams are in separate divisions and do not play each other every year.

The average driving distance between games (Table 6) once again reflects the Big Ten and SEC having the most drivable games. For Big Ten games, the average driving distance was 586 km in 2010, and 687 km in 2014. For the SEC the average driving distance was 640 km in 2010, and 717 km in 2014. The average driving distance for the Pac-12, which had the fewest games that were drivable (Table 5), was 1169 km in 2010 and 1190 km in 2014 (Table 6). The emission total and average numbers are clearly backed up by these distances, as those conferences with lower driving distances had lower emissions.

Table 6: Average distances for driving between conference games

		Average Driving Distance (kilometers)
ACC	2010	766
	2014	862
	Difference	96
	% Change	13%
Big Ten	2010	586
	2014	687
	Difference	101
	% Change	17%
Big12	2010	725
	2014	926
	Difference	201
	% Change	28%
Pac-12	2010	1169
	2014	1190
	Difference	21
	% Change	22%
SEC	2010	640
	2014	717
	Difference	77
	% Change	12%

Source: Author

Summary

Across the board, all conferences increased their total emissions. The realignment in the Power 5 conferences showed an increase in total emissions, and all conferences except the Pac-12 Conference had an increase in average emissions per game. These increases in carbon emissions are occurring at a time when environmental impact of sports are being viewed more critically. The more carbon dioxide in the air, the more global climate change is impacted. In the grand scheme of things, these increased carbon

emissions from the new conference realignments, are having a larger impact on climate change. The more carbon that is emitted, the more that is absorbed by oceans. This increased carbon in the oceans can have an increased detrimental impact on the ocean environments as was discussed in Chapter 2. This could lead to more coral reef bleaching, and a reduction of coral reefs worldwide which are important for biodiversity and even coastlines (Christopherson & Birkeland, 2016). The increase in flying also means that more emissions are occurring at high altitudes, where impacts on the environment are not as well known yet. A study in 2008, found that the rise in temperature from increased emissions, might increase air pollution deaths. The model in that study showed that with increased carbon dioxide emissions, there is an associated rise with surface ozone, particulate matter, and carcinogens, which increase death, cancer rates, hospitalization and asthma (Jacobson, 2008). The increased emissions associated with sports can contribute to degradation of human health, ironically while sports have always been viewed as part of a healthy lifestyle (Schmidt, 2006).

The new conferences post-realignment are seemingly having a greater impact on the environment. This research only looked at football related travel carbon emissions. It did not look at the carbon emissions of other sports teams or fans traveling to and from games. Presumably accounting for fan travel and/or other conference sports, such as basketball, the carbon footprint of these conferences would be much greater. Sports such as basketball are played during the middle of the week, which means more flying, and thus would result in more emissions. As this research showed, the more games that were bussed instead of flown the lower the emissions.

One of the hypotheses for the study was the possibility that the use of divisions in the conferences may have reduced the carbon emissions per game. However, that was only apparent in the Pac-12. In the Big Ten where divisions were created, the average emissions per game still rose. In the ACC and SEC where divisions were already in place and schools were added, the emissions numbers still increased, therefore disproving the hypothesis.

If emissions from other smaller conferences were included in this study, it might be possible that emissions numbers per game may have gone down. However, as was mentioned in Chapter 2, even these smaller conferences have had vast expansions with greater distances between conference teams. Conferences as a whole try to have the best available teams, and that is no different for non-Power 5 conferences. The smaller conferences just do not have as much available money to travel as often or as conveniently as the Power 5 schools do.

CHAPTER V

CONCLUSION

Sports have a major impact on the environment. This research showed that the recent NCAA Division I realignment caused a rise in carbon emissions. The spatial expansion of these Power 5 conferences caused average emissions to rise in almost every case, and the only conference that did not have a rise was the one with the largest averages per game and highest total emissions (Pac-12). The ability of teams in conferences like the Big Ten and SEC to drive to games was reflected in the emissions numbers. The closer opponents are located to each other, the less travel, and less emissions are contributed to the environment. It was clear when looking at the results that the smaller 757 charter planes had fewer emissions than the 767 and 777 charter planes.

While colleges are becoming more sustainable on campus and at stadiums, the travel-related environmental impact has risen, and may continue to rise. This research demonstrated that it has risen on an average per game basis in four of five power conferences between 2010 and 2014. After researching the spatial patterns, and calculating carbon footprint for the conferences, it is reasonable to show that the carbon footprint as a whole has increased for each of these conferences. While some is due to more teams or a change in the number of games, each conference's total emission figures increased. These results are all contingent however on how a school views environmental impact. Certain schools may not be as concerned about this issue because of the financial increases that the change in conference has given them.

These new conference alignments are not as regional as they once were, now covering more territory spatially. The ACC initially covered the whole East Coast, but

now has expanded into Kentucky, New York, and Pennsylvania. The Big Ten, a formerly Midwest conference, now has members on the East Coast. The Big 12 formerly covered only the Great Plains but now has a school in the Appalachian Mountains. The SEC expanded into Texas and Missouri. Finally, the Pac-12 expanded away from the West Coast, into the Rocky Mountains with Utah and Colorado.

With conferences producing increased emissions, clearly something needs to change. The first suggestion, is with these conferences and teams receiving large revenues from media rights, these conferences and schools could purchase carbon offsets. Some schools may already be purchasing carbon offsets, but it should be done more purposefully and consistently, and maybe even on a conferences basis. Purchasing these offsets for traveling can help contribute to reducing the impact caused by the increased travel emissions from the realignment. This is the most feasible option. These conferences receive large revenues which could be used to purchase offsets. This may not make the conferences carbon neutral, but could make them more environmentally friendly.

The next suggestion would be to realign all the power conferences. Aligning the schools that are spatially close to one another would reduce emissions. However, that is unlikely to occur with the money that is at stake, along with most traditions of these conferences. One realignment that could possibly take place would be in the ACC divisions. Having divisions more geographically based would likely help with reduction in emissions. Currently, both divisions in the ACC have teams located next to opposite division schools. The two southern most teams Florida State University and University of Miami, are located in opposite divisions, which mean these two schools are not

guaranteed to play each other every season. The same is true for the schools in North Carolina, where four ACC schools are located. Two are in the Coastal Division and two are in the Atlantic Division. These schools are all located close to each other, and having them in the same divisions would guarantee these schools play each other, which would cut down on possible emissions. A realigning of divisions might be a possibility for the SEC as well after the additions of Texas A&M and University of Missouri (Missouri). Realigning the divisions so that Missouri is located in the Western Division rather than the Eastern Division would cut down emissions, as they are the third most western school. This would also mean they are in the same division as University of Arkansas, which is located within the five-hour driving window of the school.

The next suggestion would be to look at conference scheduling more closely. For the Big 12 where every team plays every team, this is not possible. However for a conference like the Pac-12 it is. In 2014, for the out-of-division games, the University of Washington played both the University of Arizona and Arizona State University. This meant that regardless of where the game was played, travel occurred between the states of Arizona and Washington twice that year. Ideally, a team would play these teams on a road trip, however with school demands and the week between games this is not a possibility. Having teams located on the edges of the conference play fewer teams out-of-division would lead to a reduction in emissions. Having teams from the edge of a conference play other edge teams in a road trip is a possibility for some sports. For football however, this is not possible because games occur once a week, usually on weekends. After the 2012 season, the Big 12 Conference aided West Virginia in regards to travel for games. For West Virginia's second season for basketball, the conference had

the school take one road trip before the semester started, and another later on in the season, helping to lessen the travel for the team (Carvelli, 2014).

Different Approaches

An alternative way this research could have been approached is to use an all-inclusive online calculator for driving emissions and flying emissions. This would have meant that the same calculations could have been used, compared to a different calculation for driving versus flying. This may have led to some individual result changes compared to the actual results. However, as this research used the same methodology for both time frames, as long as the same methodology and one calculator was used, then the number changes and percentage changes would likely have shown a similar reflection. Using multiple calculators and comparing the results would have been another approach that this research could have used.

Future Research

In the future, a more in-depth study could provide more detail on the environmental impact of this conference realignment. Researching team by team to determine average party sizes, and the actual airports and airplane types used for each game would provide a more accurate assessment of carbon emissions. The inclusion of out-of-conference games would also be an interesting comparison. Looking at other sports could also provide valuable insight to the impact, especially those sports that are not big revenue generators. Looking at more impacts besides carbon emissions of traveling for games such as stadium emissions or practice facility emissions would provide more details of college

sport's overall environmental impact. For recruiting, coaches must travel quickly often using private jets at power conference schools. It would be interesting to look at the environmental impact of this at Power 5 schools compared to the lower level conferences where travel budgets are not as expansive. Looking at one individual team and the travel of the fans with the team would be an interesting look at the environmental impact. All-in-all there is still a large amount of work to be done in the area of college sports and environmental impact.

REFERENCES

Abbott, C. (1990). College athletic conferences and American regions. *Journal of American Studies, 24*(2), 211-221. Retrieved September 29, 2014, from JSTOR.

Atmosfair. (n.d.). The atmosfair emissions calculator. Retrieved December 10, 2014, from https://www.atmosfair.de/documents/10184/20102/Documentation_Calculator_EN_2008.pdf/21655b2c-d943-4f87-a1b5-ff8607542cda

Berkowitz, S. (2014, March 20). NCAA has net assets of $627 million, say records. *USA Today*. Retrieved October 27, 2014, from http://www.usatoday.com/story/sports/college/2014/03/20/ncaa-expenses-revenue-money-mark-emmert/6651133/

Boeing. (1995-2015). Commercial airplanes, retrieved February 11, 2015 from http://www.boeing.com/boeing/commercial/757family/pf/pf_300back.page

Brief, C., & Clark, D. (2012, January 16). How long do greenhouse gases stay in the air? *The Guardian*. Retrived February 23, 2015 from http://www.theguardian.com/environment/2012/jan/16/greenhouse-gases-remain-air

Carvelli, M. (2014, January 6). Huggs: Big 12 'terrific' in aiding WVU travel. Retrieved February 25, 2015, from http://westvirginia.scout.com/story/1363520-huggs-big-12-terrific-aiding-wvu-travel

Casper, J. M., Pfahl, M. E., & McCullough, B. (2014). Intercollegiate Sport and the Environment: Examining Fan Engagement Based on Athletics Department Sustainability Efforts. *Journal of Issues in Intercollegiate Athletics*, *7*, 65-91. Retrieved December 9, 2014 from http://csri-jiia.org/documents/puclications/research_articles/2014/JIIA_2014_7_04_65_91_intercollegiate_sport_and_the_environment.pdf

Chappelet, J. L. (2008). Olympic environmental concerns as a legacy of the winter games. *The International Journal of the History of Sport*, *25*(14), 1884-1902. Retrieved December 6, 2014 from http://dx.doi.org/10.1080/09523360802438991

Christopherson, R., & Birkeland, G. (2016). *Elemental Geosystems* (Eighth Ed.). Hoboken: Pearson Education.

Crandall, M., & Mellin, D. (2013, April 4). NBA Green Week presented by Sprint tips off encouraging fans to go green. Retrieved January 18, 2015, from http://newsroom.sprint.com/news-releases/nba-green-week-presented-by-sprint-tips-off-encouraging-fans-to-go-green.htm

DeChano, L., & Hruska, L. (2006). The sport-physical environmental relationship. In *The Geography-Sports Connection: Using Sports to Teach Geography* (Vol. 33, pp. 5-14). National Council for Geographic Education.

Dennie, C. (2011). Conference Realignment: From Backyard Brawls to Cash Cows. *Miss. Sports L. Rev., 1*, 249. Retrieved December 9 2014

Dodd, D. (2014, March 14). ACC supports deregulation of conference championship games. Retrieved February 10, 2015, from http://www.cbssports.com/collegefootball/writer/dennis-dodd/24483893/acc-supports-deregulation-of-conference-championship-games-would-change-postseason-structure

Dunham & Associates, John. (2012, June 18). Motorcoach census 2011 a benchmarking study of the size and activity of the motorcoach industry in the United States and Canada in 2010. Abafoundation, retrieved December 10, 2014 from http://www.buses.org/files/Foundation/Final_Motorcoach_Census_2011_7-3-2012.pdf

ESRI. (2014). ArcMap 10.2. ESRI, Redlands, California

Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2. Table of Final 2013 Revisions to the Greenhouse Gas.

Field, C., Barros, V., & Mastrandrea, M. (2014). *Climate change 2014: Impacts, adaptation, and vulnerability. summary for policy makers*. Technical report, IPCC.

FIFA. (1994-2015). FIFA World Cup. Retrieved January 18, 2015, from http://www.fifa.com/aboutfifa/worldcup/

Graves, W. (2013, December 21). Colleges are cutting sports teams in smaller athletic programs as costs rise. *Huffington Post*. Retrieved October 31, 2014, from http://www.huffingtonpost.com/2013/12/21/colleges-cutting-sports_n_4486419.html

Grayson, S. (2013, March 15). Big 12 commissioner discusses WVU travel, expansion. Retrieved January 16, 2015, from http://www.wvillustrated.com/story/21650890/big-12-commissioner-discusses-wvu-travel-expansion

Green Sports Alliance. (2015). Member benefits. Retrieved January 24, 2015, from http://greensportsalliance.org/members-benefits/

Havard, C. T., & Eddy, T. (2013). Qualitative Assessment of Rivalry and Conference Realignment in Intercollegiate Athletics. *Journal of Issues in Intercollegiate Athletics, 6*, 216-235. Retrieved December 10, 2014

Henly, A. (2013). Collegiate game changers how campus sport is going green. *NRDC Report*. Retrieved January 12, 2015, from http://www.nrdc.org/greenbusiness/guides/sports/files/collegiate-game-changers-report.pdf

Henly, A., Hershkowitz, A., & Hoover, D. (2012). Game changer how the sports industry is saving the environment. *NRDC Report*. Retrieved February 22, 2015, from http://www.nrdc.org/greenbusiness/guides/sports/files/Game-Changer-report.pdf

Hershkowitz, A. (2013, April 4). NBA's Green Week is unique. Retrieved December 26, 2014, from http://switchboard.nrdc.org/blogs/ahershkowitz/nbas_green_week_is_unique.html

Hubbard, J., & Durant, J. (2014, April 2). EPA welcomes NCAA Final Four and sustainability to North Texas. Retrieved February 27, 2015, from http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/79aacc94530dc39c85257cae00743b61!OpenDocument

Iboshi, K. (2014, September 14). Who gets to fly with the Ducks and the Beavers. Retrieved January 5, 2015, from http://www.kgw.com/story/sports/ncaaf/2014/09/29/flying-with-the-team--other-perks-for-ncaa-donors/16455789/

Jacobson, M. (2008). On the casual link between carbon dioxide and air pollution mortality.*Geophysical Research Letters, 35*(3). Retrieved February 27, 2015, from http://onlinelibrary.wiley.com/doi/10.1029/2007GL031101/full

Jardine, C. N. (2009). Calculating the carbon dioxide emissions of flights. *Final report by the Environmental Change Institute*.

Katz, G. L. (2005). Conflicting Fiduciary Duties Within Collegiate Athletic Conferences: A Prescription for Leniency. *BCL Rev.*, *47*, 345. Retrieved December 9, 2014 from http://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=2326&context=bclr&sei-redir=1&referer=http%3A%2F%2Fscholar.google.com%2Fscholar%3Fhl%3Den%26q%3Dconflicting%2Bfiduciary%2Bduties%2Bwithin%2Bcollegiate%2Bathletic%2Bconferences%26btnG%3D%26as_sdt%3D1%252C21%26as_sdtp%3D#search=%22conflicting%20fiduciary%20duties%20within%20collegiate%20athletic%20conferences%22

Kollmuss, A., & Lane, J. (2009). Carbon Offsetting & Air Travel. Retrieved December 10, 2010 from http://terrapass.com/images/blogposts/Air_Travel_Emissions_Paper.pdf

Lavigne, P. (2014, October 8). Collegiate sports: Realigned revenues. Retrieved December 9, 2014, from http://espn.go.com/college-football/story/_/id/11592735/financial-winners-ncaa-conference-realignments-begin-take-shape

Leibovitz, B. I. (2011). Avoiding the Sack: How Nebraska's Departure from the Big 12 Changed College Football and What Athletic Conferences Must Do to Prevent Defection in the Future. *Marq. Sports L. Rev.*, *22*, 675. Retrieved December 9, 2014

McCartney, S. (2012, October 24). Teams score elite service in the sky. *The Wall Street Journal*. Retrieved December 9, 2014, from http://www.wsj.com/news/articles/SB10001424052970203897404578076574126494236

McCartney, S. (2010, August 12). A Prius with wings vs. a guzzler in the clouds. *The Wall Street Journal*. Retrieved December 9, 2014, from http://www.wsj.com/articles/SB10001424052748704901104575423261677748 38

NASA. (n.d.). Global climate change vital signs of the planet. Retrieved January 8, 2015, from http://climate.nasa.gov/causes/

NASCAR Green. (2014). NASCAR: Leading sport and business in sustainability. Retrieved January 18, 2015, from http://green.nascar.com/about

National Geographic. (1996-2015). Ocean acidification carbon dioxide is putting shelled animals at risk. Retrieved January 8, 2015, from http://ocean.nationalgeographic.com/ocean/critical-issues-ocean-acidification/

Native Energy. (2015). Travel calculator. Retrieved January 18, 2015, from http://www.nativeenergy.com/travel.html

NBA Green. (2014). Teams and arenas. Retrieved December 26, 2014, from http://www.nba.com/green/teams_arenas.html

O'Brien, H. (2012, June 6). London 2012: How we won the Olympic bid. Retrieved February 10, 2015, from http://metro.co.uk/2012/06/06/london-2012-how-we-won-the-olympic-bid-3821882/

Pandey, D., Agrawal, M., & Pandey, J. S. (2011). Carbon footprint: current methods of estimation. *Environmental monitoring and assessment*, *178*(1-4), 135-160.

Peloquin, M. (2015, March 19). Conference Realignment. Retrieved March 24, 2015, from http://collegesportsinfo.com/conference-realignment-grid/

Pfahl, M. (2013). The environmental awakening in sport. *The Solutions Journal*, *4*, 67-76. Retrieved December 9, 2014 from http://www.resilience.org/stories/2013-07-24/the-environmental-awakening-in-sport

Pointer, M. (2014, November 10). Athletic directors talk realignment, NCAA changes, TV, more. *Indy Star*. Retrieved December 9, 2014, from http://www.indystar.com/story/sports/college/butler/2014/11/10/athletic-directors-talk-realignment-ncaa-changes-tv/18823171/

Roper, T. (2006). Producing environmentally sustainable Olympic Games and "greening" major public events. *Global Urban Development Magazine*, *2*(1), 1-6. Retrieved December 9, 2014 from http://www.globalurban.org/GUDMag06Vol2Iss1/Roper%20PDF.pdf

Samuel, S., & Stubbs, W. (2012). Green Olympics, green legacies? An exploration of the environmental legacies of the Olympic Games. *International Review for the Sociology of Sport*, 1012690212444576.

Sandhop, D. (2011, September 28). A&M to the SEC - reasons behind the decision. Retrieved January 4, 2015, from http://tamu.scout.com/story/1111631-a-m-to-the-sec-reasons-behind-the-decision

Schmidt, C. W. (2006). Putting the Earth in play: Environmental awareness and sports. *Environmental Health Perspectives*, *114*(5), A286. Retrieved December 9, 2014 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1459948/

Terret, T. (2008). The Albertville Winter Olympics: Unexpected legacies–failed expectations for regional economic development. *The International Journal of the History of Sport*, *25*(14), 1903-1921.

Trendafilova, S., McCullough, B., Pfahl, M., Nguyen, S. N., Casper, J., & Picariello, M. (2014). Environmental sustainability in sport: Current state and future trends. *Global Journal on Advances Pure and Applied Sciences, 3*. Retrieved December 9, 2014 from http://www.world-education-center.org/index.php/paas

Trednafilova, S., Pfahl, M., & Casper, J. (2013). CSR and Environmental Responsibility The case of NCAA athletic departments. In *The Routledge Handbook of Sport and Corporate Social Responsibility*. Routledge.

U.C. Berkeley CoolClimate Network. (2013). CoolClimate carbon footprint calculator. Retrieved January 18, 2015, from http://coolclimate.berkeley.edu/carboncalculator

UNEP. (2003). The voice of the environment. Retrieved January 18, 2015, from http://www.unep.org/about/

U.S. Department of Education. (2014). Retrieved October 26, 2014, from http://ope.ed.gov/athletics/GetAggregatedData.aspx

U.S. Department of Transportation. (2010). Transportation's role in reducing U.S. greenhouse gas emissions. Retrieved November 1, 2014, from http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf

U.S. Environmental Protection Agency. (2014a, April 15). Inventory of U.S. greenhouse gas emissions and sinks: 1990-2012. Retrieved January 29, 2015, from http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf

U.S. Environmental Protection Agency. (2014b). Transportation sector emissions. Retrieved October 31, 2014, from http://www.epa.gov/climatechange/ghgemissions/sources/transportation.html

USGS. (2012, January 27). Volcanic gases and climate change overview. Retrieved January 8, 2015, from http://volcanoes.usgs.gov/hazards/gas/climate.php

Weaver, K. (2013). Media deals, college football, and governance: Who's in charge? *Change: The Magazine of Higher Learning*, *45*(4), 15-23. Retrieved September 29, 2014, from Taylor and Francis Online.

Wiedmann, T., & Minx, J. (2008). A definition of 'carbon footprint'. *Ecological economics research trends*, *1*, 1-11.n

Writes, T. (2010, April 20). The real killer of the Southwest Conference. Retrieved February 27, 2015, from http://bleacherreport.com/articles/382576-the-real-killer-of-the-southwest-conference

Appendix A

College City Locations

Table A.1 A listing of Power 5 conference schools and city locations.

Conference	School	City, State
ACC	Boston College	Chestnut Hill, MA
ACC	Clemson University	Clemson, SC
ACC	Duke University	Durham, NC
ACC	Florida State University	Tallahassee
ACC	Georgia Institute of Technology	Atlanta, GA
ACC	University of Louisville	Louisville, KY
ACC	University of Miami	Coral Gables, FL
ACC	University of North Carolina at Chapel Hill	Chapel Hill, NC
ACC	North Carolina State University	Raleigh, NC
ACC	University of Pittsburgh	Pittsburgh, PA
ACC	Syracuse University	Syracuse, NY
ACC	University of Virginia	Charlottesville, VA
ACC	Virginia Polytechnic Institute and State University	Blacksburg, VA
ACC	Wake Forest University	Winston-Salem, NC
Big 12	Baylor University	Waco, TX
Big 12	Iowa State University	Ames, IA
Big 12	University of Kansas	Lawrence, KS
Big 12	Kansas State University	Manhattan, KS
Big 12	University of Oklahoma	Norman, OK

Table A.1 - Continued

Big 12	Oklahoma State University	Stillwater, OK
Big 12	University of Texas at Austin	Austin, TX
Big 12	Texas Christian University	Fort Worth, TX
Big 12	Texas Tech University	Lubbock, TX
Big 12	West Virginia University	Morgantown, WV
Big Ten	University of Illinois at Urbana-Champaign	Champaign-Urbana, IL
Big Ten	Indiana University	Bloomington, IN
Big Ten	University of Iowa	Iowa City, IA
Big Ten	University of Maryland	College Park, MD
Big Ten	University of Michigan	Ann Arbor, MI
Big Ten	Michigan State University	East Lansing, MI
Big Ten	University of Minnesota	Minneapolis, MN
Big Ten	University of Nebraska-Lincoln	Lincoln, NE
Big Ten	Northwestern University	Evanston, IL
Big Ten	Ohio State University	Columbus, OH
Big Ten	Pennsylvania State University	State College, PA
Big Ten	Purdue University	West Lafayette, IN
Big Ten	Rutgers University	Newark, NJ
Big Ten	University of Wisconsin-Madison	Madison, WI
Pac-12	University of Arizona	Tucson, AZ
Pac-12	Arizona State University	Tempe, AZ
Pac-12	University of California, Berkeley	Berkeley, CA

Table A.1 - Continued

Pac-12	University of California, Los Angeles	Los Angeles, CA
Pac-12	University of Colorado Boulder	Boulder, CO
Pac-12	University of Oregon	Eugene, OR
Pac-12	Oregon State University	Corvallis, OR
Pac-12	University of Southern California	Los Angeles, CA
Pac-12	Stanford University	Stanford, CA
Pac-12	University of Utah	Salt Lake City, UT
Pac-12	University of Washington	Seattle, WA
Pac-12	Washington State University	Pullman, WA
SEC	University of Alabama	Tuscaloosa, AL
SEC	University of Arkansas	Fayetteville, AK
SEC	Auburn University	Auburn, AL
SEC	University of Florida	Gainesville, FL
SEC	University of Georgia	Athens, GA
SEC	University of Kentucky	Lexington, KY
SEC	Louisiana State University	Baton Rouge, LA
SEC	University of Mississippi	Oxford, MS
SEC	Mississippi State University	Starkville, MS
SEC	University of Missouri	Columbia, MO
SEC	University of South Carolina	Columbia, SC
SEC	University of Tennessee	Knoxville, TN
SEC	Texas A&M University	College Station, TX
SEC	Vanderbilt University	Nashville, TN

Appendix B

Emissions Tables

Table B.1: Total Emissions Percent Change Between 2010 and 2014: Boeing 757 airplanes & Driving Under Three Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	29.88%	29.80%	29.92%	29.85%	29.95%	29.89%
Big 12	20.36%	20.27%	20.40%	20.32%	20.43%	20.36%
Big Ten	53.85%	53.60%	53.98%	53.76%	54.08%	53.88%
Pac-12	16.39%	16.40%	16.39%	16.39%	16.38%	16.39%
SEC	31.00%	30.98%	31.00%	30.99%	31.01%	31.00%

Source: Author

Table B.2: Total Emissions Percent Change Between 2010 and 2014: Boeing 767 airplanes & Driving Under Three Hours

4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
29.89%	29.81%	29.93%	29.86%	29.96%	29.90%
19.37%	19.30%	19.41%	19.34%	19.44%	19.38%
53.83%	53.59%	53.96%	53.74%	54.05%	53.86%
16.35%	16.36%	16.35%	16.36%	16.35%	16.35%
30.85%	30.84%	30.86%	30.85%	30.86%	30.85%

Source: Author

Table B.3: Total Emissions Percent Change Between 2010 and 2014: Boeing 777 airplanes & Driving Under Three Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	29.81%	29.73%	29.84%	29.78%	29.87%	29.81%
Big 12	19.32%	19.25%	19.35%	19.29%	19.38%	19.33%
Big Ten	53.63%	53.41%	53.74%	53.55%	53.83%	53.65%
Pac-12	16.46%	16.46%	16.46%	16.46%	16.45%	16.46%
SEC	30.65%	30.64%	30.66%	30.65%	30.66%	30.65%

Source: Author

Table B.4: Average Emissions Percent Change Between 2010 and 2014: Boeing 757 airplanes & Driving Under Three Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	11.33%	11.26%	11.36%	11.30%	11.39%	11.33%
Big 12	28.38%	28.29%	28.42%	28.35%	28.46%	28.39%
Big Ten	20.89%	20.69%	20.99%	20.81%	21.06%	20.91%
Pac-12	-1.18%	-1.17%	-1.18%	-1.17%	-1.18%	-1.18%
SEC	12.28%	12.27%	12.29%	12.28%	12.29%	12.28%

Source: Author

Table B.5: Average Emissions Percent Change Between 2010 and 2014: Boeing 767 airplanes & Driving Under Three Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	11.34%	11.27%	11.37%	11.31%	11.40%	11.34%
Big 12	27.33%	27.25%	27.37%	27.30%	27.40%	27.34%
Big Ten	20.87%	20.68%	20.97%	20.80%	21.04%	20.89%
Pac-12	-1.21%	-1.20%	-1.21%	-1.21%	-1.21%	-1.21%
SEC	12.16%	12.15%	12.16%	12.15%	12.17%	12.16%

Source: Author

Table B.6: Average Emissions Percent Change Between 2010 and 2014: Boeing 777 airplanes & Driving Under Three Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	11.26%	11.20%	11.29%	11.24%	11.32%	11.27%
Big 12	27.27%	27.20%	27.31%	27.25%	27.34%	27.28%
Big Ten	20.71%	20.54%	20.80%	20.64%	20.86%	20.73%
Pac-12	-1.12%	-1.11%	-1.12%	-1.12%	-1.13%	-1.12%
SEC	11.99%	11.98%	11.99%	11.98%	12.00%	11.99%

Source: Author

Table B.7: Total Emissions Percent Change Between 2010 and 2014: Boeing 757 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	31.55%	31.40%	31.62%	31.49%	31.68%	31.57%
Big 12	21.94%	21.77%	22.02%	21.88%	22.08%	21.95%
Big Ten	55.46%	55.03%	55.68%	55.30%	55.85%	55.51%
Pac-12	16.76%	16.75%	16.76%	16.76%	16.76%	16.76%
SEC	33.79%	33.70%	33.83%	33.75%	33.87%	33.80%

Source: Author

Table B.8: Total Emissions Percent Change Between 2010 and 2014: Boeing 767 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	31.72%	31.57%	31.79%	31.66%	31.85%	31.73%
Big 12	21.08%	20.93%	21.16%	21.03%	21.22%	21.10%
Big Ten	55.65%	55.23%	55.86%	55.49%	56.03%	55.69%
Pac-12	16.73%	16.72%	16.73%	16.73%	16.73%	16.73%
SEC	33.68%	33.60%	33.73%	33.65%	33.76%	33.69%

Source: Author

Table B.9: Total Emissions Percent Change Between 2010 and 2014: Boeing 777 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	31.69%	31.56%	31.75%	31.64%	31.81%	31.70%
Big 12	21.07%	20.93%	21.14%	21.02%	21.19%	21.08%
Big Ten	55.32%	54.95%	55.51%	55.18%	55.66%	55.37%
Pac-12	16.84%	16.84%	16.84%	16.84%	16.84%	16.84%
SEC	33.53%	33.45%	33.56%	33.50%	33.59%	33.54%

Source: Author

Table B.10: Average Emissions Percent Change Between 2010 and 2014: Boeing 757 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	31.69%	31.56%	31.75%	31.64%	31.81%	31.70%
Big 12	21.07%	20.93%	21.14%	21.02%	21.19%	21.08%
Big Ten	55.32%	54.95%	55.51%	55.18%	55.66%	55.37%
Pac-12	16.84%	16.84%	16.84%	16.84%	16.84%	16.84%
SEC	33.53%	33.45%	33.56%	33.50%	33.59%	33.54%

Source: Author

Table B.11: Average Emissions Percent Change Between 2010 and 2014: Boeing 767 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	12.90%	12.78%	12.96%	12.85%	13.01%	12.91%
Big 12	29.16%	29.00%	29.24%	29.10%	29.30%	29.17%
Big Ten	22.29%	21.96%	22.46%	22.17%	22.59%	22.33%
Pac-12	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%
SEC	14.59%	14.51%	14.62%	14.56%	14.65%	14.59%

Source: Author

Table B.12: Average Emissions Percent Change Between 2010 and 2014: Boeing 777 airplanes & Driving Under Five Hours

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC	12.90%	12.78%	12.96%	12.85%	13.01%	12.91%
Big 12	29.16%	29.00%	29.24%	29.10%	29.30%	29.17%
Big Ten	22.29%	21.96%	22.46%	22.17%	22.59%	22.33%
Pac-12	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%
SEC	14.59%	14.51%	14.62%	14.56%	14.65%	14.59%

Source: Author

Table B.13: Total Emissions 2010 and 2014 Boeing 757 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	2862652	2871665	3266452	3275465	3670252	3679265
ACC 2014	3718005	3727357	4243805	4253157	4769605	4778957
Big 12 2010	2726841	2740401	3108641	3122201	3490441	3504001
Big 12 2014	3281909	3295986	3742709	3756786	4203509	4217586
Big Ten 2010	2063559	2075799	2351359	2363599	2639159	2651399
Big Ten 2014	3174874	3188442	3620674	3634242	4066474	4080042
Pac-12 2010	4153466	4160732	4742666	4749932	5331866	5339132
Pac-12 2014	4834273	4843042	5519873	5528642	6205473	6214242
SEC 2010	2360967	2371959	2691967	2702959	3022967	3033959
SEC 2014	3092765	3106806	3526565	3540606	3960365	3974406

Source: Author

Table B.14: Total Emissions 2010 and 2014 Boeing 767 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	2955052	2964065	3372052	3381065	3789052	3798065
ACC 2014	3838405	3847757	4381405	4390757	4924405	4933757
Big 12 2010	2822041	2835601	3217441	3231001	3612841	3626401
Big 12 2014	3368709	3382786	3841909	3855986	4315109	4329186
Big Ten 2010	2129359	2141599	2426559	2438799	2723759	2735999
Big Ten 2014	3275674	3289242	3735874	3749442	4196074	4209642
Pac-12 2010	4248666	4255932	4851466	4858732	5454266	5461532
Pac-12 2014	4943473	4952242	5644673	5653442	6345873	6354642
SEC 2010	2449167	2460159	2792767	2803759	3136367	3147359
SEC 2014	3204765	3218806	3654565	3668606	4104365	4118406

Source; Author

Table B.15: Total Emissions 2010 and 2014 Boeing 777 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	3278452	3287465	3741652	3750665	4204852	4213865
ACC 2014	4255605	4264957	4858205	4867557	5460805	5470157
Big 12 2010	3134241	3147801	3574241	3587801	4014241	4027801
Big 12 2014	3739709	3753786	4265909	4279986	4792109	4806186
Big Ten 2010	2364559	2376799	2695359	2707599	3026159	3038399
Big Ten 2014	3632674	3646242	4143874	4157442	4655074	4668642
Pac-12 2010	4706466	4713732	5374666	5381932	6042866	6050132
Pac-12 2014	5481073	5489842	6259073	6267842	7037073	7045842
SEC 2010	2720767	2731759	3103167	3114159	3485567	3496559
SEC 2014	3554765	3568806	4054565	4068606	4554365	4568406

Source: Author

Table B.16: Average Emissions 2010 and 2014 Boeing 757 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	59639	59826	68051	68239	76464	76651
ACC 2014	66393	66560	75782	75949	85172	85339
Big 12 2010	56809	57092	64763	65046	72718	73000
Big 12 2014	72931	73244	83171	83484	93411	93724
Big Ten 2010	46899	47177	53440	53718	59981	60259
Big Ten 2014	56694	56936	64655	64897	72616	72858
Pac-12 2010	92299	92461	105393	105554	118486	118647
Pac-12 2014	91213	91378	104149	104314	117084	117250
SEC 2010	49187	49416	56083	56312	62978	63207
SEC 2014	55228	55479	62974	63225	70721	70972

Table B.17: Average Emissions 2010 and 2014 Boeing 767 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	61564	61751	70251	70439	78939	79126
ACC 2014	68543	68710	78239	78406	87936	88103
Big 12 2010	58793	59075	67030	67313	75268	75550
Big 12 2014	74860	75173	85376	85689	95891	96204
Big Ten 2010	48395	48673	55149	55427	61904	62182
Big Ten 2014	58494	58736	66712	66954	74930	75172
Pac-12 2010	94415	94576	107810	107972	121206	121367
Pac-12 2014	93273	93439	106503	106669	119733	119899
SEC 2010	51024	51253	58183	58412	65341	65570
SEC 2014	57228	57479	65260	65511	73292	73543

Source: Author

Table B.18: Average Emissions 2010 and 2014 Boeing 777 airplanes & Driving Under Three Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	68301	68489	77951	78139	87601	87789
ACC 2014	75993	76160	86754	86921	97514	97681
Big 12 2010	65297	65579	74463	74746	83630	83913
Big 12 2014	83105	83417	94798	95111	106491	106804
Big Ten 2010	53740	54018	61258	61536	68776	69055
Big Ten 2014	64869	65111	73998	74240	83126	83369
Pac-12 2010	104588	104750	119437	119598	134286	134447
Pac-12 2014	103416	103582	118096	118261	132775	132940
SEC 2010	56683	56912	64649	64878	72616	72845
SEC 2014	63478	63729	72403	72654	81328	81579

Source: Author

Table B.19: Total Emissions 2010 and 2014 Boeing 757 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	2664721	2678851	3037321	3051451	3409921	3424051
ACC 2014	3505442	3520103	3997842	4012503	4490242	4504903
Big 12 2010	2467313	2486691	2808713	2828091	3150113	3169491
Big 12 2014	3008556	3028145	3427156	3446745	3845756	3865345
Big Ten 2010	1657779	1678124	1882979	1903324	2108179	2128524
Big Ten 2014	2577186	2601632	2931386	2955832	3285586	3310032
Pac-12 2010	4063019	4072524	4638019	4647524	5213019	5222524
Pac-12 2014	4743827	4754834	5415227	5426234	6086627	6097634
SEC 2010	2000840	2020500	2275440	2295100	2550040	2569700
SEC 2014	2676888	2701410	3045288	3069810	3413688	3438210

Source: Author

Table B.20: Total Emissions 2010 and 2014 Boeing 767 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	2738921	2753051	3122121	3136251	3505321	3519451
ACC 2014	3607642	3622303	4114642	4129303	4621642	4636303
Big 12 2010	2547113	2566491	2899913	2919291	3252713	3272091
Big 12 2014	3084156	3103745	3513556	3533145	3942956	3962545
Big Ten 2010	1702579	1722924	1934179	1954524	2165779	2186124
Big Ten 2014	2649986	2674432	3014586	3039032	3379186	3403632
Pac-12 2010	4154019	4163524	4742019	4751524	5330019	5339524
Pac-12 2014	4848827	4859834	5535227	5546234	6221627	6232634
SEC 2010	2069440	2089100	2353840	2373500	2638240	2657900
SEC 2014	2766488	2791010	3147688	3172210	3528888	3553410

Source: Author

Table B.21: Total Emissions 2010 and 2014 Boeing 777 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	3032921	3047051	3458121	3472251	3883321	3897451
ACC 2014	3994042	4008703	4556242	4570903	5118442	5133103
Big 12 2010	2821513	2840891	3213513	3232891	3605513	3624891
Big 12 2014	3415956	3435545	3892756	3912345	4369556	4389145
Big Ten 2010	1884579	1904924	2142179	2162524	2399779	2420124
Big Ten 2014	2927186	2951632	3331386	3355832	3735586	3760032
Pac-12 2010	4599219	4608724	5250819	5260324	5902419	5911924
Pac-12 2014	5373827	5384834	6135227	6146234	6896627	6907634
SEC 2010	2292040	2311700	2608240	2627900	2924440	2944100
SEC 2014	3060488	3085010	3483688	3508210	3906888	3931410

Source: Author

Table B.22: Average Emissions 2010 and 2014 Boeing 757 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	55515	55809	63278	63572	71040	71334
ACC 2014	62597	62859	71390	71652	80183	80445
Big 12 2010	51402	51806	58515	58919	65627	66031
Big 12 2014	66857	67292	76159	76594	85461	85897
Big Ten 2010	37677	38139	42795	43257	47913	48376
Big Ten 2014	46021	46458	52346	52783	58671	59108
Pac-12 2010	90289	90501	103067	103278	115845	116056
Pac-12 2014	89506	89714	102174	102382	114842	115050
SEC 2010	41684	42094	47405	47815	53126	53535
SEC 2014	47802	48239	54380	54818	60959	61397

Source: Author

Table B.23: Average Emissions 2010 and 2014 Boeing 767 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	57061	57355	65044	65339	73028	73322
ACC 2014	64422	64684	73476	73738	82529	82791
Big 12 2010	53065	53469	60415	60819	67765	68169
Big 12 2014	68537	68972	78079	78514	87621	88057
Big Ten 2010	38695	39157	43959	44421	49222	49685
Big Ten 2014	47321	47758	53832	54268	60343	60779
Pac-12 2010	92312	92523	105378	105589	118445	118656
Pac-12 2014	91487	91695	104438	104646	117389	117597
SEC 2010	43113	43523	49038	49448	54963	55373
SEC 2014	49402	49839	56209	56647	63016	63454

Source: Author

Table B.24: Average Emissions 2010 and 2014 Boeing 777 airplanes & Driving Under Five Hours (kg CO_2)

	4 buses (140 people)	5 buses (140 people)	4 buses (160 people)	5 buses (160 people)	4 buses (180 people)	5 buses (180 people)
ACC 2010	63186	63480	72044	72339	80903	81197
ACC 2014	71322	71584	81361	81623	91401	91663
Big 12 2010	58782	59185	66948	67352	75115	75519
Big 12 2014	75910	76345	86506	86941	97101	97537
Big Ten 2010	42831	43294	48686	49148	54540	55003
Big Ten 2014	52271	52708	59489	59926	66707	67143
Pac-12 2010	102205	102416	116685	116896	131165	131376
Pac-12 2014	101393	101601	115759	115967	130125	130333
SEC 2010	47751	48160	54338	54748	60926	61335
SEC 2014	54652	55089	62209	62647	69766	70204

Source: Author