2017

Efficacy of Social Media to Promote Green Technology Use

Ehi E. Aimiuwu
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral dissertation by

Ehi Aimiuwu

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Sheryl Kristensen, Committee Chairperson, Management Faculty
Dr. Daphne Halkias, Committee Member, Management Faculty
Dr. Barbara Turner, University Reviewer, Management Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2017

Abstract

Efficacy of Social Media to Promote Green Technology Use

by

Ehi Aimiuwu

MBA, Kent State University, 2000

BA, Kent State University, 1997

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

August 2017

Abstract

Global warming has become a major threat to life, yet very little information systems research has been conducted to help sustain the environment and many people do not understand how social media can be used to combat global warming and climate change to save the earth. The purpose of this single qualitative case study was to explore whether social media can be used to increase the use of green technology, thereby reducing the cost of environmental sustainment. According to the integrated sustainability framework, which served as the conceptual framework for the study, firms should include green practices in their business processes, extend green culture to their customers, be innovative, and increase their green market share for the environment to be sustained. Twelve green energy professionals working in the United States were recruited from LinkedIn to participate in the study. Data were collected using structured telephone interviews, and data were analyzed using Stake's data analysis process and member checking. Key themes regarding the use of social media to increase the use of green technology included awareness, education, and reach. Key themes regarding the benefits of green technology outweighing the cost included cleaner, cheaper, and more profitable. This study shows that social media can be used to reach millions of people to educate and keep them aware of the benefits of various green technologies that can be used to live a green-friendly lifestyle towards sustaining the environment, people, and firms. The results of this study may encourage humans to use social media to increase the use of green technology to combat the threat of global warming and climate change.

Efficacy of Social Media to Promote Green Technology Use

by

Ehi Aimiuwu

MBA, Kent State University, 2000

BA, Kent State University, 1997

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

August 2017

Dedication

I would like to thank KPMG, the PhD Project, and the Americas Conference on Information Systems (AMCIS) for their help and dedication toward my success from 2010 to 2013. These organizations gave me the confidence to publish, teach, and be a confident doctoral student. These organizations also contributed greatly to the success of my 11 blind-reviewed academic publications within a period of 20 months.

I also would like to thank my lovely wife, Kehinde, my dedicated son, Ehimwenma, and my wonderful daughter, Esosa, for all their support and encouragement in getting my PhD.

Acknowledgments

I would like to personally acknowledge God, Jesus (Yeshua), and the Holy Spirit for all their guidance and protection during my entire doctoral program beginning in 2010. I also would like to thank them for sustaining me and my family since 2000, despite all the odds and setbacks. I am also assured that the future will always be brighter and more glorious because of their presence with me and within me.

I would like to thank my dissertation committee, Drs. McCollum, Kristensen, Halkias, and Turner for working with me to bring my PhD journey to a successful end.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

The negative impact of climate change has become one of the main concerns of many government agencies, businesses, and people today. Various activities such as manufacturing and using electricity have led to increased greenhouse gases that cause global warming (Magno, Polonelli, Benini, & Popovici, 2015). Evidence shows that humans are at the tipping point where the negative effects of global warming will become irreversible (Gholami, Watson, Hasan, Molla, & Bjørn-Andersen, 2016). To successfully resolve the issues of climate change, people must be informed about the need to live a green-friendly lifestyle.

Social media users are increasing annually. Social media, which has millions of users around the globe, provides new information sources that are uncontrolled and can shape consumers' decisions in real time (Tufekci & Wilson, 2012). Some of the information provided on social media is false, but information can always be researched and verified online. Information about green technology in relation to environmental sustainability can be shared on social media in an attempt to get consumers to use more green technology and follow a healthier lifestyle to reduce the cost of environmental sustainment. Green roofs give 40% higher value in managing storm water than traditional roofs, reducing energy cost, improving air quality, and providing up to 45% annual energy savings (Foster, Lowe, & Winkelman, 2011). In this single case qualitative research, I examined the effectiveness of social media use in communicating and influencing customers' decisions regarding increasing green technology use.

Background of the Study

Climate change will be an issue to address into the next century, and embracing a greener lifestyle has become the most acceptable solution to this problem (Foster et al., 2011). The combination of green infrastructure and green technologies with traditional gray infrastructure tends to be the best practice at local levels for optimizing urban sustainability (Foster et al., 2011). Green infrastructure is a management system used to conserve the environment and promote green energy resources. Green technology includes products and services that depend on green energy to reduce greenhouse emissions into the atmosphere. Gray infrastructure are maintenance systems that depend on hydrocarbon fuels for energy. To increase green-friendly lifestyles, many people will have to become users of green infrastructures and green technologies as well as organic or green products. Because social media influences behavior and empowers consumers (Goh, Heng, & Lin, 2013), social media may be an excellent platform to reach and empower online customers around the world to use green products. For example, friends on social media can influence each other toward increasing the demand of green products in exchange for reduced prices and lower insurance premiums for healthier living.

The solutions to climate change are available for consumers. There is much literature addressing the threats of climate change and the benefits of using green products as a strategy to combat the issue (Foster et al., 2011; Ryoo & Koo, 2013; Swaim, Maloni, Napshin, & Henley, 2014). There are also papers on using social media to advertise green products to people (Rahim, Zukni, Ahmed, & Lyndon, 2012; Reilly &

Hynan, 2014), but nothing is presented in the literature about using social media to educate and reach out to millions of people to increase green technology use.

Problem Statement

Urbanization has become a human problem. Higher household incomes and increased urbanization will soon make climate change irreversible by increasing global greenhouse gas emissions about 80% by 2050 (Tilman & Clark, 2014), which will lead to increased temperature, increased droughts, stronger hurricanes, and increased sea levels (NASA, 2016). The general problem is that devastating effects of climate change will continue beyond the next century due to human emission of heat-trapping gases (NASA, 2016). The specific problem is that many people, including green energy professionals, do not understand how social media can be used to sustain the environment through its big data to reduce cost. Information systems applications can mitigate harmful human emissions (Malhotra, Melville, & Watson, 2013). Little research has addressed environmental sustainability through information technology (Gholami et al., 2016). Because more information systems research is needed, this study may contribute information to combat climate change.

Purpose of the Study

The purpose of this qualitative case study was to explore how social media can increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. Information technology can be a solution for issues of environmental sustainability, but academic research in technology use is lacking (Gholami et al., 2016). There is research on climate change, environmental sustainability,

and social media, but the gap in the environmental sustainment study is that there is limited research on how social media can be used to promote green technology use to sustain the environment in a cost-effective way.

Many people including green energy professionals spend their Internet sessions on social media. Over 80% of Internet users share information, exchange ideas, recommend goods and services, and have huge followings on social media (Whiting & Williams, 2013). About 71% of Internet users are on Facebook (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). More research is needed on the effectiveness of social media in convincing online consumers to use more green technology to reduce the cost of combating climate change.

The targeted population for my case study was green energy professionals who are listed as renewable energy professionals on LinkedIn and are over 18 years of age. The profiles of the LinkedIn users that included their college degrees and work experience was very helpful. Also, green organizations around the United States connected with me on LinkedIn so that their employees and members could connect with me to assist with my study. The geographic location of my participants was the United States. The social change implications included increasing green technology use to sustain the environmental at reduced cost to people, firms, and the environment.

Research Questions

In this study, I explored what green energy professionals in the renewable energy field understood about their business practices and customers. Professionals were used as participants as a sample of the population using green technology for environmental

sustainment through the use of social media. I also explored their understanding of whether green technology had cost-benefits to the customers, firms, and the environment.

Research Question: How can social media be used to increase green technology use and reduce the cost of environment sustainment? The following interview questions were used to collect data:

- What is green energy professionals' understanding of using social media to improve green practices in their business processes?
- What is green energy professionals' understanding of using social media to extend their green culture to customers to increase the use of green technology?
- What is green energy professionals' understanding of using social media to enhance green innovation within their business and increase customer market share in the future?
- What is green energy professionals' understanding of the cost-benefit of using green technology to sustain the environment, firms, and customers?

Conceptual Framework

A conceptual framework is preferred in qualitative studies (Trotter, 2012). The chosen concept for interpretation should be appropriate and useful for the research problem being studied (Trotter, 2012). Students are expected to use the concept that suits their research question(s) and analysis of results from their collected data.

The integrated sustainability framework provided the conceptual framework for this study. According to Dao, Langella, and Carbo 2011), green companies create a green

culture and are innovative in how they extend the green culture to customers for environmental sustainment. Though it has been cited numerous times, the integrated sustainability framework is a recent concept created specifically for addressing issues of environmental sustainability through strategic information systems. Dao et al. examined the strategies and payoffs of environmental sustainment today and into the future from within and outside the green company. The framework, as shown in Table 1, is divided into four quadrants of time and location. The times are today and tomorrow strategies as well as their benefits, while the locations are internal and external strategies. Some of the researchers who have used this framework discussed issues of green information systems adoptions in environmental performance, information systems in green transformations, sustainability performance of a supplier, and sustainability supply chain management (Govindan, Khodaverdi, & Jafarian, 2013; Gholami, Sulaiman, Ramayah, & Molla, 2013).

Table 1.

Integrated sustainability framework (Dao et al., 2011).

	Internal	External
Today	Strategy: • Prevent pollution via optimized operation to reduce cost & environmental impact. • Create organizational green culture & improve employee management practices. Payoff: • Reduced cost • Reduced risk • Increased profits	Strategy: • Improve extended green supply chain to reduce pollution & process choices. • Extend organizational green culture to both external & internal stakeholders. Payoff: • Increased legitimacy & reputation • Reduced environmental impact • Increased competitive advantage
Tomorrow	Strategy: • Develop ability to enable enhanced Green IT. • Develop processes to improve social and environmental issues. Payoff: • Increased innovation • Enhanced strategic position	Strategy: • Include green capabilities in all products, processes, & supply chains. • Sustainability Vision: Dialogue with stakeholders in resolving social issues & increasing growth. Payoff: • Growth trajectory

The today/internal quadrant explains what is expected for the organization to do to enhance sustainment, and the today/external quadrant addressed how firms should extend their green culture to consumers. The tomorrow/internal quadrant deals with firms proactively looking for ways to enhance sustainment of the environment and society, and the tomorrow/external quadrant extends the proactive quest to include customers to increase market share and global sustainability. Some of the payoffs for firms in the framework include reduced cost, risk, and pollution, as well as increased profits, reputation, innovation, and strategic advantage. Sustainability is achieving societal goals within commercialized goals while optimizing environmental, social, and economic

balance simultaneously (Malhotra et al., 2013). This framework was used to explain how social media can inform both employees and consumers about sustaining the environment, society, and economy to reduce cost. A single case study can be used to examine a single strategy and a single outcome to establish a causal inference based on rigorous methodological and analytical evidence of processes and sequences of events in the case (Willis, 2014). A single case study based on the integrated sustainability framework was best suited to study how social media can help sustain the environment, businesses, and people. Interviews with green energy professionals were used to examine a single idea and a single outcome to establish a causal inference (see Willis, 2014).

Nature of the Study

The study was a qualitative single case study based on interviewing employees in the green energy industry. Case study research has a practical and technical interview process that should be based on a plan, design, preparation, data collection, analysis, and reporting (Yin, 2014). A single case study can be used to explain the key sequences of steps, processes, and alternate explanations, which can be traced (Willis, 2014). A single case study was the best choice for this study because the purpose was to examine the effectiveness of using social media to increase green technology use for environmental sustainment at reduced cost to people, firms, and the environment (see Willis, 2014).

This study was about understanding how social media can help shape the behavior of users toward increasing green technology use for environmental sustainment. The value of qualitative research includes the ability to explore a subject or topic in great depth using conceptual frameworks, symbolic interactions, and social constructs;

qualitative research has many data-gathering and analysis methods that affect how participants are selected and when to stop data collection (Cleary, Horsfall, & Hayter, 2014). Human behavior is affected by the consequences of the behavior, normative expectations of others, and presence of factors that may affect the behavior, which combine to lead to behavioral intention (Ajzen & Klobas, 2013). For social media to positively influence the behaviors of users toward increasing use of green technology, users must understand the need to use green technology, the availability of green technologies and their purposes, and costs and benefits of living a green lifestyle.

Trotter (2012) stated that qualitative research differs from quantitative research in five areas. First, qualitative research is cultural representation, such as green culture, while quantitative research is individual representation. Second, qualitative research depends on an expert framework while quantitative research provides a probabilistic framework. Third, qualitative research depends on a saturated model while quantitative research depends on a statistical model. Fourth, qualitative research has generalizations that are analytical, such as analyzing themes, while quantitative generalizations are statistical. Fifth, qualitative research focuses on consensus or saturation, while quantitative research focuses on variation of responses. Based on the above five comparisons by Trotter (2012), qualitative research was preferred for this study because it dealt with green culture, expert framework, saturated model, analyzing themes, and consensus.

A single case study was the best design for this study because I examined how one factor, social media, affected a desired outcome (see Willis, 2014). The five

qualitative research designs are narrative to examine personalized stories, phenomenological to analyze respondents' lived experiences; ethnographic to explain a situation from a respondent's environment, grounded theory to construct a theory from data, and case study to demonstrate effectiveness or efficiency (Lewis, 2015). The purpose of the current study did not align with narrative, phenomenological, ethnographic, or grounded theory designs. A single case study was conducted using 12 green energy professionals of any career level who were in the green industry, were above the age of 18, and used social media. Small studies reach saturation before larger ones, and saturation is required for the study to have quality and validity (Fusch & Ness, 2015).

Single individuals and youths tend to be influential on social media, so all persons above the age of 18 were essential for a good study. Youths and unmarried persons are more influenced by social media than other population groups in terms of accepting advertised products (Aral & Walker, 2012). The case study included interviews with green energy professionals above the age of 18, regardless of career level and marital status. Social media was presented as the information systems strategy to take green technology to the citizens to lower carbon emissions and cost while sustaining the environment. Results of analysis of interview transcripts indicated how much influence social media had on increasing green technology use.

Definitions

To fully understand the study, some of the environmental, technological, and cultural definitions are defined below:

Big data: Huge data sets that are too large or complex for regular techniques in data analysis or data processing applications (Manyika et al., 2011).

Climate change: Weather patterns' abnormal variations that affect the physical, chemical, and biological nature of the planet over a long period of time (Malhotra et al., 2013).

Cost: Prices, value, or savings for goods and services, as well as for natural resources, to governments, corporations, people, and the environment (Mills, 2009).

Environmental sustainability: The conservation of natural resources from depletion by reducing heat-trapping gasses from human activities that affect the physical, chemical, and biological nature of the planet over a long period of time (Dao et al., 2011).

Global warming: The gradual increase of the earth's temperature, which is negatively affecting the atmosphere as well as oceans and is changing the earth's climate permanently (Gholami et al., 2016).

Green infrastructure: The economical and efficient management mechanism of protecting, restoring, and replicating the natural cycles of water, heat, and vegetation to reduce waste of natural resources and release of unnecessary energy from human activities into the atmosphere (Morelli, 2013).

Green technology: Products and services made with the intent to mitigate the effects of heat-trapping gases from human activities on the earth's atmosphere (Yang, Sun, Zhang, & Wang, 2016).

Heat-trapping gases: The gases that are increased in the earth's atmosphere from human activities. The gases absorb heat, which in turn increases the earth's temperature

to negatively affect the physical, chemical, and biological attributes of the earth permanently. These gases are also called *greenhouse gases*, and they include ozone, carbon dioxide, water vapor, methane, and nitrous oxide (Tilman & Clark, 2014).

Lifestyle: The way an individual, group, or a culture lives or represents themselves in terms of beliefs, mind-set, opinion, interests, government, and law (Cranshaw, Schwartz, Hong, & Sadeh, 2012).

Social media: Interactive Web 2.0 Internet applications or computer-mediated technologies that allow users to produce, discuss, influence, and share information, ideas, opinions, interests, goods, and services through virtual communities as well as through virtual networks (Reilly & Hynan, 2014).

Assumptions

In this case study, I assumed that the participants in the interviews would answer truthfully and would provide a representative sample from the population to report about views, knowledge, understanding, and business processes within and around the green industry. I also assumed that little research had been conducted in information systems regarding environmental sustainability. Despite the fact that climate change is one of the most critical threats to global sustainability in this generation, there have been few information systems studies that have provided solutions to global warming (Gholami et al., 2016). I assumed that there was little information systems research on global warming, but more research may have been conducted while the study was taking place.

Next, I assumed that green energy professionals perceived global warming and climate change as increasing threats to people's lives and the health of the planet. There

is societal pressure to create environmental sustainability awareness about the dangers of global warming to generate sustainable practices and behaviors that are most productive at a personal level (Scholtz, Burger, & Zita, 2016). Some green energy professionals may not believe in global warming and may not care about it, but I assumed that these individuals were a minority.

The next assumption was that green energy professionals would respond positively, through social media, to the use of green technology as a way to improve the quality of their lives and health and to reduce cost in energy use, insurance premiums, and natural resources. Users of Facebook and YouTube had the best positive experiences for environmental awareness at 96% and 79% rate respectively; meanwhile, environmental awareness had increased from 43% before a social media campaign to as high as 95% after the campaign (Scholtz et al., 2016). With green awareness more than doubling after a social media campaign, I assumed that the positive increase in green awareness would also lead to an increase in green technology use.

The next assumption was that users of social media would increase green technology use by informing their online friends and peers about enjoying the benefits of green technology. When deciding to accept product offers, the younger users and unmarried people are easiest to influence on social media; men have more influence than women, but women have more influence on men than on other women (Aral & Walker, 2012). Gender and age may be relevant on social media.

The final assumption was that social media use can increase green technology use, which may lead to a substantial decrease in carbon dioxide emissions that lead to

about 81% of global warming in the United States (EPA, 2014), and may ultimately lead to a reduction in climate change. Citizens tend to respond to green infrastructure and technologies positively when they understand its life-cycle cost savings, get financial benefit from green use, have laws to implement green infrastructure on private properties, and mandate public projects to include green infrastructure in their processes (Foster et al., 2011). I assumed that if social media users of all career levels and departments understood cost and financial benefits of using green technology, green technology use would increase and it would help reduce the threat of global warming as well as climate change.

Scope and Delimitations

The scope, which is the boundaries and parameters of a study, focused on climate change becoming a threat, more research needed on information systems as a solution, and the need to increase green technology use to combat climate change. Climate change is becoming one of the most critical threats of this generation (Gholami et al., 2016). Little has been done in the field of information systems or information technology to combat climate change (Dao et al., 2011). Researchers need to develop a more accurate method to measure how green information systems affect environmental and economic performance (Ryoo & Koo, 2013). The current study may inspire more green information systems research to help combat the threat of climate change.

The delimitations of this study included a participant sample of 12 green energy professionals above the age of 18 who used social media (LinkedIn) regularly. Employees in the green industry were chosen in accordance with the integrated

sustainability framework (Dao et al., 2011) to research the internal perspective within an organization and the external perspective with green technology customers.

Limitations

Limitations are the weakness in the study that may affect the results and conclusion. In qualitative research, issues of credibility (Fusch & Ness, 2015) and dependability (Houghton, Casey, Shaw, & Murphy, 2013) are considered limitations. Credibility refers to the actual and factual responses of participants, while dependability refers to the accuracy of transcribed responses from the participants.

This study could have been quantitative if over 150 survey respondents had been used, but a sample of 12 green energy professionals was used, which fit the study size parameters for a single case. Employees of the green industry were chosen for the study instead of the general public because they were expected to be more familiar with green technology issues internally within the company and with how customers were responding to its use externally. Employees were also expected to know how green technology was affecting their community and the world as well as how they felt the use would impact the future in terms of innovation and customer market share. A larger pool of green technology employees may have yielded different results. In terms of dependability, if a different group of 12 green energy professionals with similar criteria had been studied, the result may have varied based on changes in the group members' gender, age, educational levels, comfort with social media, and time difference between this study and similar studies.

Another limitation in this study was that it is focused on people who claimed to be green energy professionals from LinkedIn and not the customers or public. Green energy professionals may be biased in their responses to promote their green products and justify the importance of their industry to consumers. Consumers and the general public may have been more candid in their responses based on lack of knowledge about green technology, indifference toward climate change and green technology, or dissatisfaction with their green products. Triangulation was not done in this study because the firm's policies and employees' ethics on social media in the workplace was irrelevant to the study of exploring whether social media could increase green technology use because employees can use social media on their personal mobile phones at work or after work.

Significance of the Study

Social media could be used to persuade people to use more green technology to reduce the cost of sustaining the environment by adopting green infrastructures for renewable energy, producing cheaper renewable energy sources for green technologies, as well as lowering insurance costs for green consumers and firms (See Malhotra et al., 2013). The continuous threat of climate change could be combated with the use of social media to reduce cost and to persuade online customers to embrace environmental sustainability as a lifestyle, which may become necessary in the field of information systems to fight climate change (See Ryoo & Koo, 2013). Because knowledge from management and information systems is for the benefit of the community, companies could take advantage of the big data produced by social media to encourage their consumers to combat climate change. Many firms are moving toward big data because

they hope to optimize productivity and have a competitive advantage based on discovery patterns, quantity, knowledge, speed, and data management (Economist Intelligence Unit, 2011). Management and information systems professionals need to analyze these big data from social media to gain competitive advantage. The increase in social media use has produced much big data (Manyika et al., 2011). This means there is a wealth of information in social media's big data that can tell firms a great deal about online users, especially through discovery patterns and data management.

This big data from social media can be analyzed for regression, clustering, classification, and association of consumers to understand how to target customers in terms of using green products that would reduce the cost of living a greener lifestyle. Sustainability is composed of the triple bottom line (TBL): natural environment, society, and economic performance; the TBL is derived from balancing economic performance with social and environmental goals (Dao et al., 2011). If more consumers use affordable green products in exchange for cheaper insurance, discounts, or credits, the cost to meet higher green technology demand may be reduced.

Significance to Theory

This study of using social media to increase green technology use to combat global warming and climate change contributed to the information systems solution for environmental sustainability. This study also enhanced the integrated sustainability framework (Dao et al. 2011) by identifying the main strategies through which firms can incorporate green practices in their business processes, spread green culture to their customers, and become innovative in how they increase their green market share. Also,

this qualitative case study provided the main strategies by which the benefits of using green technology in the future would outweigh its cost.

Significance to Practice

There are many green technologies in the market today. Insurers, for example, have about 80 energy-efficient and renewable-energy technologies that help provide loss-prevention benefits and strategies, including comprehensive general liability, home and work indoor air quality hazard, and workers' compensation (Mills, 2003). Sustainable practices lead to reduced risks; due to the link between accident risk, energy use, and driving distance, insurers give major discounts on workers' compensation and environmental coverage (Mills, 2009). New insurance policies offer discounts for hybrid cars or limited driving time (Tergesen, 2008). For insurers to be profitable and maintain their competitive advantage in their industry, they may have to take advantage of the link between the purchase of green technologies and the sales of discounted insurance policies. Environmental and sustainable development is essential because it increases productivity, reduces costs, and enhances profitability of many firms while eliminating waste, emission, friction, unused resources, noise, and unnecessary energy use (Watson, Boudreau, & Chen, 2010). Reduced cost, profitability, and productivity become the benefit of sustainable practices with the use of business intelligence to mine big data from social media to target potential customers willing to live a greener lifestyle.

Significance to Social Change

Social media has millions of users. Millions of people are on social media daily, with 88% of users socializing and 80% sharing information (Whiting & Williams, 2013).

Social media may be the most effective avenue to share information about green technologies for homes, workplaces, and vehicles to reduce the cost of environmental sustainability. Informing more green energy professionals through social media about sustainability and the use of green technology may not only reduce the cost of green technology due to increased demand but may also lower environmental risks from human activities and lower insurance premiums for people living a green lifestyle.

Summary and Transition

In Chapter 1, I introduced the study and provided a background of using green technology through social media to combat climate change. The research question was presented along with the integrated framework for sustainability and the nature of the study, which involved green energy professionals discussing the effectiveness of green technology and social media to combat climate change from the perspective of the industry and customers now and into the future. Definitions were provided for key terms, assumptions were explained to justify why the expected outcome of the study was possible, and limitations were presented to explain why the sample for the case study was selected and how the outcome of a similar study may be different.

In Chapter 2, I present the literature review to explain the threat of climate change and the need to sustain the environment, as well as the importance of social media in empowering online customers by sharing information for decision-making in real time. Also, I discuss the usefulness of green technology in combating climate change, and the analysis of big data from social media in targeting various green customers through business intelligence.

Chapter 2: Literature Review

Urbanization has become a human problem. Increased incomes and urbanization will soon make climate change irreversible by increasing global greenhouse gas emissions about 80% by 2050 (Tilman & Clark, 2014), which will lead to increased temperature, increased droughts, stronger hurricanes, and increased sea levels (NASA, 2016). The purpose of this qualitative case study was to explore how social media could increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. Climate change is now one of the biggest threats facing humans today, and it will continue into the next century mainly because of gas emissions from human activities. Human emissions are responsible for 95% of global warming, due to its high concentration of greenhouse gases, so strategies are urgently needed to prevent greenhouse gases from warming the atmosphere above 2°C (Stocker et al., 2014). Solutions are desperately needed to modify human activities to reduce the amount of greenhouse gases affecting the earth's climate negatively.

One of the possible solutions is to explore how social media can be an information systems strategy to reach millions of online customers to use more green technology and green products to reduce the emissions of greenhouse gases from human activities. Reduction of greenhouse gases will reduce global warming, which in turn will reduce the negative impact of climate change (Stocker et al., 2014). In Chapter 2, I present the literature search strategy as well as the conceptual framework on which the study was based. I examine evidence of climate change, followed by various green technologies and green strategies that have been suggested to mitigate the problems of

climate change. I also discuss the effectiveness of social media as an influential communication tool to reach millions of customers, and how big data from social media can be used to target customers to positively influence their behavior toward increasing green technology use.

Literature Search Strategy

I search the literature using Google Scholar, Google, and the Walden University Library database ProQuest. I also used older journals I own and retrieved others from experts in the field of sustainability, which were verified on Google Scholar and Google. The key search terms used were *climate change*, *global warming*, *environmental sustainability*, *green technology*, *green IT*, *green IS*, *social media*, *big data*, *sustainability*, and *behavior*. These key search terms were also combined to see if more relevant results could be generated. The combined terms were *climate change, environmental sustainability, green IT,* and *green IS*; *social media* and *environmental sustainability*; *social media, green IT,* and *green IS*; *social media* and *big data*; *social media* and *global warming*; *big data* and *clustering*; *big data* and *classification*; *big data* and *association*; and *big data* and *regression*.

The primary objective in the literature search strategy was to provide evidence that climate change is real and is a problem. I then used research based on global warming and environmental sustainability to further justify that climate change is a real problem that needs to be addressed with information systems strategy as a viable solution. The secondary objective was to search for literature on green technology as products that have been provided to address climate change. The last objective was to

find literature on social media and big data to study how social media can influence customers to use more green technology. Most of the articles used for the literature review were published between 2011 and 2016, and less than 10% were published between 2003 and 2010.

Integrated Sustainability Framework

The conceptual framework for this study was the integrated sustainability framework (Dao et al., 2011). Dao et al. (2011) explained how green companies can use social media as an information systems strategy to create a green culture internally and extend the green culture to customers to reduce the cost of environmental sustainment externally. The integrated sustainability framework (Dao et al., 2011) is a recent concept that has been cited 319 times on Google Scholar as of June 2017 and was created specifically for addressing issues of environmental sustainability through strategic information systems. Examples of some of the research that has included this framework are studies of green information systems adoptions in environmental performance, information systems in green transformations, sustainability performance of a supplier, and sustainability supply chain management (Govindan et al., 2013; Gholami et al., 2013).

The integrated sustainability framework aligned with the research question because it presents four expectations that should be met to sustain the environment, people, and firms. Both the framework and research question dealt with firms improving green practices in their business processes, extending their green culture to customers to increase green technology use, enhancing green innovation to increase future market

share, and spreading the cost-benefit of using green technology to customers and potential customers. The framework also aligned with the qualitative single case study because the interview questions for the study were derived from the framework.

For sustainability to be effective, the three factors of environment, society, and people must be addressed. Long-term business profitability materializes from balancing economic performance with social and environmental goals (Dao et al., 2011). The relationship between this framework and the case study was that the green industry is sustained economically by transferring green culture to its customers, who are then sustained by using their green technology; the environment is sustained by the reduction in greenhouse gases caused by humans using the green technology provided by the green industry. The aim of this framework is to encourage firms to become more innovative in expanding their market share and to have more customers using green technology in the future. This case study addressed the use of social media as an innovative strategic information tool to increase green technology use.

Climate Change and Environmental Sustainability

Evidence of Climate Change

Although some people still doubt there is any evidence of climate change or global warming, world governments, organizations, and scientists consider it one of the serious threats facing this generation (NASA, 2016). The threat of climate change against people, societies, and natural environments is real and urgent (Malhotra et al., 2013). Human activities are increasing the levels of greenhouse gases in the earth's atmosphere that are responsible for trapping large amounts of heat, thereby increasing the earth's

temperature (NASA, 2016). Human emission is responsible for 95% of global warming due to a high concentration of greenhouse gases, so strategies are needed to prevent greenhouse gases from warming the atmosphere above 2°C (Stocker et al., 2014). In the past million years, the earth's temperature increase has not exceeded 1°C, and the quest to keep human heat emissions today from causing a 2°C increase may fail because a rapid reduction of carbon-related fuel use is mandatory to save the planet (Hansen & Sato, 2012). Carbon dioxide is the main greenhouse gas responsible for global warming, and it constitutes over 80% of all greenhouse gases in the United States and 65% globally (EPA, 2014). Scientists are working to develop models to study, monitor, and predict different effects of climate change.

Models have been created to study climate change. Climate models that have been extended into the earth system model can be used to predict future climate change based on represented biogeochemical cycles relevant to climate change, carbon dioxide calculated for stable levels, and climate variables (Flato et al., 2013). Humans need to reduce the effects of climate change by reducing carbon emissions through the use of renewable energy such as solar, wind, and water instead of natural resources such as fuels from hydrocarbons (Moosavian et al., 2013). It seems both green technology and green infrastructure will play a pivotal role towards the reduction of carbon emissions.

Urban areas tend to have high carbon emissions. Urbanization is a major reason for high carbon emissions into the earth's atmosphere from fuels from hydrocarbons and deforestation of trees that use up carbon dioxide (Tilman & Clark, 2014). Urban regions will have to manage extreme issues with temperatures, storms, sea levels, and

precipitation into the next century (Foster et al., 2011). Urbanization and the need for carbon energy has led to the following percentages of carbon dioxide production: electricity 30%, transportation 26%, industry 21%, firms and homes 12%, and agriculture 9% (EPA, 2014). The reality of climate change means that enforcing green policies that promote a green-friendly lifestyle to reduce global warming is needed.

Urban governments are working to encourage citizens to embrace a green lifestyle to counter the effects of carbon emissions from industrialization. Green issues are becoming global, with many countries becoming green friendly in an attempt to counter the negative effects of modernization (Rahim et al., 2012). A green lifestyle depends on renewable energy sources and green technology instead of carbon sources (brown energy) that include gray technology and infrastructure. Humans must learn to manage their activities to stop the life-threating hazards negatively affecting the earth's atmosphere (Morelli, 2013). It seems the increased use of green technology and green infrastructure may greatly reduce greenhouse emissions in the atmosphere.

Greenhouse gases are increasing with human activities. By 2050, about 80% of agricultural greenhouse-gas emissions globally will be from food production and land clearing due to rising incomes to depend on processed foods and urbanization (Tilman & Clark, 2014). Hydrocarbon fuels are used in urban areas for food production and deforestation for building structures. Green awareness has become necessary for citizens to tackle climate change. Environmental sustainability awareness practices should include equipping people to be conscious of their norms, values, and skills to make reasonable decisions regarding a greener lifestyle, and social media campaigns are effective

environmental-awareness tools (Gholami et al., 2016). In this digital age, social media appears to offer a viable way for the government and organizations to make citizens aware of the need to embrace a green lifestyle to sustain the environment.

Strategies to Sustain the Environment

To efficiently and successfully sustain the environment, citizens of the world have to be aware of the value of living a green lifestyle and be encouraged to modify some of their habits and activities. There is societal pressure to create environmental sustainability awareness by informing people about the dangers of global warming to generate sustainable practices and behaviors, which should be initiated at a personal level to be productive (Scholtz et al., 2016). Green awareness may be effective in sustaining the environment as long as the people are aware of the benefits of living a green lifestyle. Environmental sustainment involves meeting human needs from the ecosystem without devaluing the health of the ecosystem, and economic sustainability is minimizing costs of meeting environmental sustainment standards without determining the standards or burdening the future generation (Morelli, 2013). Social sustainability is the positive conditions within a society that promotes equity in access to social and legal services, business, and politics for all cultures and generations (Morelli, 2013). Corporations and organizations may need to play a big role in green awareness to get their customers to use green technologies.

Businesses around the world need to respond to combat the threat of climate change. Global companies are responding to the need of sustainability, which ranges from producing green products to exploring social justice (Reilly & Hynan, 2014).

Companies' involvement to influence their customers' awareness of green technology will be beneficial to the environment, and it can be achieved by sponsoring green research and advertisement. Green research can be consumer based to identify characteristics of consumers that are differentiated by levels of environmental concern, and advertising based to identify levels of green awareness and the ability to influence customers' perceptions as well as awareness (Rahim et al., 2012). Green awareness from firms can be considered part of their social responsibility to the communities where they do business or where their customers live. Social responsibility may include better working conditions, reduced water use, alternate fuel use, and recycling e-waste such as cell phones (Reilly & Hynan, 2014). Green awareness can also include programs, activities, and annual celebrations that involve the community.

Companies that incorporate green strategies and procedures in their business processes can also involve their employees in various green activities for the community. There has been a rise in green buildings, "no plastic day" policies, plant or save-a-tree programs, renewable energy, eco-labeling, and eco-friendly cars (Rahim et al., 2012). These companies should also be interested in promoting and encouraging green research through information systems (IS), business strategies, and information technology. Most information systems research about sustainability has been on green IT in regard to reduction of energy consumption of IT systems, but more strategies are needed to upgrade business cultures and redesign business processes (Dao et al., 2011). Companies taking part in green social responsibility can help in reducing the cost of environmental sustainability for the firm and people.

Companies benefit financially from partaking in social responsibility. Firms that are highly involved in corporate social responsibility (CSR) tend to have a reduced cost of equity capital (CEC) because they attract dedicated investors and analyst coverage; meanwhile, firms that have a high CEC in one year usually disclose CSR the following year (Dhaliwal, Li, Tsang, & Yang, 2011). CSR can be a form of economic sustainment for firms to sustain both the environment and people. There are four ways firms address strategic management of Green IS. First, firms might talk about environmental issues but implement nothing. Second, firms might resort to green IT for motivation, economic expectation, and legitimacy (reduce green IT). Third, firms might use information and communication technology (ICT) to reduce environmental issues within their products (substitute green IT). Last, firms might embrace eco-friendly goals and combine environmental protection with economic growth (transform green IT) (Bohas & Poussing, 2016). Green IT strategies adopted at the end of the process are called "Preventive Green IT" and those done at the beginning to avoid eco-degradation are called "Curative Green IT" (Bohas & Poussing, 2016). Strategic CRS only has positive effects in adopting Reduce Green IT and Preventive Green IT, Adopting Green IT is affected positively by cost and corporate image, which belongs to a firm that uses ICT intensely, and Substitute Green IT, Transform Green IT, and Curative Green IT only benefits large firms (Bohas & Poussing, 2016). Both small and large companies benefit by adopting CRS for strategic reasons and use Green IT at the end of their business processes, while only large firms benefit when they use ICT, combining environmental with economic goals, and Green IT at the beginning of their business processes.

There are CSR benefits for firms in sustaining the environment, but governments also should play a role in supporting both business and customers to sustain the environment through policies and taxes. Governments can also help conserve green space and habitats in support and protection of green lifestyles. “Green grabbing” has always been based on the agenda for a greener environment that conserves biodiversity, for ecosystem services, for producing biofuels, or for producing biocarbon (Fairhead, Leach, & Scoones, 2012). Governments should also provide policies to determine how these green-grabbed lands are administered for the benefit of all. There should be rules and regulations about how these grabbed lands are accessed, used, and managed and how green capital from the lands is circulated to benefit the environment, firms, and citizens (Fairhead et al., 2012). Governments, firms, and citizens can come together to agree on how lands are intentionally reserved for the sole purpose of benefiting the environment, firms, and individuals in the community.

For firms to be fully committed to green activities in their communities, governments also must ensure that policies and taxes appear lucrative to firms. Firms are committed based on cost savings, corporate image, and their core values, which means that diffusion of Green IT depends on taxes and grants as well as on corporate awareness and voluntary agreements by firms (Bohas & Poussing, 2016). Collaboration between governments and firms is essential for sustaining the environment, firms, and society through utilizing and depending on both green technology and green infrastructures.

Green Technology for Environmental Sustainment

Green Technology Strategies

Renewable energy and green technology is used to reduce carbon emissions and other greenhouse gases towards rectifying climate change. Carbon dioxide is the main greenhouse gas from human activities that causes global warming (Epa.gov, 2014). For example, more cellular networks demanding huge mobile data in future will use green energy in the future, which will greatly reduce carbon emissions (Han & Ansari, 2014). One of many ways to greatly reduce carbon emissions from human activities is to depend on renewable energy sources to generate electricity and lighting in buildings. Electric use leads to 35% of carbon dioxide (CO_2) emissions, and 40% of electric use is for lighting buildings (Magno et al., 2015). Lights in buildings are responsible for about 14% of total carbon emissions, which means that using lights that depend fully on electricity from renewable sources will reduce total carbon emissions by a descent percentage of about 5%. Light Emitting Diode (LED) is becoming a popular light source due to its longevity, low power use, lack of poisonous mercury like in fluorescent lights, and lighting levels that can be regulated to save energy (Magno et al., 2015). More green or energy-saving technology for light is needed to reduce carbon emissions and the cost of environmental sustainment.

To reduce carbon emissions and reduce the cost of sustaining the environment, firms, and people, electricity for lighting could be generated from a green or renewable energy source. Photovoltaic Light Emitting Diode (PV-LED) is a green technology that produces photovoltaic electricity with the use of a light emission diode, which has a

storage battery that provides electricity at night or on cloudy days, and it saves more than 90% of electric used by the traditional system (Zhang, Wu, Feng, & Xu, 2015). It seems PV-LED lighting could save close to 32% of the 35% of carbon emissions from traditional electricity use if most buildings, especially in urban areas, used it. To achieve sustainable society, humans need technological advancement in renewable power sources and to embrace greener behaviors consciously (Gholami et al., 2016). Humans need to make a conscious effort to embrace green infrastructures, green technology, and a green lifestyle to reduce the cost of environmental sustainment.

Citizens need to be aware of the types of green technology and practices available. Some green infrastructure and green technological practices are green alleys and streets; green, blue, and white roofs; urban forestry; architecture built to withstand floods and hurricanes; and parks and wetlands (Foster et al., 2011). Much of this green infrastructure and these green technological practices need to be advertised in social media, traditional media, or print so that citizens can be aware and use them. Advertising to increase consumer use of green energy should also include psychological brand benefits to the environment and use benefits, in terms of nature experience, to create a strong brand attitude and purchase intention (Hartmann & Apaolaza-Ibanez, 2012). People need to get closer to nature to understand nature's usefulness and to psychologically (mentally) see green products as a brand to be appreciated in order to embrace the use of green energy and green technology, but many citizens are still lagging behind in awareness.

Challenges of Green Technologies

Despite increase in both green technology use and green awareness, more research is needed from information systems on the best strategy to reach the citizens of the world about using green technology to reduce the cost of environmental sustainment. Information systems scholars now need to focus on addressing the issues of environmental sustainability based on its success across different businesses because business leaders are reorganizing their core competencies in that direction today (Watson, Lind, & Haraldson, 2012). Business leaders are now including green material and green strategies in their business processes, but information systems research is lagging behind in how to solve the problem of green technology use strategically. For Green IS and Green IT research to become relevant in both short– and long-term benefits to sustain the environment, businesses, and people, scholars have to provide solution-based research now (Sarkis, Koo, & Watson, 2013). But information systems research still has much work to do in environmental sustainment.

Research in information systems should not just be about theory but rather must have practical application toward resolving the issues of governments, firms, and people. It is time for information systems research to align its identity and relevance to tackle societal problems by first understanding the demand from society (Becker, vom Brocke, Heddier, & Seidel, 2015). The demand of society now is to reduce the amount of carbon emissions in the atmosphere to prevent greenhouse gases from absorbing more heat, which leads to global warming that causes climate change, so green infrastructure is needed to reduce dependence on carbon or gray infrastructure. There needs to be a shared

scope and characteristics between Green IT and Green IS, and Green IS initiatives should inform and optimize organizational processes and enable IS innovations and infrastructure solutions (Loeser, 2013). The IS field needs to collaborate with IT industry and the green industry to come up with better innovative strategies to facilitate societal understanding and embrace of green technology use. IS research needs to look outward to tackle issues based on social values by collaborating with environmental scholars; IS research can also set a standard for sustainability in academics (Brocke, Watson, Dwyer, Elliot, & Melville, 2013). The collaboration of information systems, information technology, and environmental researchers should lead to innovative sources of renewable energy on which the demand for more green technology will depend.

Increase in global population will lead to increases in electric and energy use. Global energy needs will increase 60% by 2030, which means producing electricity with renewable energy sources, which are natural, clean, and sustainable, is a great way to combat climate change (Moosavian, Rahim, Selvaraj, & Solangi, 2013). Renewable energy sources would be beneficial to the environment, organizational profitability, and society at large. Green energy has long-term benefits for environmental and social performance, but additional resources may be needed initially to align capital and human cost for communication as well as coordination to get short-term operational and economic benefits (Yang et al., 2016). Firms may be discouraged from embracing green processes and green energy because it may cost more than necessary to reap the desired profits in the short-term. Investment in implementing green technologies and green infrastructures is more expensive than using traditional technologies, and the payback

period tends to be longer, which affects property managers negatively; these managers also lack implementation experience (Zhang et al., 2015). More resources are definitely needed to make economic and operation benefits a reality in the short-term to encourage businesses to embrace various forms of renewable energy sources.

Solar energy is an efficient source of renewable energy. Solar power's market value is higher than electricity's, with a low market penetration of between 2% to 5%, because the weather is usually sunny when electricity is in high demand (Hirth, 2014). Other forms of renewable energy, such as wind, water, and biofuels, can be used to increase market penetration and keep market value as high as possible for renewable energy. Increased solar power use has led to decreased costs of solar equipment and solar panels. The solar investment is beneficial for private use and individual investors but not for society due to the high cost of electricity networks and higher taxes (Hirth, 2014). For a society to use renewable energy successfully, green technology use may be on an individual basis like generators used in individual homes in many third world countries. Green energy, such as solar and wind, are not always available, which means to decrease the use of brown carbon energy from electrical grids, the supply of green energy must meet the demand (Goiri, Le, Nguyen, Guitart, Torres et al., 2012). Each home, building, or facility owner or decision maker should have its chosen source of renewable energy or a system that combines multiple sources of renewable energy in case one or more sources is unavailable in the area at a given time.

In society, governments, and firms, the cost of implementing green infrastructure may not be profitable considering taxes and the cost of building electric networks. Only

48% of shareholders feel that sustainability contributes positively to short-term value; 11% expect that a reputation for sustainability will add value. Extractive firms feel that the biggest barrier to sustainability is lack of incentives (42% of shareholders) or transport (45%) (Bonini, 2012). Among executives in the extractive industry (mining, drilling, quarrying, etc.), 25% feel that lack of capabilities is a barrier and other executives were at 15% (Bonini, 2012). Despite the fact that many business owners and executives do not see the short-term economic benefits of green technology and green energy use, the benefits still outweigh setbacks if green technology is made available for private use in homes, offices, and factories.

Reducing Hydrocarbons for Green Energy Source

Hydrocarbons, or fossil fuels, are the main source of energy today, and their carbon content is responsible for most of the greenhouse gases that cause global warming, which leads to climate change. The use of fossil fuels to generate energy is mainly responsible for carbon dioxide emissions, so biogas should be upgraded as a form of renewable energy to be used as a replacement (Chaemchuen, Kabir, Zhou, & Verpoort, 2013). About 80% of greenhouse gases are from energy production and fossil fuels (hydrocarbons—crude oil, natural gas, and coal), main contributors to climate change, and 40% of energy use comes from buildings (Moosavian et al., 2013). It is highly necessary to replace or reduce dependence on hydrocarbons with renewable energy, especially in the areas of buildings, electricity, and lights. Renewable energy technologies are a potential solution against climate change. An example is Photovoltaic (PV), which is becoming popular because it is noiseless, has no toxic emissions, and is simple to

operate and maintain (Moosavian et al., 2013). So producing electricity with renewable energy sources is mandatory for the future of the planet.

It is great to have renewable energy sources for electricity and light, but it would also be better to have network sensors that control the amount of electricity and light being used at a given time. Network sensors communicate with appliances to monitor and control usability. Information and communication technology (ICT) is going from a goods orientation to service orientation because it makes goods smarter and uniquely recognizable through the Internet, allows sensors and actuator networks to be integrated with electric grid infrastructure, and promotes reliable and efficient environmental sustainability (Kranz et al., 2015). These networks and sensors from ICT will be great in reducing carbon use in exchange for green energy while demand for energy increases with time. The need and uses for green, renewable energy will increase as brown carbon energy increases in cost (Aksanli, Venkatesh, Zhang, & Rosing, 2012). Cellular networks also use carbon energy.

About 40% of energy use comes from lights in buildings, and other electrical devices and networks, such as cellular networks, also need to rely on green energy to further reduce carbon emissions. Green communication is on the rise, and base stations make up about 50% of energy use in cellular networks, so running base stations on green energy technologies will reduce on-grid (electric) use and thereby reduce carbon dioxide (Han & Ansari, 2013). Intelligent Cell brEathing (ICE) can optimize green energy in cellular networks by minimizing the highest energy use rate of base stations to reduce carbon emissions (Han & Ansari, 2012). Increasing the use of green energy in cellular

base stations and using ICE will contribute greatly to diminishing the threat of climate change.

Another future area of interest is green energy for generators and refrigerators in buildings. Generating green electricity for heating and cooling homes and the workplace is essential for modern living. Solar energy is now being used to make thermoelectric generators for heating and thermoelectric refrigerators for cooling in order to reduce cost and carbon dioxide (Zhang, Sun, Xu, & Zhu, 2014). Researches are promoting both solar and wind energy as the best renewable sources for the future, but Photovoltaic is a more attractive solar producer of electricity, and, by 2050, solar energy could produce about 11% of electricity used globally (Moosavian et al., 2013). Solar energy is favored to help increase the use of green energy, but other sources of green energy are needed to make up for the unavailability of solar at night, during rain, or in winter, though solar energy can be stored for later use.

Green energy can also come from biomass, where carbon can be reduced into other substances that require fewer emissions, such as in waste management or recycling. Acetone-Butanol-Ethanol is a biomass source of green energy that emits less carbon into the atmosphere than other fuels (Chang, Lee, Lin, & Wang, 2013). Renewable energy can be introduced into the chemical production chain by converting carbon dioxide into feedstock, an efficient, sustainable resource that could lead to a low-carbon economy for society (Perathoner & Centi, 2014). Waste management or recycling can be helpful when converting waste into low-carbon substances. Renewable and sustainable energy can be derived from solar, water, wind, biofuel, and geothermal energy and bioenergy can be

derived from waste through the sustainment of waste management strategies (Hosseini, Andwari, Wahid, & Bagheri, 2013). Titanium dioxide photocatalyst, for instance, cleans both water and air because it is non-toxic, easy to prepare, has surface acid-base qualities, and is extremely hydrophilic, but its use for green energy application is being enhanced in pollutant degradation, hydrogen evolution, organic synthesis, and use under solar light (Devi & Kavitha, 2014). With these various sources of green energy to meet future demands for energy for the future, there are many opportunities for the use of green technologies in the future.

Benefits of Green Technologies

The main goal of green technology is to reduce carbon emissions through energy savings, green infrastructure, and recycling. Tree planting, green alleys, and green streets are up to 6 time more efficient than traditional methods in managing storm water; an acre of green infrastructure greatly improves air quality and property value as well as reduces energy demand and carbon emissions (Foster et al., 2011). Storm water can be recycled for agricultural use elsewhere, and green infrastructure can reduce energy use, heat, and various greenhouse emissions. Green roofs give 40% higher value than traditional methods in storm water management, reduced energy cost, and better air quality as well as up to 45% annual energy savings (Foster et al., 2011). Likewise, white roofs may save up to 65% and blue roofs can store about 50% of rainwater annually, which can reduce electricity use when treated (Foster et al., 2011). Permeable pavement can reduce storm flow by up to 90%. Simply increasing pavement reflectivity by 35% can reduce

temperature, energy use, and ozone levels in the earth's atmosphere (Foster et al., 2011). Green technology will be useful in the future and will depend on green infrastructure.

Green infrastructure and green technology reduce heat and greenhouse gas emissions, and the same can be done with buildings and lights. Many carbon emissions come from building and lights. Buildings use about 50% of electrical energy and contribute almost 50% of carbon dioxide emissions in Europe; in the United States, buildings use about 74% of all electricity and emit about 40% of carbon dioxide, so green buildings and technologies in buildings are important for their energy and water savings as well as their low waste and carbon emissions (Zhang et al., 2015). This means that going Green on both energy and lights for buildings can tackle up to about 50% of carbon emissions, which will cause a significant reduction in global warming. For example, light emitting diodes (LED) are more efficient in terms of consumption and wastage that traditional lights when used in homes, workplaces, industrial settings, and agricultural facilities (Magno et al., 2015). Within six months, smart lighting systems can reduce power consumption by 55% and up to 69% in the spring because their motion and light sensors use low-power and low-cost wireless systems to automatically adjust light intensity (Magno et al., 2015). Advancement in wireless sensor networks, such as occupancy and photo sensors, can now monitor and control houses, offices, and buildings by collecting and processing data (Magno et al., 2015). It seems the use of sensors, monitors, and controls could help reduce carbon emissions from building lights.

Aside from building and light emissions, another producer of carbon emissions is in communications, especially cellular networks. Information and communication

technology emits much carbon dioxide, but scheduled cloud computing algorithms can be used to control cloud datacenters to increase utilization and efficiency of hardware equipment as well as to reduce energy consumption by 5%–25% (Wu, Chang, & Chan, 2014). Many advanced cellular systems, designed for very high traffic, for user equipment consume large amounts of energy, which, due to having many sub-carriers, can be reduced by scheduling the transmission to user equipment in fewer time slots (Chu, Chen, & Fettweis, 2012). The possibility of reducing energy use in communication and especially cellular networks will also help to combat climate change.

Before the world can rely solely on green energy, if at all possible, there will be a period of combining gray and green technologies. Some benefits of combining gray infrastructure with green infrastructure include prevention of sea level rise and floods, reduced temperatures, more capital cost savings, better water capture and conservation, and improved human health and air quality (Foster et al., 2011). A reduction in gray infrastructure use or combination with green infrastructure is still a step toward alleviating the threat of climate change. In fact, just planting trees or removing fewer trees when building houses can go a very long way. A building with a 20% tree canopy can enjoy up to 18% annual cooling savings, up to 8% annual heat savings, and up to 37% increase in residential property value (Foster et al., 2011). To benefit exceptionally from green technology, there has to be adequate internal and external strategies. Green supply-chain management (GSCM) and green information systems (GIS) are useful strategies. GSCM is an external strategy, and GIS is an internal strategy for sustainable development for any organization to combat climate change (Yang et al., 2016). Social

media is an effective information systems strategy to reach both employees internally and customers externally in regards to using green technology to reduce carbon emissions in the atmosphere.

Effectiveness of Social Media

Impact of Social Media on Consumers

Firms should make good business decisions in reaching their customers to achieve their business goals, including corporate social responsibility (CSR) goals. People should be encouraged to make business decisions based on corporate environmental objectives, which should be addressed in higher business education (Swaim, Maloni, Napshin, & Henley, 2014). Green advertisement should promote both a green lifestyle and CSR (Rahim et al., 2012). One effective business decision is the use of social media to advertise a green lifestyle to both employees and customers as part of CSR. Social media provide new information (which can be false, but can be verified online) that is uncontrolled and can shape consumers' decisions in real time (Tufekci & Wilson, 2012). Social media enhance interaction among peers; provide better tailored, more available information; influence others; and provide a wide access range, emotional support, and surveillance (Moorhead et al., 2013). Social media should make a great tool for reaching out to citizens of the world to embrace a lifestyle of using more green technology to reduce carbon emissions in a cost-effective way.

Social media has been used for green awareness with great success. Social media is useful for individual and team situation awareness (Yin, Lampert, Cameron, Robinson, & Power, 2012). In using social media to reach customers, firms have to be tactful and

understand the personality and nature of each target group. Socializing, as well as seeking and exchanging information online, is related to personality, and the preference for types of social media is also related to personality differences (Hughes, Rowe, Batey, & Lee, 2012). Citizens tend to respond to green infrastructure and green technologies positively when they understand the life-cycle cost savings, get financial benefit from green use, have laws to implement green infrastructure on private properties, and mandate public projects to include green infrastructure in their processes (Foster et al., 2011). Customers may use green technology if they are adequately informed through social media about the benefits of green technology.

Friends on social media interact with each other and influence each other's decisions. About 66% of social media users have used social media to post their thoughts, follow others' likes and links, and influence friends to act or vote, joined an online social group, and respond to others' posts (Rainie, Smith, Schlozman, Brady, & Verba, 2012). About 67% of social media users participate actively in privacy management with around 63% removing unwanted friends from their lists, 37% removing their names from tagged pictures, and 44% deleting unwanted comments made on their profiles (Madden, 2012). Social media can help customers form partnerships with government, firms, and industries. For example, through social media, citizens can influence how their governments function in terms of budgets and collaborations, instead of just being a consumer of public services (Linders, 2012). Social media are platforms to share and produce news for social, economic, political, and entertainment benefits, but social media is only significant to those with social media experience as well as to those who are

gratified by seeking information, status, and socialization (Lee & Ma, 2012). Customers who are comfortable with social media can always be an asset to combating climate change by producing their own content in support of green technology use to reduce cost of environmental sustainment.

There are four types of customer relationships with sellers. The customer engagement cycle on social media has stages of connection, satisfaction, loyalty, engagement, retention, interaction, and advocacy, which lead to four types of customer relationships with sellers: loyal, transactional, delighted, and fans (Sashi, 2012). Green customers on social media can fall into any of these four relationship groups as they grow in their leaning and awareness of green technology use. Social media enables a personal learning environment and self-regulated learning by integrating both formal and informal learning approaches (Dabbagh & Kitsantas, 2012). Social media aid in fostering relationships with customers. Vivid, interactive posts increase the number of likes; only interactive brand posts enhance comments, but positive comments on brand posts directly correlate to number of likes (De Vries, Gensler, & Leeflang, 2012). In this interaction, social media can bring firms and customers together to be partners in combating climate change.

Impact of Social Media on Firms

Social capital from social media can benefit firms. Social media are more than marketing tools but can also help entrepreneurs benefit from new insights and available resources as they expand their social capital (Fischer & Reuber, 2011). Communication is a basic tool used to bring organizational change, and it is relevant to maintain

commitment to sustainability (Reilly & Hynan, 2014). Social media as communication tools are essential in making citizens commit to sustaining the environment. Social media is playing an active role in transforming the way people communicate, interact, consume, collaborate, and create, both in business and society (Aral, Dellarocas, & Godes , 2013). The level of citizens' commitment, innovations, creativity, and interactions toward sustaining the environment can also depend on how social media is used.

Corporate social responsibility (CSR) is now important to many firms. CSR gives firms good reputations, so combining it with sustainability as a key performance indicator is a vast improvement to the corporate way of doing business (Reilly & Hynan, 2014). Companies are trying to become innovative in how to make their employees more engaged with environmental activities (Swaim et al., 2014). Using social media can be an innovative way to engage both employees and customers in environmental sustainment and informing the public about the firm's CSR in an attempt to enhance their profitability and market share.

Social media play a critical role in purchase intent online and is great for relationship marketing because information is received with conformity, trust, ease, and loyalty (Laroche, Habibi, & Richard, 2013; Kim & Ko, 2012). Firms can provide trusted content to customers to increase online purchase of green technology as well as form trust and loyal relationships with customers. Social media enhance organizational communication processes because they have visibility, consistency, and association qualities (Treem & Leonardi, 2013). It is a good business decision for firms to have a

brand on social media so that customers can build loyalty and trust for the brand through association and engagement.

Social media provides numerous benefits for firms with brands. Branded communities on social media positively correlate customers to products, brands, companies, and other customers, which lead to a positive effect on brand trust, and brand trust has a positive effect on brand loyalty (Laroche et al., 2013). Branded communities on social media have the positive effect of shared consciousness, public obligations, shared traditions, and shared rituals, which positively affects engagement, brand use, and management (Laroche, Habibi, Richard, & Sankaranarayanan, 2012). Firms can also benefit from public brand awareness from social media even in the areas of politics and culture. Social media's correlation to predicting users' social capital, as well as users' civic and political behaviors both online and offline, is positive and significant (Gil de Zúñiga, Jung, & Valenzuela, 2012). Social media are functions of technology, culture, and politics that affect both global and local events as well as consumer behavior, and are dependent on technology (Berthon, Pitt, Plangger, & Shapiro, 2012). Social media venues used as an information systems strategy can transcend a firm and its brand through many sectors of society in an attempt to get customers to combat climate change through green technology brands.

In terms of media outreach for brands, social media has a positive impact on sales. Traditional media (publicity and press releases) and social media (blog and online community posts) both affect sales (Stephen & Galak, 2012). Despite the fact that traditional media have higher per-event sales, social media have greater sales elasticity

due to more frequent activity and also drive traditional media activities (Stephen & Galak, 2012). Social media marketing, in terms of interaction, trendiness, entertainment, customization, and word-of-mouth are positively correlated to value equity, brand equity, and relationship equity (Kim & Ko, 2012). Value equity and relationship equity especially had positive influences on purchase intentions, and there is a significant relationship between purchase intention and customer equity (Kim & Ko, 2012). Social media will be effective in getting customers to interact with each other and in driving up the value of green technology to get more people sustaining the environment to reduce cost. Social media can bring masses of people from diverse backgrounds to physical spaces to achieve a common goal (Juris, 2012), such as using green technology to sustain the environment. The goal of this study is, by using social media, to gather people around the world to reduce carbon emissions through the use of green technology to reduce the cost of environmental sustainment.

Challenges of Social Media

Not all social media venues are recommended for environmental sustainment. When using various social media for environmental awareness, LinkedIn users report a neutral experience; Instagram, Blogs, and Twitter report negative experiences at 71%, 64% and 56% of users, respectively; while Facebook and YouTube report the most positive experiences at 96% and 79%, respectively (Gholami et al., 2016). It seems that only Facebook and YouTube see positive experiences for customers in regards to environmental or green issues. Many youths are aware of what “green living” means because of advertisement, but only few actually put it into practice because they lack

comprehensive understanding (Rahim et al., 2012). There is a need to improve on the creative delivery of green information in advertising to youths (Rahim et al., 2012). When dealing with the youth population, they must understand the importance of the issues so they will be engaged in implementing the required solutions. Government using social media to interact with their citizens will be an effective vehicle to enhance government services, share ideas, improve decision and policy making, and solve problems, it has also led to many concerns in, for example, privacy, security, access, and archiving (Bertot, Jaeger, & Hansen, 2012). Social media have many communication benefits, but improvements are needed to block strangers from accessing various users' accounts from search engines, messages received from strangers, and unauthorized users reading or using another's information, as well as to recover past information effectively. Despite these problems, social media still provide strategic advantages for business owners.

Social Media for Strategic Advantage

The strategic advantages or benefits of social media are numerous. Many entrepreneurs have adopted social media as a method to promote their business (Fischer & Reuber, 2011). Green companies are more willing to share sustainability information in their communication and use social media outlets than non-green companies (Reilly & Hynan, 2014). Strategic information systems help companies transform value chain activities into environmental and economic benefits that also impact social life positively (Malhotra et al., 2013). The use of social media as a strategy can bring environmental and

economic success to the green industry, have a positive effect on citizens' health, and can reduce insurance costs for those with green lifestyles.

Insurance companies can also use social media to increase policy sales. Sustainable practices lead to reduced risks; due to the link between accident risk, energy use, and driving distance, insurers give major discounts on workers' compensation and environmental coverage (Mills, 2009). New insurance policies offer discounts for hybrid cars or limited driving time (Tergesen, 2008) and give financial incentives for pay-at-the-pump insurance to reduce driving time as well as to reward fuel economy (Mills, 2003). Pay-as-you-go insurance, which has a discount of up to 60%, is based on the link between accident risk, energy use, and driving distance (Mills, 2009). Insurers using social media to advertise these discounts related to green lifestyles will benefit the environment, people, and firms. Insurance purchase can be directly linked to social norms or expectations rather than actual risk because social norms influence insurance purchasing decisions based on status and how risk is perceived within a social circle or society (Lo, 2013). Using social media to convince friends of the risk of climate change and about insurance discounts received by making green lifestyle the norm will reduce the cost of environmental sustainment.

It is essential for firms to invite customers to their social media sites. For customers to participate on social media, firms should offer incentives, such as credits, discounts, and new services (Treem & Leonardi, 2013). To keep green conversation going on social media, the conversation must be interesting enough to make people want to purchase green products online. Social media are effective when positively influencing

knowledge sharing, attitudes, and behaviors, especially toward environmental awareness, because they are fast, easy to use, and cost effective and because they reach a wide audience (Gholami et al., 2016). Firms need to be involved in the conversation to keep it positive, polite, and informative and to respond punctually to customer concerns. Firms need to also understand their customers to use social media efficiently. The younger users and the unmarried are easiest to influence on social media, and men have more influence than women, but women have more influence on men than on other women when it comes to decision to accept product offers (Aral & Walker, 2012). Men and women seem to be very influential on social media.

Social media is not only affected by gender, but it is also affected by culture. There is a strong correlation between the social media content generated by the residents of neighborhoods and districts to the distinct structures, compositions, and characteristics of those areas and the cultural, social, or political forces that define the areas (Cranshaw et al., 2012). Knowing the content discussed on social media by various groups in various segments of society can help firms channel particular green technology to particular groups or areas that would be interested or are in need of that technology. Mobile social media applications can be used for marketing research, brand loyalty, communication, relationship development, discounts, and sales promotion (Kaplan, 2012). Social media can be used to target groups and segments of society for loyalty and to build relationships based on their social and political needs.

Social media is also efficient for customers' needs in promoting green issues. The relationship between social media and political change leads to content that reflects

shared values, has digital forms, and becomes a cultural product, as well as to people and organizations that produce the content by using social media tools (Howard & Parks, 2012). Social media can help individuals share a common bond on issues that can transform their political unit and lives, such as environmental sustainment and how it can lead either to reduced cost in green lifestyles or too risky living. By enhancing political change, social media can be used to shape ideas, frame necessary issues, promote unifying symbols and ideals, and transform online activism to offline movements (Lim, 2012). Social media can definitely transform people's attitudes toward embracing a green lifestyle that would drastically reduce greenhouse gases that lead to climate change. Using Twitter for microblogging, for example, allows organizations to share information with shareholders, engaging them dialogically in community-building activities for action; in this, social media is replacing websites as well as other forms of public engagement (Lovejoy & Saxton, 2012). Many local governments are using Web 2.0 and social media tools to promote transparency but are still behind their citizens when it comes to using it for corporate dialogue and e-participation (Bonsón, Torres, Royo, & Flores, 2012). Social media encourages dialogue between governments, firms, customers, and the green industry to enhance the sustainment of the environment.

Best Social Media for Environmental Sustainability

Facebook and YouTube seem to be the best social media for promoting environmental sustainment. Facebook and YouTube report the most positive experiences at 96% and 79%, respectively; environmental awareness went from as low as 43% before the social media campaign to as high as 95% afterward (Gholami et al., 2016). The main

social medium used for environmental campaigns is Facebook it reaches a large audience in America. Because of social media's communication, collaboration, and engagement abilities, many companies use them as an electronic word-of-mouth to create brand value, trust, loyalty, and commitment while receiving instant feedback (Gholami et al., 2016). Social media is a form of advertising in of itself.

Social media has been used to advertise environmentalism. Women respond more positively to green advertising and environmentalism and all consumers respond better first to broadcast advertising (TV) and second to online media (social media) than to print (Rahim et al., 2012). Women are influential in social media communication, especially if they are highly educated, have high economic resources, and are frequent users. Social media also give the voiceless or powerless a voice and some power (Tufekci & Wilson, 2012). Social media is effective for men in responding to high-priced green products, it is used by educated women with higher income to carry on the discussion for environmental sustainment, especially on Facebook and YouTube. The majority of senior citizens above 65 years of age use at least one type of social media and many organizations see it as an effective means of corporate communication toward innovative corporate practice (Reilly & Hynan, 2014). Facebook has 71% of all internet users and is still the most popular of social media. The percentage of adults using more than two social media sites is now at 52%; and 56% of seniors above 65 years use Facebook (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). Even senior citizens are able to use Facebook to influence men, women, and youth in their circle of friends to embrace a greener and healthier lifestyle for the future. With such diversity in users Social media

will provide necessary data for firms to know which customers to invite on social media, using incentives to generate and continue green conversations.

Big Data from Social Media

Value of Big Data

Social media will almost be meaningless as an information systems or business strategy without its big data capabilities. It is the classification, regression, clustering, and association of social media's big data that will make social media beneficial as a business and information systems strategy. Understanding what kind or type of social media user that is most like interested in green technology use and its online discussion is what makes social media as a strategic information system valuable to business owners and decision makers. Insurance, green, electric, and health companies can strategically invite these targeted customers with incentives to join their social media to extend green technology dialogue to friends and family online.

Big data are becoming a strategic advantage for businesses in the future. "Big data" refers to data sets too large for database software to retrieve, manage, store, manipulate, and analyze efficiently (Manyika, 2011). Many firms are moving toward big data because they hope to optimize their productivity and have a competitive advantage based on discovery patterns, quantity, knowledge, speed, and data management (Economist Intelligence Unit, 2011). Within these unstructured masses of data are hidden customer patterns that can be used for both predictions and decision making. Data can now be managed more precisely that ever before with more accurate predictions, smarter decision making, and more effective target intervention (McAfee, Brynjolfsson,

Davenport, Patil, & Barton, 2012). Data are useful to businesses if their relationships to important related concepts are understood as well as the fundamental principles of data analysis for decision making (Provost & Fawcett, 2013). When data are understood and analyzed properly, the value of the data is measurable.

Data quality is essential for credibility to decision makers. Data measurement is the modern equivalent of a microscope that allows computer algorithms to measure behaviors and sentiments in minute detail as content is produced, which allows instant, accurate decisions to be made (Lohr, 2012). The four value chain of big data is that data must be generated, acquired, stored efficiently, and then analyzed for the right decisions (Chen, Mao, & Liu, 2014). Data are meaningless if they have not been cleaned for quality and credibility.

Data can be collected from various sources. The Internet is creating big data that can be analyzed for solutions, and companies are now collecting big data from sensors and social media that need to be cleaned to enhance both data quality and credibility in order to provide timely, accurate, and reliable insights from the discoveries and trends found within the data (Gholami et al., 2016). To improve effective managerial and strategic decisions, decision makers need to have access and the ability to turn big data into meaningful information in their data warehouse (Padhy, Mishra, & Panigrahi, 2012). Business owners need quality data to increase profitability. Decision making based on big data can increase productivity by 5%–6%, and firms that use big data strategically achieve higher financial performance than their competitors (Economist Intelligence Unit, 2011). When it comes to the new opportunities big data creates, 51% of firms say

that big data have increased operational efficiency, 36% report informing strategic directions, 27% reported better customer service, and 24% identified newer products and services to develop (Economist Intelligence Unit, 2011). Big data have been undoubtedly improved business productivity.

Big data has five characteristics. The five characteristics of big data are the volume of unstructured data from social media; the high speed of data production; variation in data types produced; variability of social media data that are inconsistent and unstructured at different times of day or seasons; and complexity of data that needs to be correlated and connected (Shirkhorshidi, Aghabozorgi, Wah, & Herawan, 2014). There are also various ways to generate big data. The four types of generated big data are transactional, where customers are buyers and generate online order trends; communication, where customers are idea creators that provide feedback and complaints; participative, where customers are designers and actively participate in product and service deployment; and transboundary, where customers are intermediaries who import and export knowledge across different systems (Xie, Wu, Xiao, & Hu, 2016). Cellular networks also generate lots of data.

These generated big data listed above can also be derived from mobile networks. The cellular industry is a huge contributor to big data. Mobile Business Intelligence for data mining is now considering applications for enterprise, e-commerce, socializing, and industry-specific uses for finding trends in economic, social, and behavioral models needed for games, social marketing, and mobile advertising (Chen, Chiang, & Storey, 2012). Mobile big data, even from games, can say a lot about customers and how to serve

them better. Big data have been used to transform vast amounts of data into information and then into knowledge to assist organizations in meeting their goals and objectives in the areas of retail sales, search engine optimization, and even politics (Murdoch & Detsky, 2013). Big data can be used in every field of study. Organizations that depend on big data pay attention to data flow instead of stocks; rely on data scientists, products, and process developers instead of data analysts; and are moving analytics away from information technology to areas of core business, operations, and production units (Davenport, Barth, & Bean, 2012). The future of business will be run off the knowledge of data management for consumer retention and acquisition.

Big data come in an unstructured form and need to be cleaned to be useful for knowledge discovery. Manage and utilizing big data is now a necessity because unstructured and various data types are being produced at high speed, which has led to new services such as social networks, clod computing, and the Internet of Things (Xiaofeng & Xiang, 2012). Due to the speed, velocity, volume, and structure of these new data sets that cannot be managed or analyzed by traditional analytic techniques, big data mining has the capability to extract useful and needed information for decision makers from the large unstructured streams of datasets (Fan & Bifet, 2013). Mobile big data are able to predict human behavior patterns and share data based on mobility of humans and visualization analysis and techniques for unstructured data sets, as well as to correlate the variables between human behavior and the environment, including the weather (Laurila et al., 2012). These unstructured big data contain a wealth of information needed to study customers who can be invited on firms' social media to

participate in dialogue promoting the use of green technology to reduce the cost of environmental sustainment.

Big data can be collected from micro-processes and smart cities. Much big data research is actually based on the analysis of online networks that can be improved upon in terms of formation and evolution to study social and behavior research to understand knowledge generation in micro-processes (Snijders, Matzat, & Reips, 2012). A smart city is a digital concept with massive computing activities by people who create and manage its entrepreneurship, economy, creativity, governance, and innovation with digital devices that produce big data for real-time analysis; new urban governance; and more sustainable, productive, and transparent cities (Kitchin, 2014). Big data from social media will play a big role in the future of environmental sustainment.

Challenges of Big Data

Big data still have many challenges to overcome for a better future in information management. The future benefits of big data outweigh these challenges in terms of increased business productivity, evolutionary scientific breakthroughs, and progress in many fields, but advances are still needed for the capture, storage, analysis, and visualization of data (Chen & Zhang, 2014). Big data have both big problems and big opportunities, so the code of conduct for information systems academics should be to contribute effectively to the well-being of society, to avoid and prevent harm to others by eliminating falsehood, and to be honest and trustworthy in order to protect the privacy, dignity, and integrity of data (Clarke, 2016). More work is needed to make managers

understand and appreciate big data by, for example, making data easier to use and keeping data secure from competitors and intruders.

Big data has many setbacks. One of the setbacks of big data is that some decision-making executives do not see the benefits of big data in optimizing productivity and competitive edge (Economist Intelligence Unit, 2011). About 25% of organizations with big data have no idea what to do with them, 53% only use half of them, and 73% increase their data collection yearly (Economist Intelligence Unit, 2011). The challenges of big data are solvable and require both social and technical solutions in terms of data privacy, design that addresses specific needs, improved communication between stakeholders, and policies for continuously advancing technological innovations (Neff, 2013). Information systems, information technology, and social scientists, such as environmentalists and health care scientists, need to collaborate to solve security and communication issues and improve the confidence of users of big data. Big data will become mainstream in health care due to their ability to provide insight for adequate decision making, but rapid progress in their platforms and tools is needed to address issues of privacy, security, standards, and governance (Raghupathi & Raghupathi, 2014). Providing security and standards through adequate governance is essential for the adaptability of big data to business owners.

Aside from security issues, big data are needed to help in making timely decisions. Big data, from a data-mining perspective, require aggregated information sources, consideration for security and privacy, model for user interest, and mining as well as analysis (Wu, Zhu, Wu, & Ding, 2014). Managing big data effectively in the

future will require adequate data management capabilities, algorithms that automatically create metadata for unstructured data, cybersecurity tools and data deduplication, software that analyzes large and diversified data sets, and optimized software for real-time analysis in systems (Gantz & Reinsel, 2013). Privacy has become a relevant issue because of the increase in sharing data across industries and with law enforcement, so there are now tools that analyze and correlate data for easier privacy violations, but improved techniques are needed for developing applications with privacy recommendations and principles (Cardenas, Manadhata, & Rajan, 2013). Valuable data need protection through encryption, and data should be confidential.

Lastly, more is needed in knowledge-discovery technology within big data. Despite the fact that big data have changed the landscape of data management even beyond the impact of the technological world, there is much to be done in the area of machine learning as well as in integrating people in the discovery process (Kraska, 2013). Databases do not solve big data issues, but improvement is needed in both statistics and machine-learning algorithms to accommodate users with less experience as well as to develop a data-management ecosystem based on the algorithms so that users can manage, evolve, visualize, and understand their own algorithm results (Madden, 2012). Business owners need to be able to manage, understand, and use their own big data efficiently. To gain value from big data, they have to be analyzed in depth to deliver insights that will be given back to the organization in order to enhance products and services and to make the data adaptable for customer use (Dumbill, 2013). Efficient data management is ultimately for adequate customer service.

Efficient data management is a requirement in order to benefit from big data. Big data are scalable analytics with problems on both the application side and systems levels, but they require a cloud-based platform for data management to be efficient (Labrinidis & Jagadish, 2012). The cloud has become more common for customer use, but firms need clouds that are more accurate, accessible, and void of ethical issues. Big data redefine how we derive knowledge, but they may not always be accurate or objective or better data. Big data may be taken out of context, and their accessibility does not make them ethical, yet, because not everyone can access them, the digital divide may increase (Boyd & Crawford, 2012). In 2013, Google's prediction of doctor visits, drawn from big data, was double the actual count according to the Center of Disease Control and Prevention (Lazer, Kennedy, King, & Vespignani, 2014). Accurate and reliable data will be needed from social media's big data in order to better target suitable green customers for social media conversations to help lower the cost of sustaining the environment.

Mining Social Media's Big Data

Big data are unstructured data created at high speed in large volumes in real time and have to cleaned and categorized into relevant groups for analysis. Time series representation can be grouped into pattern discovery and clustering, rule discovery and summarization, classification, and clustering (Fu, 2011). Time series can be used to extract meaningful statistics for forecasting and predicting what customers will be efficient to invite and will be effective to promote green technology conversations. Social media data need to be analyzed for customer opinions, sentiments, and texts through association rule, segmentation, and clustering (Chen et al., 2012). By categorizing big

data from social media, firms can easily see patterns or trends of green customer conversations and can determine the best customers to invite to their social media, with incentives.

Big data can be categorized for analysis in many ways. Some of the methods used in analyzing big data are Analysis of Variance (ANOVA), where a control group is compared with many test groups; Association Rule, where associating relationships are discovered based on association rules; and Cluster Analysis, which uses diverse groups divided into smaller similar groups (Manyika et al., 2011). Another way to define these techniques are: clustering technique, analyzing various data variables without known segments or classes; Association Rule is finding frequent item sets and generating strong association relationships; and Sequence Discovery is finding sequential patterns within the data (Padhy et al., 2012). Clustering is an important data-mining technique and tool for analyzing big data in terabytes and petabytes of data as social media produce hundreds of gigabytes of content per minute (Shirkhorshidi et al., 2014). Clustering divides data into unknown groups where one group has similar identities or properties that are still unique from other groups (Shirkhorshidi et al., 2014). Other methods include Data Integration, where data are integrated and analyzed from various sources, Data Mining, which uses patterns extracted from large databases, and Regression, which is how the effect of the dependent variable is measured with changes to any independent variables (Manyika et al., 2011). Any of these analytical methods can be used by firms to study and understand green customers better from the content they produce in their social media conversations.

Gap in the Literature

The research gap in the literature is that information systems research towards environmental sustainability is limited as of 2016. Information systems research is too limited in the area of environmental sustainability (Gholami et al., 2016). This information systems research is an attempt to contribute a solution towards resolving the threat of global warming and sustaining the environment. This research is about how to use social media to reach online customers to use more green technology to reduce the cost of environmental sustainment. There is research on the use of social media for environmental awareness (Rahim et al., 2012; Scholtz et al., 2016); for communication and marketing (Aral et al., 2013; Reilly & Hynan, 2014); and for building relationships, trust, and loyalty with customers (Treem & Leonardi, 2013;); but none has explored how social media can be used to increase the use of green technology.

The responses of the green energy professionals shows if social media is a good medium to keep green energy professionals engaged in green practices and green customers engaged in using green technology to reduce the cost of environmental sustainment. If social media is useful in promoting green technology use, then social media's big data will be essential in knowing how to target customers for green technology use. Also, for the future, the green energy professionals' responses show that social media is innovative and increases the strategic position of the firm and increases the market share of customers who use green technology.

Summary and Conclusions

In the literature review, I discussed the problem of climate change becoming a threat into the next century and provided the foundation for a single case study to explore if social media can be a strategic information systems solution to combat the menace of climate change. The literature search strategy was also presented to show the key terms and research databases used to search for relevant journals to support the study. This was followed by a summary of the integrated sustainability framework (Dao et al., 2011) to explain how social media can play a critical role in sustaining the environment in a cost-effective manner within and outside organizations today and into the future. Evidence of climate change was presented to show that the earth is getting warmer due to greenhouses gases emitted mainly by humans, which was followed by a discussion of strategies and products that can combat climate change.

Green technology strategies showed detailed information about various green technologies and how they are used; then, the challenges of green technologies showed the improvements needed in green infrastructure to replace carbon energy. Reducing hydrocarbons with green energy sources was explored to understand the various processes that increase green energy use, which led to discussing the benefits of using green technologies to reduce cost of sustainment. Discussing the impact of social media on consumers showed how social media empower customers, and the impact of social media on firms showed how social media give firms competitive advantage. The challenges of social media explained the improvements needed to increase social media's efficiency, social media for strategic advantage explained how various firms use social

media for profit, and determining the best social media for environmental sustainability explored how social media can be used to combat climate change. The value of big data was presented to show why big data from social media is important in understanding how to target customers for green technology use on social media; this was followed by the challenges of big data to explain the improvements needed to make big data more profitable to firms. Lastly, in discussing mining social media's big data, I explored the information needed by the big data and business intelligence departments in the green industry to target customers for environmental sustainment.

In the future, the cost of sustaining the environment should be greatly reduced with efficient green technology use after scholars invent more advanced techniques in finding and understanding big data knowledge discovery in social media. Social media security and access issues being effectively addressed will also reduce the cost of sustaining the environment, as will green energy infrastructure successfully replacing gray (carbon) infrastructure.

In Chapter 3, the research method for the qualitative single case study research was discussed, followed by the procedures for recruitment, participation, and data collection. I clearly explained how green energy professionals were recruited from social media and how I verified that each participant was a green energy professionals and was not a minor. I also discussed how I conducted and recorded the interviews for the study. The data analysis plan was addressed as well as issues of trustworthiness in the study.

Chapter 3: Research Method

The purpose of this qualitative case study was to explore how social media can increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. The research question in a qualitative study is used to determine who the participants will be, their number, and the topic of study (Cleary et al., 2014). Qualitative research is an approach to studying humans based on the need to develop a theory, explore a person's experiences, or describe a phenomenon (Cope, 2014). Green energy professionals' perspectives regarding using social media to enhance use of green technology was explored in this study because the success of using social media to increase the green technology use depends on how well it can change people's behavior toward a green lifestyle.

This chapter includes the research design and rationale as well as the role of the researcher and the methodology. Case study methodology should include the design rationale, techniques for data collection, and procedures for reliable data analysis (Yin, 2014). In the logical design of the case study, I show how and where data were collected to determine the object of data analysis. I present the participant selection logic, instrumentation, recruitment procedure, participation criteria, data collection plan, and data analysis plan. Next, I discuss issues of trustworthiness to explain credibility, transferability, dependability, confirmability, and ethical procedures. Trustworthiness and validity of findings in qualitative case studies are essential for the studies' results to have any value.

Research Design and Rationale

The research question for this qualitative single case study was the following: How can social media be used to increase green technology use and reduce the cost of environment sustainment? I explored how green energy professionals feel about the use of social media as an information systems strategy to encourage online customers to use more green technology to sustain the environment. The following interview questions were used to collect data: What is green energy professionals' understanding of using social media to improve green practices in their business processes? What is green energy professionals' understanding of using social media to extend their green culture to customers to increase the use of green technology? What is green energy professionals' understanding of using social media to enhance green innovation within their business and increase customer market share in the future? What is green energy professionals' understanding of the cost-benefit of using green technology to sustain the environment, firms, and customers?

In this study, I examined how social media could shape the behavioral intention of online customers to purchase and use green technology to reduce the cost of environmental sustainment. Human behavior is affected by three beliefs—consequences of behavior, normative expectations of others, and presence of factors that may affect behavior—that combine to form behavioral intention (Ajzen & Klobas, 2013). Trotter (2012) stated that qualitative research differs from quantitative research in five areas. First, qualitative research is cultural representation, such as green culture, while quantitative research is individual representation. Second, qualitative research depends on

an expert framework while quantitative research provides a probabilistic framework. Third, qualitative research depends on a saturated model while quantitative research depends on a statistical model. Fourth, qualitative research has generalizations that are analytical, such as analyzing themes, while quantitative generalizations are statistical. Fifth, qualitative research focuses on consensus or saturation, while quantitative research focuses on variation of responses. Based on the above five comparison by Trotter (2012), qualitative research was preferred for this study because it dealt with green culture, expert framework, saturated model, analyzing themes, and saturation.

A single case study was the best design for this study because I examined how one factor, social media, affected a desired outcome (see Willis, 2014). The five qualitative research designs are narrative to examine personalized stories, phenomenological to analyze respondents' lived experiences; ethnographic to explain a situation from a respondent's environment, grounded theory to construct a theory from data, and case study to demonstrate effectiveness or efficiency (Lewis, 2015). The purpose of the current study did not align with narrative, phenomenological, ethnographic, or grounded theory designs. A single case study was conducted using 12 green energy professionals of any career level who were in the green industry, were above the age of 18, and used social media. Small studies reach saturation before larger ones, and saturation is required for the study to have quality and validity (Fusch & Ness, 2015).

Role of the Researcher

As the researcher, I was the instrument for data collection. I had no relationship with the participants because I interviewed employees in a green company I had never visited. If I had known any of the participants, I would not have interviewed them to avoid any form of bias or discomfort.

I did not perform interviews at my workplace and did not provide any incentives for participation, so that effects of bias, power, and conflict of interest were mitigated. An effective case study is challenging and depends on the skills and expertise of the researcher, and it must withstand questions of reliability, credibility, and validity (Yin, 2014). A case study must be done with a high level of professionalism to be academically acceptable.

I presented the recruitment letter and consent form to each participant before the study began, and I emphasized that I must maintain the ethical expectations of Walden University's institutional review board (IRB) and the Natural Commission of the Protection of Human Subjects. When conducting the interviews, I created an environment that encouraged the participants to be comfortable and confident. I recorded the responses and conducted member checking to ensure reliability, credibility, and validity.

Methodology

One of the values of qualitative research is knowing when the data are saturated. The value of qualitative research is the ability to explore a subject or topic in depth and ground the study in conceptual frameworks, symbolic interactions, and social constructs; qualitative research has many data-gathering and analysis methods that affect how

participants are selected and when to stop data collection (Cleary et al., 2014). Using the integrated sustainability framework (Dao et al., 2011), I studied the effect that social media use, as a symbolic interaction with green energy professionals, has on using green technology use as a social construct.

I used LinkedIn to connect with 10-30 green energy professionals across the United States who may have been interested in participating in the qualitative single case study. I ensured that participants were all above the age of 18 by looking at their work experiences and college degrees, and I also verified this age requirement prior to the recorded interviews. After participants accepted my connect invitation, I sent them a LinkedIn email asking if they would like to participate in the study as green experts. I requested their email and phone number to schedule interviews. I conducted interviews until I got the necessary data to reach saturation. A good research design has its components working in harmony so the study can be functional and successful (Maxwell, 2013). To have a successful study, I first made sure that the participants understood the research question and the purpose of the study. I wrote out participants' recorded answers to the interview questions so I did not miss any valuable data.

I followed an interview protocol (Appendix B) that included all of the questions that were asked of each participant. I asked employees how their company uses social media for business processes within the company, how social media is used to interact with customers, and how efficient social media has been to date. Also, I asked how social media can enhance green innovation within the company, increase the company's market

share and profitability of green technology in the future, and contribute to sustaining the environment in terms of cost.

I used NVivo qualitative software to create nodes for each interview question and subnodes to categorize the positive and negative responses from each participant. The words and phrases from these subnodes were helpful in discovering matching patterns of how the green energy professionals felt about how social media could increase green technology use. Pattern matching was easy to do through the word query feature of the software, and source and reference data were provided to estimate saturation.

Participant Selection Logic

The sample for the qualitative single case study included 12 employees in the green industry who were above the age of 18 and used social media. Participants were chosen in accordance with the study's framework to research the internal perspective within a green organization and external perspective with green technology customers. The number of participants was sufficient to provide thick, rich data and reach saturation. Smaller studies reach saturation quicker (Fusch & Ness, 2015). As requested by the Walden IRB office, I also verified during the recorded interviews that the women were not pregnant. The green energy professionals knew about the efficiency of green technology use and its current impact on customers. These participants also knew what their firm was doing to enhance green technology use internally to improve both social and environmental environments, as well as externally in terms of growing the customer market share.

Instrumentation

I was the instrument for conducting the qualitative single case study. I used data collection tools that included an observation sheet, interview protocol, digital audiotape, and NVivo qualitative software. The observation sheet was one page with all of the interview questions and space for short responses. The interviews were conducted on the phone and took an average of 10 to 20 minutes. The audiotape was digital so that it could be downloaded and played on the computer. Interviewing is a common method in qualitative research; the data can be recorded in observation notes, transcripts, and digital audiotapes, but a combination of all three is the most effective way to manage qualitative data (Tessier, 2012). Recorded data is effective for data correctness and consistency. Computer Assisted Qualitative Data Analysis (CAQDAS) software such as MaxQData and NVivo (are used to explore, describe, order, explain, and predict all forms of data or text responses for analysis (Miles, Huberman, & Saldana, 2014). I used NVivo software to analyze the data from the study after transcribing the interview results.

The interview protocol, located in Appendix B, included interview questions that were aligned with the research question. The interview protocol is an instrument used to ask questions that are consistent with the focus of a study (Patton, 2015). The interview protocol was aligned with the research question because the four interview questions were derived from the integrated sustainability framework that was used to address the issue of environmental sustainment in the study.

The four interview questions were used to collect data for the single case study based on the integrated sustainability framework (Dao et al., 2011) to explore the role of

social media in increasing the use of green technology and reducing the cost of sustaining the environment. Interview protocols should be guided by the research question and should include open-ended interview questions (Jacob & Furgerson, 2012). The four interview questions were open-ended to allow participants to express themselves freely.

The content validity of the study involved a transcribed data review procedure in which I e-mailed the transcribed data from the interview to each participant to confirm the accuracy of the transcribed data. Participant validation of response is an effective technique to establish trustworthiness in qualitative research and to understand participants, convey data analysis procedures, reconstruct data collection while remaining open to change, compare responses, and incorporate new respondent validation (Kornbluh, 2015). Confirmation of the accuracy of responses from participants is crucial for validity, credibility, dependability, and confirmability.

Expert Consensus

I contacted five green energy professionals on LinkedIn to determine whether my four interview questions were aligned with the research question. The professionals were also asked to determine whether the questions were valid, reliable, credible, and appropriate to prevent any bias in the participants' responses. All five green energy professionals were satisfied with the questions, and some provided recommendations. Researchers are encouraged to test their interview questions with people who are similar to the sample participants to verify that the questions are easy to understand and align with research question (Jacob & Furgerson, 2012). The four interview questions explored (a) how green firms use social media for their business processes; (b) how green firms

use social media to interact with their customers; (c) how green firms use social media to be innovative and increase market share; and (d) how green firms explain the cost-benefit of using green technology to the firms and customers.

Procedures for Recruitment, Participation, and Data Collection

For size and saturation purposes, the numbers of participants recruited for the qualitative single case study was 12. A study reaches saturation when every interview question has been totally explored in detail to the extent that latter participants provide the same concepts and themes as the participants before them (Cleary et al., 2014). Saturation is attained when there is enough collected data for the study, new data and themes can no longer be attained, and further coding (how data is organized and sorted to tell a story) becomes impractical (Fusch & Ness, 2015). Data collection stopped as soon as saturation was reached.

I used LinkedIn to connect with 12 employees out of 82 that were contacted in the green or renewable energy industry and the 12 that were interested were invited to participate in the study through a recruitment letter (Appendix A). After the approval of the Institutional Review Board (IRB) application, I sent a recruitment letter to invite each participant by email. Also, I sent the consent form to the interested green energy professionals by email explaining what the study is all about; option to withdraw; procedure; possible risk or discomfort; time limit; statement to participate voluntarily and no consequence for refusal; rights to confidentiality and withdrawing at any time without consequence; and benefit of study to society.

Data was collected over the phone. I, the researcher, collected the data as an observer of the interview process. Data collection continued daily until I had 12 participants and the study was saturated at 9 participants with newer participants providing repeated similar concepts and themes in their responses as the previous participants, but I stopped at 12 participants. Duration of data collection events was between 10–20 minutes. Data was recorded on both the digital audiotape and the observation sheet. I used Microsoft Word to transcribe participants' responses into data. There were no follow-up interviews after the initial one was completed. I shared their transcribed data with each participant through email for final verification or as a member check procedure. Only 2 out of the 12 participants made modifications during the member checking process. At the end of the interview, I assured each participant that the information was only for research, their responses and identities were confidential, and that the materials collected will be destroyed after 5 years. Audio recording will be deleted after dissertation defense because IRB recommended it in case verification is needed.

Data Analysis Plan

The data from the open-ended questioned interview were analyzed by me based on how participants responded to how social media can help sustain the environment through the use of green technology. There is no demographic data in the data analysis because the study is about what green energy professionals, regardless of race, gender, or age above 18, understand about how social media can increase green technology use. Data was analyzed using Stake's two strategic ways to analyze data - Categorical

Aggregation and Direct Interpretation (see Yazan, 2015). NVivo qualitative software was used to segment and categorize the transcribed data of the participants. The data presentation from the NVivo software was analyzed by me and presented in the results. CAQDAS software performs many tasks in qualitative research, including data segmentation and categorization, search and retrieval of data, and providing visual representation (Talanquer, 2014). Any discrepant observation or case was also be reported, and a possible explanation was provided. Accurate reporting, which is essential in all stages of qualitative research methods, includes recruitment details, description of participants, inclusion and exclusion criteria, and any unexpected adaptation (Cleary et al., 2014). The purpose of the interview protocol is to answer the main research question for the case study based on common themes.

The NVivo software was used to derive the segmentation or categories of common codes, words, and phrases that are in the participants' responses. I used the pattern matching data analysis strategy (see Yin, 2014) to compare words and phrases in the participants' responses between each node or protocol question. I felt that pattern matching was the best data analysis technique to interpret the visual presentations of categories and segments from the NVivo software because I could identify the main themes in the participants' responses between each node.

Issues of Trustworthiness

Credibility

Credibility of a study can most likely be ensured if the study has minimal researcher's bias and quality time is spent on understanding the participants' responses.

Credibility is determining if results are believable and truthful enough to capture the phenomenon being explored, which is based on researchers' prolonged engagement in understanding participants' perspectives and on persistent observation to avoid researcher bias (Billups, 2014). I met with every participant over the phone for between 10–20 minutes and explained to each participants that they could end the interview at any time. I wrote down and audiotape their responses as well as sent their transcribed data responses back to them after the interview to make sure that we both validated and confirmed the data as a member check procedure. This response verification process should prevent any form of reflexivity so that my views do not affect the answers of the participants. Saturation is also required for the study to have quality and validity (Fusch & Ness, 2015). I ended the study when I began to see a similar pattern in the responses of the participants after about 9 participants have responded to the interview protocol.

Transferability

To ensure transferability, a reader should be able to determine if the results from the study can be transferred to their specific context (Houghton, Casey, Shaw, & Murphy, 2013). This means that the researcher must provide real detailed information to help the reader to make the required decision. The research was a thick, rich, and deep description of the methodology, data collection, and findings through the NVivo coding of themes that are considered factual based on the responses of all participants in the study. The original context of a study should be described by the researcher in detail to include context accounts, research methods, findings, and samples of data so readers can determine the transferability of its results to their specific context (Houghton et al., 2013).

The research was detailed so that readers can determine easily if the study can be transferred to their own context.

Dependability

To ensure dependability of the study, the transcribed data from the participants were accurate before coding it with NVivo software. Dependability is determining if the results have consistent themes and if the same research process and data collection methods are applied (Billups, 2014). Dependability is based on an audit trail of decisions made by the researcher throughout the study that shows the researcher's methodological rationale, contextual data, and interpretive judgment (Houghton et al., 2013). If a different researcher performs a similar case study with the same participants within a short time span, the second researcher will most likely get a similar result. Dependability will only be affected if participants have formed a different opinion based on an updated experience since the initial study was performed.

Confirmability

In order to get accurate and factual answers from the participants, I must make sure that the participants are comfortable and allowed to speak freely. Confirmability is determining if the results are neutral, accurate, can be corroborated, and have minimal researcher bias or reflexivity (Billups, 2014). After the interview, I transcribed the participants' responses into data and email it to each of them for verification, which is the member check procedure. Participant validation of response is a valid technique to establish trustworthiness in qualitative research (Kornbluh, 2015). This will confirm that the answers are legitimately those of the participants as they were written and spoken.

Ethical Procedures

Walden University expects all research done on humans to be approved by Walden University's Institutional Review Board (IRB). The IRB application (Approval No. 05-23-17-0701460) was completed and used to gain access to participants. IRB is useful for the study of human subjects and it makes sure that participant or human subjects will not be harmed in any way (Jacob & Furgerson, 2012). The treatment of human participants requires institutional permissions, including IRB approvals. I stored all recruitment materials and processes to prevent any issues of privacy and confidentiality.

No data collection or intervention activities took place until after receiving approval from the IRB. Participants refusing to participate or desiring early withdrawal from the study were reminded that there is no penalty or risk for not participating, and their responses were not at risk from confidentiality and piracy issues. Data collection was done anonymously because each participant was a number rather than a name, and I kept responses in a private, secure place. Only I have access to it. All data will be kept for 5 years and then will be destroyed. Audio recording will be deleted after dissertation defense because the IRB recommended it in case verification was needed.

Summary

In this chapter, I discussed research design and rationale, the role of the researcher, and methodology. The methodology included participant selection logic; instrumentation; procedures for recruitment, participation, and data collection; and a data

analysis plan. Issues of trustworthiness were next examined to explain credibility, transferability, dependability, confirmability, and ethical procedures.

Chapter 4 contains the data analysis and results for the qualitative single case study. This includes the research setting, demographics, data collection, data analysis, discrepant cases, evidence of trustworthiness, and the study results.

Chapter 4: Results

The purpose of this qualitative case study was to explore how social media can increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. In the study, 12 green energy professionals provided responses about how social media could enhance green practices within a firm, promote green culture externally to customers, and increase green technology use. Participants also described the cost-benefit of using green technology. The results from the study showed that social media is an efficient information systems platform to reach millions of people and firms and to educate them on the cost-benefit of using more green technology to sustain the environment. In this chapter, I discuss the expert consensus, research settings, and participant demographics of the study. I also address the issues of data collection, data analysis, and trustworthiness.

Expert Consensus

I contacted five green energy professionals on LinkedIn to verify that my interview protocol was aligned with the research question and could be approved for validity, reliability, credibility, and appropriateness and to prevent any bias from participants' responses. All five professionals were satisfied with the questions, and some provided recommendations. One felt that two of the interview questions may be too similar and another felt some responses may be too broad, but I felt the interview questions were appropriate. I informed each professional about the sustainability framework (Dao et al., 2011) via email and provided the conclusions as stated by the authors of the framework. In the same email, I listed the interview protocol and asked the

professionals to review the alignment between the main research question, interview protocol, and sustainability framework. Although all five professionals verified that the four interview questions were aligned with the main research question and the sustainability framework, one professional felt that the cost-benefit question would be too broad. Another professional felt that the responses to increasing the use of green technology may be similar to the responses for spreading green culture to customers, but I felt that the protocol questions as they were would provide the open-ended responses I needed and some consistency for the pattern-matching technique.

Research Setting

I used LinkedIn to connect with green energy professionals who used social media and were older than 18 years of age based on work history and college graduation year. Additionally, I verified their age in the digitally recorded interviews. I first sent LinkedIn e-mails to 82 green energy professionals asking them to participate in the study, but only 19 showed interest in the study. The 19 professionals were sent both the recruitment letter and consent form by email, but only 12 returned the signed consent form. The seven professionals who initially showed interest but did not agree to participate gave various reasons for not participating. One wanted to get a lawyer's approval before participation, another wanted to provide only written responses rather than recordings, and others said they would call me back but never responded to my calls again.

Demographics

Demographic data were not necessary in this single qualitative case study because the research design did not require any demographic data. All responses were relevant regardless of participants' race, gender, age, sexual orientation, religion, or disability. I verified in the digitally recorded interview that all participants were above the age of 18 and that none of the women was pregnant, as required by Walden IRB.

Data Collection

I collected data from 12 green energy professionals recruited from LinkedIn. I sent a total of 82 emails through LinkedIn to determine the interests of the green energy professionals who may have wanted to be involved in the study. Of the 82 recipients, 19 responded as interested participants for the study, but only 12 finally participated. Each of the 12 participants received both a recruitment letter as well as a consent form by e-mail, and each consented through e-mail to participate in the study. Each of the green energy professionals who participated also gave consent to be digitally recorded over the phone for 10 to 20 minutes and were instructed to quit the interview, if needed, at any time without any pressure or penalty. The confidentiality of each participant was also ensured in the consent form and discussed in the digitally recorded interview.

The interview process took 4 days to complete with an average of three interviews per day. Some participants e-mailed the best time to call them, and others accepted my proposed time for the interview. Each interview took place over the phone, and the length was between 10 and 20 minutes. I initially wanted to use the iPhone Call Recorder, which would record the conversation digitally and transcribe the conversation, but the program

failed at the beginning of the first interview. The phone was disconnected, and I could not re-call the participant. The participant also tried to call me back with an undisclosed "dummy number" used by the iPhone Call Recorder. I rescheduled the appointment with the participant and bought a digital recorder at Target.

The digital recorder that I used was the Olympus Digital Voice Recorder VP-10, which is advertised for recording at meetings and conferences. It is easy to use, can record for 1,620 hours, and has a storage capacity of 4 gigabytes. I recorded all interviews with the digital recorder as I took handwritten field notes to document the participants' responses to the interview questions. After completing the interviews, I transcribed each response from the field notes onto a Microsoft Word document. I then sent each participant the transcribed data from the responses by e-mail for the transcribed data review procedure. All of the transcribed data were verified, though one received minor modification because a response needed clarification.

After the transcribed interview responses had been verified by each participant, I prepared to use the NVivo software to code and categorize the responses by watching YouTube videos. I had purchased the NVivo software online and watched videos made by the software owners on how to use it on YouTube. I also asked for advice from Walden's NVivo's expert and a Walden PhD graduate who had used NVivo for his dissertation. After I felt comfortable using NVivo, I began coding the verified transcribed data from the interviews.

Data Analysis

I used the NVivo 11 Starter for Students for data analysis and I followed Stake's two strategic ways to analyze data: categorical aggregation and direct interpretation (Yazan, 2015). To analyze the data from all 12 interviews, I opened a new project and imported the 12 transcribed interviews verbatim separately from each participant on Microsoft Word. I then created four nodes and eight subnodes. Each node was coded to indicate one of the four interview questions, as shown in Table 1, and each node had a positive and negative subnode based on how the participants responded to the question. A response was considered to be positive if it was favorable toward promoting and spreading green technology use, but was considered negative if it did not. The responses of each participant were categorized into positive and negative remarks within each node as the subnodes. The total of the subnodes was higher than the nodes because one participant provided both positive and negative responses to a single interview question.

In Table 2, the source is the number of participants who contributed to the nodes and subnodes. The reference is the number of quotations from the participants that corresponded to each subnode. For the reference, the sum of the subnodes added up to the total for the nodes. The percentage of source for each subnode shows the value of positive and negative participants responding to each interview question. A source could have provided both a positive and a negative response, so the total percentage of source could have been above 100%. The percentage of reference shows the value of positive and negative quotations from each participant for each node, and it added up to 100%. I accepted over 70% for both source and reference percentages as saturation for each node

because it showed that most of the participants and their responses favored social media as a good tool to increase green technology use (see Fusch & Ness, 2015). Saturation is attained when there are enough collected data for the study, new data and themes can no longer be attained, and further coding becomes impractical (Fusch & Ness, 2015). Data collection stopped when saturation was reached.

Table 2

NVivo Nodes and Subnodes

Nodes and Subnodes	Source	Reference	% Source	% Reference
Green Business Process	**12**	**37**		
Positive	9	29	75%	78%
Negative	4	8	33%	22%
Green Cost–Benefit	**12**	**64**		
Positive	12	58	100%	91%
Negative	4	6	33%	9%
Green Customer Base	**12**	**27**		
Positive	10	21	83%	78%
Negative	5	6	42%	22%
Green IT Use	**12**	**32**		
Positive	11	23	92%	72%
Negative	5	9	42%	28%

I derived the themes from the coded nodes and subnodes through NVivo's Word frequency query, which produced the top 40 key words or themes in the transcribed interviews. Many of the top themes were already in the interview protocol, such as using, green, customer, technology, people, increase, cost, media, and social, so I focused on the themes that answered the interview questions. The themes included the top 10 themes in the verified responses of the participants who answered the interview questions. The top 10 themes are shown in Table 3.

These 10 themes accurately summarized the results from the single qualitative case study. Only one of the themes represented the negative category or subnode and the other nine themes represented the positive categories or subnodes. This was another indication of saturation because 90% of the top 10 themes that addressed the interview questions were in the positive category. There were three types of evidence that met the 70% conditions for saturation in this study, which were the source percentage, the reference percentage, and the Top 10 theme percentage.

Table 3

NVivo Word Frequency Top 10 Themes

Word	Count
Reduce	28
Awareness	25
Solar	24
Cleaner	21
Educate	21
Cheaper	16
Savings	16
Little	12
Profitable	12
Reach	12

The top 10 themes aligned with the four nodes showing that both awareness and reach affected three nodes, educate affected two nodes, little affected one node, and the other six themes affect the cost-benefit node. These themes were used to answer the research question of this single case qualitative study. I used the NVivo text search query for each theme to make conclusions about the study's findings. The four nodes with the top 10 themes were as follows:

- improve business processes: awareness, educate, little, reach;
- enhancing Green IT use: awareness, reach;
- increasing customer base: awareness, educate, reach;
- cost-benefit of green IT use: reduce, solar, cleaner, cheaper, savings, profitable.

Evidence of Trustworthiness

Credibility

The credibility of a study is usually ensured if the study has minimal researcher bias and if sufficient time has been spent on understanding participants' responses (Billups, 2014). In this study, each participant was relaxed during the interview and took adequate time to answer every question because he or she had received the interview questions ahead of the interview. The time to answer the interview questions, including probing questions that were given to participants ahead of time with their consent form, was between 10 and 20 minutes. To comply with the transcript review procedure, each participant was given enough time to verify through e-mail the transcribed data to each question. Every transcribed data was confirmed by participants as the exact response given at the interview, except one who made some changes.

Transferability

Research should be so detailed that readers can determine easily if the study or results can be transferred to another context (Houghton et al., 2013). The procedures and process of the entire study was written in great detail. I have presented how I selected, contacted, and recruited participants from LinkedIn. How the interview protocol and the

conceptual framework were aligned were explained. I have also addressed how the interested participants received a recruitment letter and consent form by email as well as how I conducted phone interviews. I have presented how I verified the transcribed data with the participants through a member checking process via email and how I used NVivo software to code nodes, categories, and themes. Finally, I addressed how I analyzed the themes for each coded node and summarized them to make conclusions on the study results.

Dependability

To ensure dependability of the study, the transcribed data from the participants had to be accurate before being coded with NVivo software (Houghton et al., 2013). Before the coding of the transcribed data from the participants, I gave each participant the interview protocol, which included the probing questions as well, and enough time to respond to each question effectively. Clarifying or probing questions were asked for certainty, and each participant had enough time to perform the member checking procedure by verifying their transcribed data for accuracy. Only after the member checking process was conducted successfully did I code each transcribed data into the NVivo qualitative software to derive the main themes from the coded nodes and subnodes.

Confirmability

A study is confirmed when the responses presented are legitimately those of the participants (Billups, 2014) after it has been verified through the member checking process. Not only did each participant complete the member checking process to verify

that the transcribed data were accurate, but also the entire interviews were digitally recorded, and handwritten field notes were taken for comparison.

Study Results

In this single case qualitative study, results indicated that social media are effective for increasing the use of green technology, enhancing Green business practices, and spreading Green culture to customers. Also, the findings indicated that the benefits of the world going Green far surpassed the costs of going Green. The coding from the nodes and subnodes of this study revealed that 75%–100% of sources said social media has positive influence in improving business processes, increasing customer base, and enhancing green technology use and that there is positive benefit-to-cost ratio in using Green technology. Only 33%–42% of participants said there is little or no positive impact. Also, the results from the coding showed that 72%–91% of references implied that social media has positive influence in improving business processes, increasing customer base, and enhancing green technology use and that there is positive benefit-to-cost ratio in using Green technology. Only 9%–28% of references implied that there is little or no positive impact. Both the source and reference percentages are presented in Table 3.

The fact that over 70% of both sources and references see the use of social media as an efficient way to improve green technology use suggests that the study was saturated. Also, the top 10 themes in responses to the protocol questions prove saturation because 2 of the 10 themes (Awareness and Reach) sufficiently answered three of the four protocol questions (Business process, Green IT use, & Customer base), and four out

of 10 themes sufficiently answered the business process question. The remaining six themes were used in the cost–benefit question or discussion.

The themes are discussed below in the analysis of the coded results. Each node represents a protocol question, and the subnodes are the positive and negative responses from participants. The source percentage represents the number of participants and the reference percentage represents their quotations in their responses. The reference percent adds up to 100%, but the source percent is usually over 100% because some participants may have provided both a positive and negative response to the same protocol question.

The results were presented based on the interview protocol. Each node and subnode were addressed based on source and reference percentages. Then, I used the themes to explain both the source and reference percentages. Finally, I explained the themes based on actual responses from the participants to make conclusions for that protocol question.

Protocol Question 1

What is green energy professionals' understanding of using social media to improve green practices in their business processes?

Source percent. 75% of participants felt positive that social media can improve Green practices in their business processes, compared to 33% who felt otherwise. This shows saturation in the responses to this protocol question.

Reference percent. 78% of participants' quotations reflected positive belief that social media can improve Green practices in their business processes, compared to 22% who felt otherwise. This shows saturation in the responses to this protocol question.

Themes. Awareness, Educate, Little, and Reach

Participants' theme expressions. 33.3% of participants felt that the primary aim of social media in impacting business practices was through *Awareness*. The main quotations concerning awareness were "large role in raising awareness," "reaching customers", "Create communities and connect people," and "spreading awareness." Other quotations were "Share ideas" and "Help to promote." Figure 1 shows the NVivo text search query for *Awareness*.

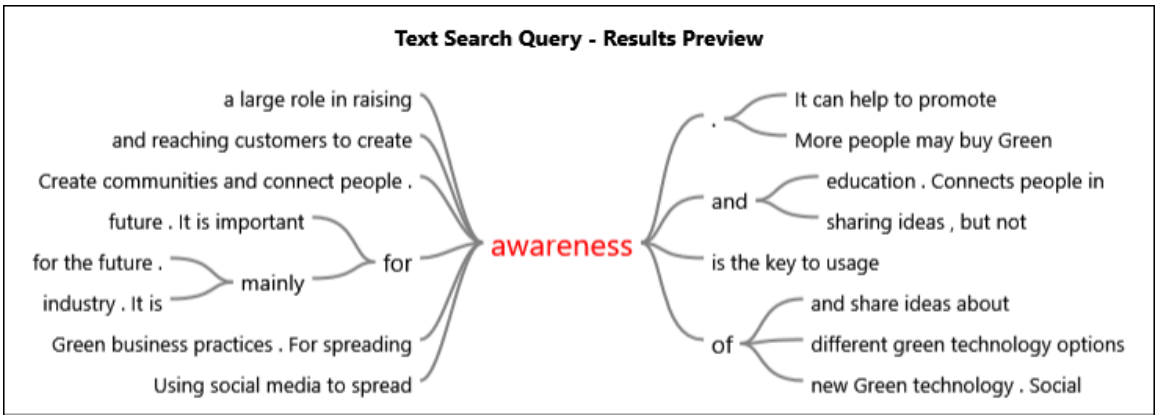


Figure 1. NVivo text search query for "awareness."

The next theme in responses to this question was *Educate*. 58.3% of participants felt that social media were very helpful in educating employees and potential customers about the benefits of going green. Some of the quotations used by participants were "Authenticate the facts about" and "Educate people about green technology." Figure 2 shows the NVivo text search query for *Educate*.

The third theme in responses to this question was *Little*. It was the only negative theme in the top 10 themes coded for this study. 33.3% of participants felt that social media had little use in their business processes. Some of the quotations for little were

"Little impact" and "Elementary stage." Figure 3 shows the NVivo text search query for *Little*.

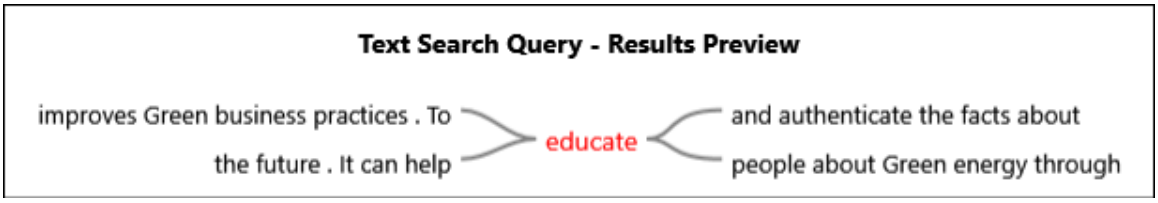


Figure 2. NVivo text search query for "educate."

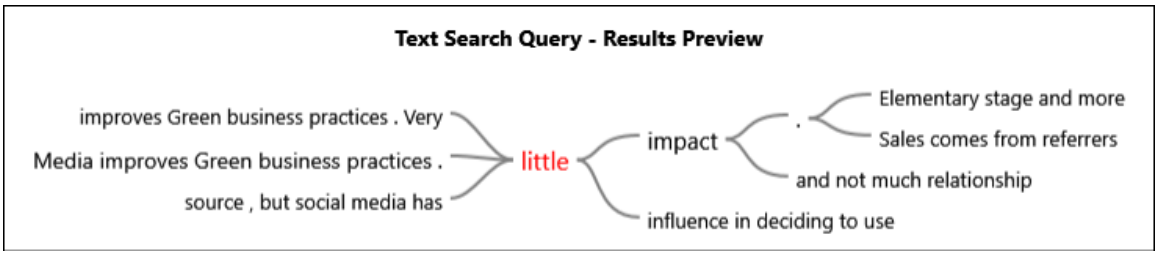


Figure 3. NVivo text search query for "little."

The last theme rising from this protocol question was *Reach*. 8.3% of participants felt that social media was popular and a good way to reach millions of customers and green energy professionals quickly and daily. They felt that the reach of social media could increase use green technology. Some of the participants' quotations were "increase reach and exposure," "promote green culture," and "increase green technology use."

Protocol Question 2

What is green energy professionals' understanding of using social media to extend green culture to customers in order to increase the use of green technology?

Source percent. 92% of participants felt positive that social media can increase Green technology use, compared to 42% who felt otherwise. This shows saturation in the responses to this protocol question.

Reference percent. 72% of quotations from participants reflected positive belief that social media can increase Green technology use, compared to 28% who felt otherwise. This shows saturation in the responses to this protocol question.

Themes. Reach and Awareness

Participants' theme expressions. Many of the participants felt that social media were very useful in increasing the use of green technology. The main theme rising from this protocol question was *Reach*. 16.7% of participants felt that social media were popular and a good way to reach millions of people quickly and daily. They felt that the reach of social media could increase decisions to buy and use green technology. Some of the participants' quotations were "wide range of customers," "customer acquisition and retention," "increase reach and exposure," "promote green culture," and "increase green technology use." Figure 4 shows the NVivo text search query for *Reach*.

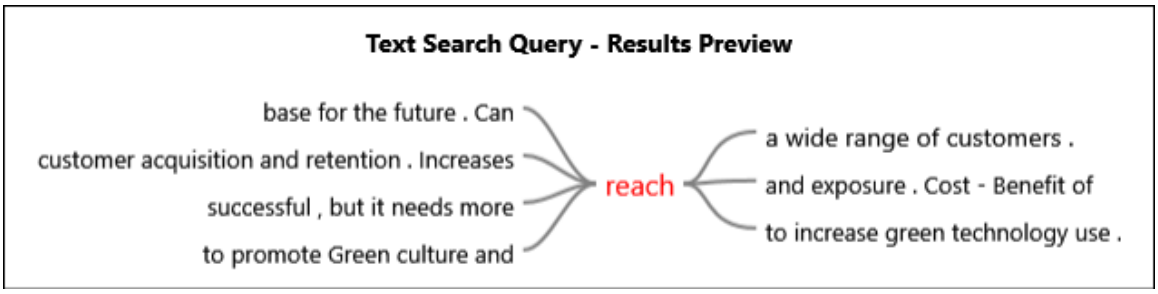


Figure 4. NVivo text search query for "reach."

The last theme in this question was *Awareness*. 8.3% of participants felt that increasing awareness of green technology could increase knowledge, discussion, and debate about new green technologies as well as their purchase and use. Some quotations from participants were "More people will buy," "Key to usage," "New green technology," and "Different green technology options."

Table 4

Coded Source and Reference Percentage

Nodes and Subnodes	% Source	% Reference
Green Business Process		
Positive	75%	78%
Negative	33%	22%
Green Cost–Benefit		
Positive	100%	91%
Negative	33%	9%
Green Customer Base		
Positive	83%	78%
Negative	42%	22%
Green IT Use		
Positive	92%	72%
Negative	42%	28%

Protocol Question 3

What is green energy professionals' understanding of using social media to enhance green innovation within their businesses and increase customer market share in the future?

Source percent. 83% of participants felt positive that social media can enhance Green innovation in their businesses and increase market share (customer base), compared to 42% who felt otherwise. This shows saturation in the responses to this protocol question.

Reference percent. 78% of quotations from the participants reflected positive belief that social media can enhance Green innovation in their businesses and increase market share (customer base), compared to 22% who felt otherwise. This shows saturation in the responses to this protocol question.

Themes. Awareness, Educate, and Reach

Participants' theme expressions. Many of participants felt that social media are very instrumental in reaching more people to increase the Green market share or customer base. 16.7% of participants felt that the primary theme in this protocol question is still *Awareness*, keeping people informed to buy and use green technology. Some of the quotations used by participants included "large role in raising awareness," "reaching customers," "spreading awareness," "share ideas," and "help to promote." Others were "More people will buy," "Key to usage," "New green technology," and "Different green technology options."

The next theme appearing in responses was *Educate*. 8.3% of participants felt that social media is very helpful in educating people, especially potential customers, about the new green technologies and their benefits for increasing the customer base of green technology. Some of the quotations used by participants were "authenticate the facts about" and "educate people about green technology."

The final theme in response to this protocol question was *Reach*. 8.3% of participants felt that the popularity of social media can reach millions of people to increase the number of buyers and users of green technology in the energy marketplace. Some of the quotations used by participants were "wide range of customers," "customer acquisition and retention," "increase reach and exposure," and "increase green technology use."

Protocol Question 4

What is green energy professionals' understanding of the cost–benefit of using green technology to sustain the environment, firms, and customers?

Source percent. 100% of participants felt positive that the benefits of society going Green far outweigh the costs, compared to 33% who felt otherwise. This shows saturation in the responses to this protocol question.

Reference percent. 91% of quotations from participants reflected positive belief that the benefits of society going Green far outweigh the costs, compared to 9% who felt otherwise. This shows saturation in the responses to this protocol question.

Themes. Reduce, Solar, Cleaner, Cheaper, Savings, and Profitable

Participants' theme expressions. There was overwhelming support for the benefits of going Green versus the related costs. This was the only protocol question that had six unique themes because it was the only question that did not deal with social media use but rather with the cost–benefit of green technology. The six themes are discussed below.

The first theme for cost–benefit responses for Green technology use was *Reduce*. 41.7% of participants believed that the use of green technology would reduce cost of electricity, pollutants in the atmosphere, and negative effects of climate change. Some of the participants' quotations were "receive incentives to reduce cost," "reduce cost of electricity," "reduce pollutants," and "reduce negative effect of social change." Figure 5 shows the NVivo text search query for *Reduce*.

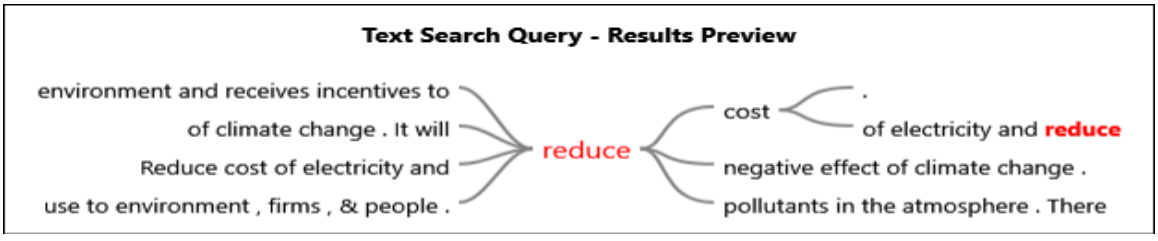


Figure 5. NVivo text search query for "reduce."

The second theme was *Solar*. Solar is the most popular form of green energy among the participants, compared to wind and water energy. 41.7% of participants spoke of solar energy highly as a source of energy that was dependable, reliable, free, and available. Some of their quotations were "efficient source of energy," "growing profitable market," "gives enough power to run," "guaranteed source of energy," and "leaves no waste." One of the participants, whose opinions appeared more negative than the other green energy professionals, stated that solar was not self-sufficient and that there was some misinformation about it. Figure 6 shows the NVivo search query for *Solar*.

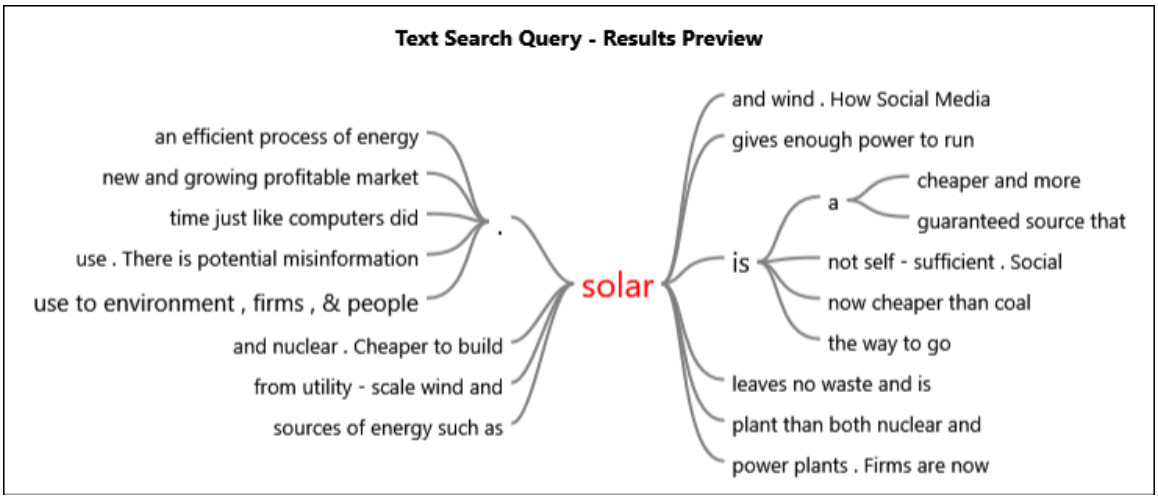


Figure 6. NVivo text search query for "solar."

The third theme for the cost–benefit protocol question was *Cleaner*. 58.3% of the participants felt that green technology use will produce cleaner atmosphere, air, water, and environment. Some of their quotations were "cleaner air and water," "cleaner atmosphere," and "cleaner energy." Figure 7 shows the NVivo text search query for *Cleaner*.

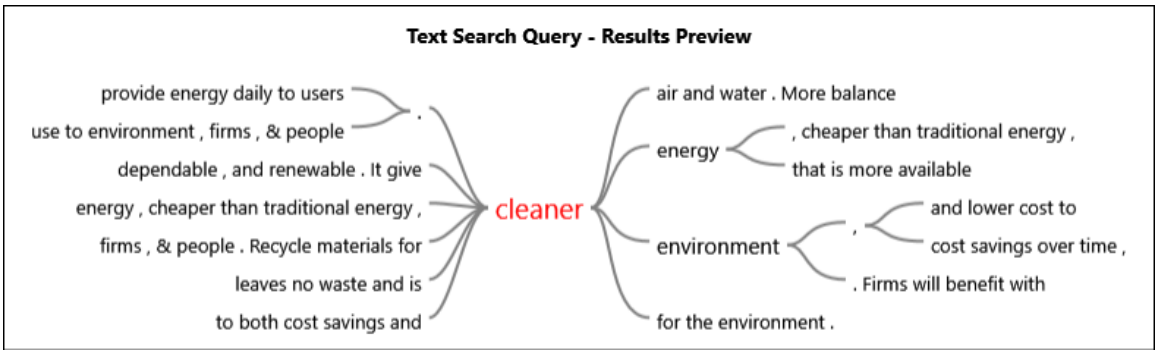


Figure 7. NVivo text search query for "cleaner."

The fourth cost–benefit theme was *Cheaper*. 33.3% of participants felt that green energy is cheaper than coal and nuclear energy, that it costs less to build a green plant than a nuclear or traditional plant, and that green energy was cheaper than conventional fossil fuels. Figure 8 shows the NVivo text search query for *Cheaper*.

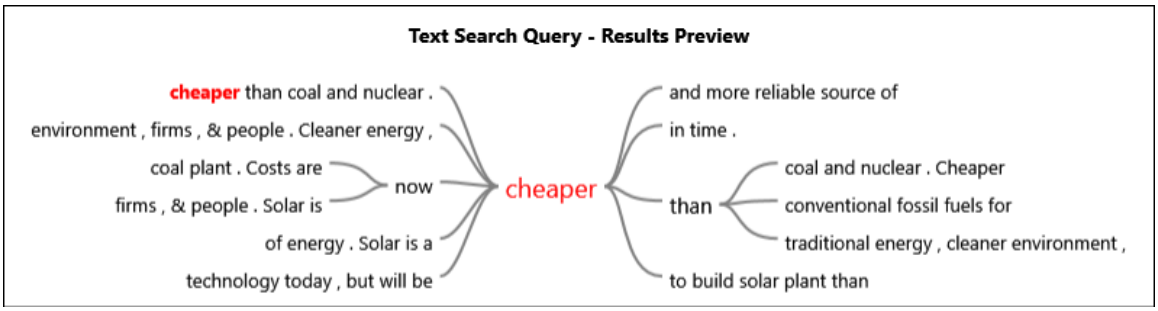


Figure 8. NVivo text search query for "cheaper."

The fifth theme for cost–benefit responses was *Savings*. 33.3% of participants felt that, despite the initial cost of going green or investing in green technology and green energy, there will be savings over time. Some argued that, like computers, green technology will get cheaper with increased demand and that corporations will resolve how to get more green energy from green technology at a reduced cost to the customer because of its benefit to people's health, firms' profitability, and the cleanliness of the

environment. Some of the quotes from these responses were “savings over time,” “savings and environmental cleanliness,” and “savings to benefit customers.” Figure 9 shows the NVivo text search query for *Savings*.

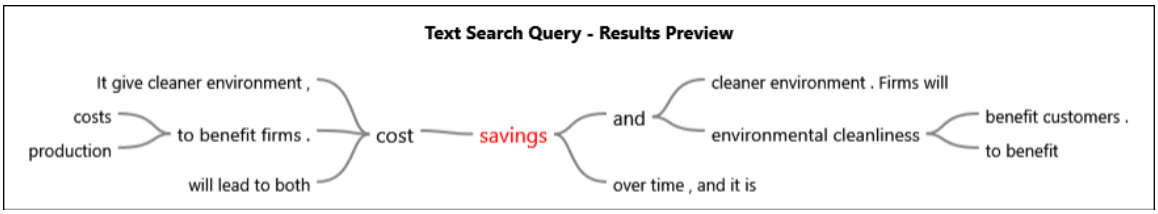


Figure 9. NVivo text search query for “savings.”

The last theme for cost–benefit responses was *Profitable*. 33.3% of participants stated that many firms are going Green because green energy is a profitable, quickly growing industry. Some participants argued that it is profitable for firms and markets to target single-family homeowners. Figure 11shows the NVivo text search query for *Profitable*.

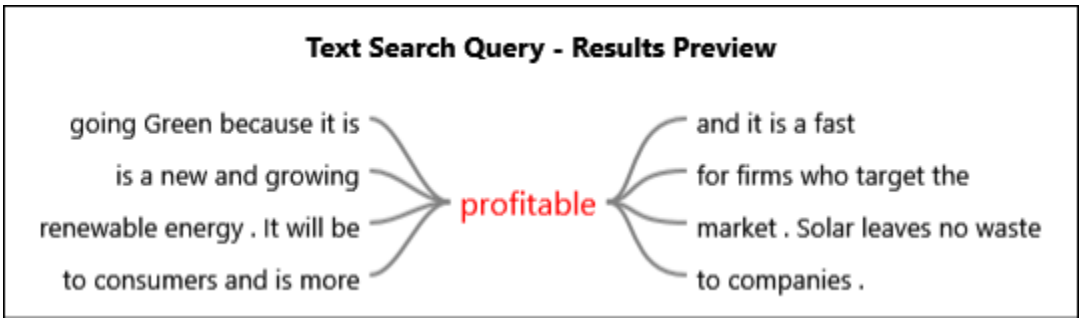


Figure 10. NVivo text search query for “profitable.”

Summary

In summary, the participants in this study reported that social media are an efficient information systems strategy to promote and increase green technology use. Social media promote awareness, educates both green energy professionals and

customers, and reaches far and wide to influence potential customers. Also, the participants believed that the benefits of green technology far outweigh the cost of using green technology. The benefits of using green technology will not only improve the lives and health of humans, but they will also save money in terms of cheaper electric costs and discounts in insurance costs. Also, green technology use will be profitable for firms, the environment will be cleaner, and more employment will be created.

In Chapter 5, I interpret the findings, discuss the limitations of the study, and present recommendations from the study. Finally, I address the implications and conclusion of the study. As the final chapter, it should, hopefully, enlighten readers about the efficacy of social media in improving green technology use.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative case study was to explore how social media can increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. I recruited green energy professionals on LinkedIn to participate in the study and received consent from 12 of the green energy professionals. The 12 participants were green energy professionals, social media users (LinkedIn), older than 18 years of age, and not pregnant. Based on IRB expectations for vulnerable populations during research, I verified in the digitally recorded interviews that none of the participants were minors or pregnant. Each interview was recorded digitally. I also included handwritten field notes and verbatim transcriptions from field notes in Microsoft Word, which were verified by each participant via e-mail to comply with the transcript review procedure.

The interview questions were as follows: What is green energy professionals' understanding of using social media to improve green practices in their business processes? What is green energy professionals' understanding of using social media to extend their green culture to customers to increase the use of green technology? What is green energy professionals' understanding of using social media to enhance green innovation within their business and increase customer market share in the future? What is green energy professionals' understanding of the cost-benefit of using green technology to sustain the environment, firms, and customers?

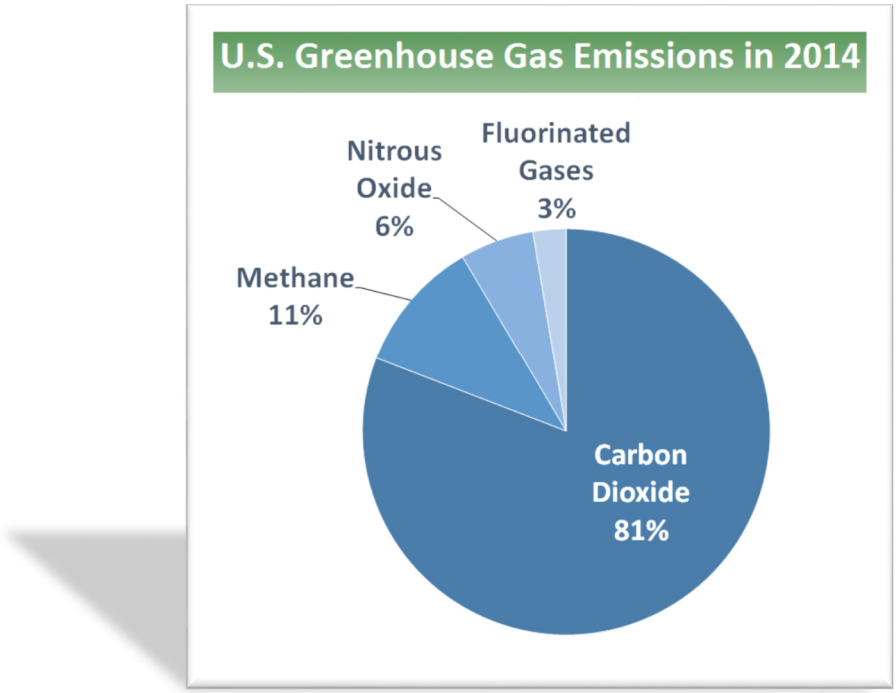
Interpretation of Findings

The purpose of this study was to explore how social media can increase the use of green technology for environmental sustainment at reduced cost to people, firms, and the environment. The study was a qualitative single case study based on interviewing employees in the green energy industry. The goal of this study was to provide an information systems strategy that could contribute to the effort to combat the issues of global warming and climate change.

According to researchers, social media would be an effective information system tool and strategy to spread awareness of green technology to millions of employers, customers, and potential customers daily and in real time. Studies indicated that there is danger to human health and the earth's ecosystem if humans continue increasing emissions of carbon dioxide into the atmosphere (Foster et al., 2011). There were many solutions suggested for combating the threats of climate change and global warming by reducing the amount of carbon dioxide emitted (EPA, 2014) from human activities into the atmosphere; most notable was the use of green technology that depends on green or renewable energies including solar, wind, and water.

Many of the participants in the current study reported that there was a great need to increase the use of green technology through awareness to combat humans' carbon emission. Researchers have shown that green technology can be used to combat the high emission of carbon dioxide into the atmosphere, and that the main causes of carbon dioxide emissions, as well as other greenhouse gases that cause global warming and climate change, are electricity use, transportation, and industry (EPA, 2014). Most green

technology was invented to reduce electricity and light use in homes and offices and to reduce gas and fossil fuel use in transportation and industry. For example, network sensors help reduce electricity and light use. Carbon dioxide comes from 35% of electricity use, and light is responsible for 40% of electricity use (Magno et al., 2015), so light is responsible for 13-14% of human carbon dioxide emissions in the atmosphere. Figure 12 shows carbon dioxide as the main greenhouse gas responsible for global warming and climate change in the United States.



.

Figure 11. Gas percentages that lead to global warming and climate change (EPA, 2014).

Some participants in this study felt that seeing neighbors use green technology in their homes or referrals from neighbors led directly to green technology purchase. The ability to regulate or control the amount of light that homes, offices, and industries use or depend on is crucial to combating global warming and climate change, as well as

deriving light and electricity from green or renewable sources. Sensor networks, for example, can regulate and control light and electricity use (Kranz et al., 2015). Sensors can indicate if there is someone in the room, by the television, or at the desk, and they can regulate the amount of light needed and the on/off switch. Not leaving light on for hours at constant light level and using electricity from green sources would greatly reduce carbon dioxide emissions from electricity use. Similarly, photovoltaic light emitting diode (PV-LED) is a green light bulb that can reduce up to 90% of electricity use (Zhang et al., 2015). This means that using electricity from renewable or green sources, having network sensors to regulate light, and using PV-LED lights can eliminate 30-35% of carbon dioxide that comes from electricity, of which 13-14% is from light use. Additionally, biofuels, which are fuels derived from natural materials instead of carbon fuels, can be improved and used for cars, trains, and planes. Biofuels can also be used for industrial and agricultural machineries. Figure 12 shows electricity as the main source of greenhouse emission in the United States.

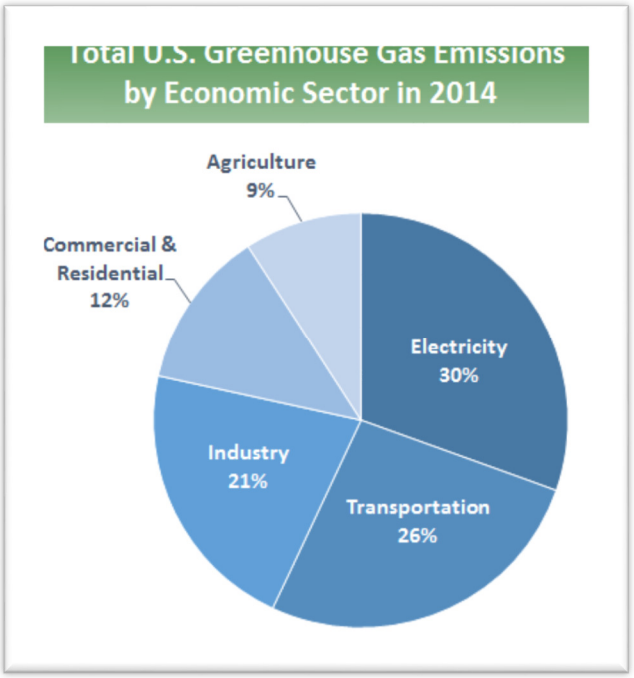


Figure 12. Gas source percentages that lead to greenhouse emissions (EPA, 2014).

Many participants in the current study reported that reaching many customers to educate them about the lower cost of green infrastructure with time compared to the cost of carbon infrastructure would make a great selling point for green technology use. Green infrastructures, such as urban forestry, green alleys, and green streets, parks, and wetlands should be encouraged to help reduce carbon dioxide in the atmosphere. Increases in green infrastructure would lead to a decreased dependence on carbon infrastructure (Morelli, 2013). Instead of felling trees, burning bushes, and deforesting, which kills the trees and plants that would be using the carbon dioxide in the air for food production, organizations and individuals should be planting more trees in urban areas, building homes and offices among trees, and preserving both tree parks and wetlands (Foster et al., 2011). A tree can use about 48 pounds of carbon dioxide in a year and a ton

within 40 years (NCSU, 2017). In a year, an acre of forest can use more carbon dioxide than the amount produced by an average car driven that year (Americanforests.org, 2017). Urban forestry, building among trees, tree parks, and standing against deforestation are essential in the quest to defeat global warming.

Some participants in the current study reported that increased use of mobile phones and increased presence of social media on mobile phones will be effective to keep people educated and aware of the need to increase green technology use. Information and communication technology (ICT) deals with all forms of networks that are used to aid communications daily and across the world, including networks for computers and cellular devices. The ICT industry is currently going green to reduce dependence on carbon energy for electricity use (Kranz et al., 2015). Cellular phones are also using green technology to reduce their carbon emissions (Han & Ansari, 2014). As more human tools and activities depend on green technology and green energy, less climate-changing carbon is emitted into the atmosphere. Human activity has been responsible for about 95% of carbon-related gases in the atmosphere (Stocker et al., 2014). The earth's temperature must not rise more than 2ºC from the earth's original temperature (Stocker et al., 2014); at that point, global warming and climate change will affect the physical, chemical, and biological levels of life on earth irreversibly (Stocker et al., 2014).

According to the findings in the current study, for green technology use to increase, people have to be informed and educated through awareness of green technology's benefits to the environment, their workplace, their health, their income and job opportunities, and their investments for the future in green infrastructures,

technologies, firms, and products. People need to be targeted efficiently and invited to participate in green discussions to spread green awareness; through social media, these discussions can reach millions of people daily. The promotion of awareness via social media may lead to sales and purchases that will inspire neighbors, family members, and friends to try green technology. Through the clustering, associating, classification, and regression of big data (Chen et al., 2012) from green stores, green sales, and green purchases, customers can be invited by e-mail or phone to "like" firms that provide green services. This will allow the customer to receive green messages, testimonials, opinions, debates, conferences, and explanations not only from the firms but also from green energy professionals and other customers who will help the customer make an informed decision on green technology.

Participants in the current study explained that other financial beneficiaries of going green are the environment, people, and firms. The environment will have cleaner air, water, land, and vegetation, which will reduce the need for expensive cures for unhealthy human waste, thereby reducing the earth's temperature closer to normal. People currently receive discounts in home and health insurance for living a green lifestyle as well as automobile discounts for driving low-emission cars or participating in limited driving insurance premiums. Firms that are green or going green attract investors and media attention (Dhaliwal et al., 2011) as well as tax breaks (Bohas & Poussing, 2016). Therefore, customers need to be informed and educated about the vast benefits of going green for the environment, people, and firms so that the world can move away from carbon or brown infrastructure and energy sources.

Table 5 shows how this study, through the top 10 text search query, was aligned with the research question, four interview questions, and the integrated sustainability framework. For the internal segment today, firms need to use social media to promote the benefits of a cleaner environment among green professionals and educate each other about the latest trends in green culture to improve their management practices. This strategy pays off in terms of lower costs, savings in insurance premiums for green customers, and increased profitability for firms. Regarding the internal segment for tomorrow, firms need to become more innovative in how they use social media's big data to target customers for profit and increase awareness through social media on mobile phones. The payoff is increased innovation, profits for firms, and awareness to the public.

Table 5

How findings from study align with integrated sustainability framework.

	Internal	External
Today	Strategy: • Social media is used to share information of green products, services, & **cleaner** environment. • Social media is used to **educate** other green professionals about current green culture & improving employee management practices. Payoff: • **Reduced** cost **/ cheaper** with time • **Reduced** risk **/ savings** in insurance • Increased **profitability**	Strategy: • Social media is used to **reach** & **educate** customers about green supply chain, **cleaner** environment, & keep them **aware** of green choices. • Social media is used to **reach** both external & internal stakeholders about organizational green culture. Payoff: • Increased legitimacy & reputation • **Reduced** environmental impact • Increased **profitability**
Tomorrow	Strategy: • Invite green customers on social media to mine hidden knowledge about customers in order to sell green products & services for **profit**. • More mobile phone with increase social media will lead to discussion & **awareness** of social and environmental issues. Payoff: • Increased innovation for **awareness** • Enhanced strategic position **/ profit**	Strategy: • Use social media to create **awareness** of green lights, network sensors, biogas, urban forestry, & **solar** for homeowners. • Sustainability Vision: Dialogue with stakeholders in **reducing** prices, promoting green technology, & increasing growth of market share. Payoff: • Growth trajectory **/ profit** • High demand is **savings / cheapness**

For the external segment of today, social media should be used to reach out to customers to educate them about the benefits of a cleaner environment and make them aware of their various green choices. The payoff is that firms become more reputable to the public and thereby increase their competitive advantage, and pollutants in the environment are greatly reduced. The external segment for tomorrow should increase awareness of green infrastructures and benefit of solar energy to single homeowners. Also, the sustainability vision among stakeholders should lead to reduced prices and

more affordable green technology to attract sales to increase market share. The payoff will be growth of the green industry and green demand that should lead to both savings in insurance for people and taxes for firms, as well as cheaper and more affordable green products and services.

Limitations of the Study

The limitations in this study were few. First, the study could have been quantitative, but I chose a single qualitative case study because the research question was simple (Lewis, 2015). Others may have preferred a different research method and research design, which could become an issue of dependability (Houghton et al., 2013). Second, green energy professionals participated instead of the general public. The green energy professionals may not have been as honest about some negative facts in their industry compared to customers from the general public who may have wanted to share their dissatisfaction about their green experiences, which could become an issue of confirmability (Billups, 2014). A third limitation could be that the reader would prefer more details or a different explanation of findings, which could become an issue of transferability (Houghton et al., 2013). The last limitation was that a larger sample could have been used for the study to get more variety in responses, which could become an issue of credibility (Fusch & Ness, 2015), but the study reached saturation by the ninth participant. This study only focused on green energy professionals' beliefs about the efficacy of using social media to promote green technology use and reducing the cost of environmental sustainment, so triangulation of firms' policies on social media and employees' ethics on social media was unnecessary.

Recommendations

For future research, a qualitative study could be done to understand the marketing strategies of how social media can help to increase green technology use. Also, surveys may be given to the general public in order to get accurate and factual responses about how successfully? Firms are incorporating green practices in their business and how innovative firms are in promoting green culture to their consumers. A research design to get more participants involved in the study could also be beneficial.

Based on this study, I recommend that green firms seriously consider big data from green stores and insurance policies in order to find hidden patterns of customers who can be invited to join their social media and help spread awareness and educate others about the benefits of green technology. Big data from green stores will have data of customers that frequently buy green products and services for health reasons, status, or just because they love it. Big data from insurance firms will have data of customers that have premiums for low driving, green vehicles, frequent runner, or buildings with environmental friendly materials. Customers can be clustered in the big data based on how they use their green services. Firms should be able to tell the type of customers who prefer green technology for insurance discounts from the type of customers who just love green gadgets. Also, firms should be able to tell the kind of customers who use green technology in their vehicles from those who like it in their offices or homes. The customers can be further classified within the big data as those who like green technology for health reasons, status reasons, career justification, discounts or cost reasons, driving lifestyle, or the associated incentives or tax breaks.

Firms may also want to know what other types of green technology each customer cluster or class within the big data could be associated with for cross-selling and discussion on social media. Firms may want to know if customers who love low-mileage driving are also associated with green light bulbs (PV-LED) or if those who love insurance discounts are associated with light network sensors. This knowledge will help to increase the sale of green technology as well as lead to more discussions on social media about the many fascinating green gadgets in use.

Implications

The implication from this study is that social media can be used to encourage people to use more green technology in order to combat both global warming and climate change. The earth's temperature has been on the rise the last 50 years, and this increase is about to surpass 2^{o}C, a difference that ultimately leads to climate change. The biological, physical, and chemical nature of the earth will be affected negatively if this continues.

Greenhouse gases are responsible for global warming, and carbon dioxide is over 80% of the greenhouse gases emitted. Humans have been responsible for about 95% of carbon emissions. This means that humans need to be educated and made aware by reaching as many people as possible through social media, which is used daily and already helps people make decisions in real time. Big data from social media and green stores can be mined to discover hidden patterns of customer behavior through their green-related discussions. These customers can be clustered based on the type of green technology they use, classified by the reasons they use those types of green technology,

and associated with other green technology they may be interested in for further green technology sales.

There are many types of green technology available today. Many of these technologies help reduce carbon emissions through green or renewable energy sources like solar, wind, and water. Using these green sources for electricity will eliminate about 30%–35% of carbon emissions. For example, using products like PV-LED will eliminate about 13%–14% of carbon electricity use. Using network sensors can regulate light and electricity use by turning lights off when no one is in the room and regulating the amount of light depending on what the user is doing. These sensors limit the amount of electricity use for lights. Sensor can also help conserve water in sinks and toilets in homes and workplaces.

Awareness of these facts on social media will lead to engaging discussions among peers deciding to go Green or use Green products. Reaching people and friends across countries and continents on social media is like neighbors influencing each other in direct sales in face-to-face interactions. Peers like to involve themselves in others' interests, and people do not like to be "left behind" in technology. Individuals typically want to meet the expected status or new trend. Social media are a convenient platform for promoting education about green facts that could lead to more green technology use.

Other green issues on which social media could inform people across the world are the actual benefits of green-friendly living for the environment, people, and firms. The environment would be cleaner and healthier for all forms of life and habitats. The earth's temperature would be reduced back to average, and global warming and climate

change would be an issue of the past. People would also receive insurance discounts as incentives for living a green lifestyle, and they would live healthier. Firms also receive incentives and tax breaks for being in the green industry, as well as investments and respectable media coverage.

Conclusions

The purpose of my research was to explore if social media can increase the use of green technology. This study affirms that social media is a good platform to reach millions of users daily to keep them aware of the benefits of green technology and educate them about the various types of green technology. The increase of green technology will increase the demand of green infrastructure, which will replace current carbon infrastructure that relies on hydrocarbons for energy. The goal is for humans to combat global warming by reducing carbon emission, a major greenhouse gas. The use of green technology can greatly reduce carbon emissions through, for example, transportation using biofuels and electricity deriving from renewable energy such as solar, wind, and water. Human activities have been responsible for about 95% of greenhouse gases, and carbon is currently over 80% of greenhouse gases. As human activities use more green technology, which depends on green or renewable infrastructure, carbon emissions will lower, ultimately resolving global warming that leads to climate change.

References

American Forests. (2017). Forest Facts. Retrieved from http://www.americanforests.org

Ajzen, I., & Klobas, J. (2013). Fertility intentions: An approach based on the theory of planned behavior. *Demographic Research, 29*(8), 203-232. doi:10.4054/DemRes.2013.29.8

Aksanli, B., Venkatesh, J., Zhang, L., & Rosing, T. (2012). Utilizing green energy prediction to schedule mixed batch and service jobs in data centers. *ACM SIGOPS Operating Systems Review*, *45*(3), 53-57. doi:10.1109/mc.2012.249

Aral, S., Dellarocas, C., & Godes, D. (2013). Introduction to the special issue-social media and business transformation: A framework for research. *Information Systems Research*, *24*(1), 3-13. doi:10.1287/isre.1120.0470

Aral, S., & Walker, D. (2012). Identifying influential and susceptible members of social networks. *Science*, *337*(6092), 337-341. doi:10.1126/science.1215842

Becker, J., vom Brocke, J., Heddier, M., & Seidel, S. (2015). In search of information systems (grand) challenges. *Business & Information Systems Engineering*, *57*(6), 377-390. doi:10.1007/s12599-015-0394-0

Berthon, P. R., Pitt, L. F., Plangger, K., & Shapiro, D. (2012). Marketing meets Web 2.0, social media, and creative consumers: Implications for international marketing strategy. *Business horizons*, *55*(3), 261-271. doi:10.1016/j.bushor.2012.01.007

Bertot, J. C., Jaeger, P. T., & Hansen, D. (2012). The impact of polices on government social media usage: Issues, challenges, and recommendations. *Government Information Quarterly*, *29*(1), 30-40. doi:10.1016/j.giq.2011.04.004

Billups, F. (2014). The quest for rigor in qualitative studies: Strategies for institutional researchers. *The NERA Researcher*, 1-5. Retrieved from https://www.airweb.org

Bohas, A., & Poussing, N. (2016). An empirical exploration of the role of strategic and responsive corporate social responsibility in the adoption of different Green IT strategies. *Journal of Cleaner Production*, *122*, 240-251. doi:10.1016/j.jclepro.2016.02.029

Bonini, S. (2012). The business of sustainability. *McKinsey on Sustainability and Resource Productivity*, 96-105. Retrieved from http://www.mckinsey.com/

Bonsón, E., Torres, L., Royo, S., & Flores, F. (2012). Local e-government 2.0: Social media and corporate transparency in municipalities. *Government Information Quarterly*, *29*(2), 123-132. doi:10.1016/j.giq.2011.10.001

Boyd, D., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication & Society*, *15*(5), 662-679. doi:10.1080/1369118x.2012.678878

Brocke, J. V., Watson, R. T., Dwyer, C., Elliot, S., & Melville, N. (2013). Green information systems: Directives for the IS discipline. *Communications of the Associations of Information Systems, 33*(30), 509-520. Retrieved from http://aisel.aisnet.org/cais

Cardenas, A., Manadhata, P., & Rajan, S. (2013). Big data analytics for security. *IEEE Security and Privacy Magazine*, *11*(6), 74-76. doi:10.1109/msp.2013.138

Chaemchuen, S., Kabir, N. A., Zhou, K., & Verpoort, F. (2013). Metal–organic frameworks for upgrading biogas via CO 2 adsorption to biogas green energy. *Chemical Society Reviews*, *42*(24), 9304-9332. doi:10.1039/c3cs60244c

Chang, Y. C., Lee, W. J., Lin, S. L., & Wang, L. C. (2013). Green energy: Water-containing acetone-butanol-ethanol diesel blends fueled in diesel engines. *Applied Energy*, *109*, 182-191. doi:10.1016/j.apenergy.2013.03.086

Chen, C. P., & Zhang, C. Y. (2014). Data-intensive applications, challenges, techniques and technologies: A survey on big data. *Information Sciences*, *275*, 314-347. doi:10.1016/j.ins.2014.01.015

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, *36*(4), 1165-1188. Retrieved from https://www.researchgate.net/

Chen, M., Mao, S., & Liu, Y. (2014). Big data: A survey. *Mobile Networks and Applications*, *19*(2), 171-209. doi:10.1007/s11036-013-0489-0

Chu, F. S., Chen, K. C., & Fettweis, G. (2012). Green resource allocation to minimize receiving energy in OFDMA cellular systems. *IEEE Communications Letters*, *16*(3), 372-374. doi:10.1109/lcomm.2012.010512.2339

Clarke, R. (2016). Big data, big risks. *Information Systems Journal*, *26*(1), 77-90. doi:10.1111/isj.12088

Cleary, M., Horsfall, J., & Hayter, M. (2014). Data collection and sampling in qualitative research: Does size matter? *Journal of Advanced Nursing, 70,* 473-475. doi:10.1111/jan.12163

Cope, D. G. (2013). Methods and Meanings: Credibility and Trustworthiness of Qualitative Research. *Oncology Nursing Forum, 41*, 89-91. doi:10.1188/14.onf.89-91

Cranshaw, J., Schwartz, R., Hong, J. I., & Sadeh, N. (2012). The livehoods project: Utilizing social media to understand the dynamics of a city. *International AAAI Conference on Weblogs and Social Media*, 58. Retrieved from http://www.aaai.org

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and higher education*, *15*(1), 3-8. doi:10.1016/j.iheduc.2011.06.002

Dao, V., Langella, I., & Carbo, J. (2011). From green to sustainability: Information technology and an integrated sustainability framework. *Journal of Strategic Information Systems*, *20*, 63-79. doi:10.1016/j.jsis.2011.01.002

Davenport, T. H., Barth, P., & Bean, R. (2012). How big data is different. *MIT Sloan Management Review*, *54*(1), 43. Retrieved from http://sloanreview.mit.edu/

Devi, L. G., & Kavitha, R. (2014). Review on modified N–TiO 2 for green energy applications under UV/visible light: selected results and reaction mechanisms. *RSC Advances*, *4*(54), 28265-28299. doi:10.1039/c4ra03291h

De Vries, L., Gensler, S., & Leeflang, P. S. (2012). Popularity of brand posts on brand fan pages: An investigation of the effects of social media marketing. *Journal of Interactive Marketing*, *26*(2), 83-91. doi:10.1016/j.intmar.2012.01.003

Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary nonfinancial Disclosure and the cost of equity capital: The initiation of corporate social Responsibility reporting. *The accounting review*, *86*(1), 59-100. doi:10.2308/accr.00000005

Duggan, M., Ellison, N. B., Lampe, C., Lenhart, A., & Madden, M. (2015). *Social media update 2014*. A report from the Pew Research Center. Retrieved from http://www.pewinternet.org/

Dumbill, E. (2013). Making sense of big data. *Big Data*, *1*(1), 1-2. doi:10.1089/big.2012.1503

Economist Intelligence Unit. (2011). *Big data: Harnessing a game-changing asset*. A report from the Economist Intelligence Unit sponsored by SAS. Retrieved from https://www.eiu.com/home.aspx

Environmental Protective Agency (EPA). (2014). Greenhouse gas emissions. Retrieved from http://epa.gov

Fairhead, J., Leach, M., & Scoones, I. (2012). Green Grabbing: a new appropriation of nature?. *Journal of Peasant Studies*, *39*(2), 237-261. doi:10.1080/03066150.2012.671770

Fan, W., & Bifet, A. (2013). Mining big data: current status, and forecast to the future. *ACM SIGKDD Explorations Newsletter*, *14*(2), 1-5. doi:10.1145/2481244.2481246

Fischer, E., & Reuber, A. R. (2011). Social interaction via new social media: (How) can interactions on Twitter affect effectual thinking and behavior? *Journal of Business Venturing*, *26*(1), 1-18. doi:10.1016/j.jbusvent.2010.09.002

Flato, G., Marotzke, J., Abiodun, B., Braconnot, P., Chou, S. C., Collins, & Forest, C. (2013). Evaluation of Climate Models. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. *Climate Change 2013*, *5*, 741-866. doi:10.1017/CBO9781107415324.020

Foster, J., Lowe, A., & Winkelman, S. (2011). The value of green infrastructure for urban climate adaptation. *Center for Clean Air Policy*, *750*, 1-52. Retrieved from http://ccap.org/

Fu, T. C. (2011). A review on time series data mining. *Engineering Applications of Artificial Intelligence*, *24*(1), 164-181. doi:10.1016/j.engappai.2010.09.007

Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report, 20*, 1408-1416. doi:10.1080/08941920.2014.888791

Gantz, J., & Reinsel, D. (2013). The digital universe in 2020: Big data, bigger digital shadows, and biggest growth in the far east. *IDC iView: IDC Analyze the future*, 1-7. Retrieved from https://www.emc.com/

Gholami, R., Sulaiman, A. B., Ramayah, T., & Molla, A. (2013). Senior managers' perception on green information systems (IS) adoption and environmental

performance: Results from a field survey. *Information & Management*, *50*(7), 431-438. doi:10.1016/j.im.2013.01.004

Gholami, R., Watson, R. T., Hasan, H., Molla, A., & Bjørn-Andersen, N. (2016). Information systems solutions for environmental sustainability: How can we do more?. *Journal of the Association for Information Systems*, *17*(8), 521-536. Retrieved from http://research.cbs.dk/en/publications/

Gil de Zúñiga, H., Jung, N., & Valenzuela, S. (2012). Social media use for news and individuals' social capital, civic engagement and political participation. *Journal of Computer-Mediated Communication*, *17*(3), 319-336. doi:10.1111/j.1083-6101.2012.01574.x

Goh, K. Y., Heng, C. S., & Lin, Z. (2013). Social media brand community and consumer behavior: Quantifying the relative impact of user-and marketer-generated content. *Information Systems Research*, *24*(1), 88-107. doi:10.1287/isre.1120.0469

Goiri, Í., Le, K., Nguyen, T. D., Guitart, J., Torres, J., & Bianchini, R. (2012). GreenHadoop: leveraging green energy in data-processing frameworks. In *Proceedings of the 7th ACM European Conference on Computer Systems* (pp. 57-70). ACM. doi:10.1145/2168836.2168843

Govindan, K., Khodaverdi, R., & Jafarian, A. (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *Journal of Cleaner Production*, *47*, 345-354. doi:10.1016/j.jclepro.2012.04.014

Han, T., & Ansari, N. (2012). ICE: Intelligent cell breathing to optimize the utilization of green energy. *IEEE Communications Letters*, *16*(6), 866-869. doi:10.1109/lcomm.2012.042312.120486

Han, T., & Ansari, N. (2013). On optimizing green energy utilization for cellular networks with hybrid energy supplies. *IEEE Transactions on Wireless Communications*, *12*(8), 3872-3882. doi:10.1109/tcomm.2013.051313.121249

Han, T., & Ansari, N. (2014). Powering mobile networks with green energy. *IEEE Wireless Communications*, *21*(1), 90-96. doi:10.1109/mwc.2014.6757901

Hansen, J. E., & Sato, M. (2012). Paleoclimate implications for human-made climate change. In *Climate change* (21-47). Vienna: Springer. doi:10.1007/978-3-7091-0973-1_2

Hartmann, P., & Apaolaza-Ibáñez, V. (2012). Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. *Journal of Business Research*, *65*(9), 1254-1263. doi:10.1016/j.jbusres.2011.11.001

Hirth, L. (2014). The market value of solar power: Is photovoltaics cost-competitive? *IET Renewable Power Generation*, *9*(1), 37-45. doi:10.1049/iet-rpg.2014.0101

Hosseini, S. E., Andwari, A. M., Wahid, M. A., & Bagheri, G. (2013). A review on green energy potentials in Iran. *Renewable and Sustainable Energy Reviews*, *27*, 533-545. doi:10.1016/j.rser.2013.07.015

Houghton, C., Casey, D., Shaw, D., & Murphy, K. (2013). Rigour in qualitative case-study research. *Nurse Researcher*, *20*(4), 12-17. doi:10.7748/nr2013.03.20.4.12.e326

Howard, P. N., & Parks, M. R. (2012). Social media and political change: Capacity, constraint, and consequence. *Journal of communication*, *62*(2), 359-362. doi:10.1111/j.1460-2466.2012.01626.x

Hughes, D. J., Rowe, M., Batey, M., & Lee, A. (2012). A tale of two sites: Twitter vs. Facebook and the personality predictors of social media usage. *Computers in Human Behavior*, *28*(2), 561-569. doi:10.1016/j.chb.2011.11.001

Jacob, S. A., & Furgerson, S. P. (2012). Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research. *The Qualitative Report*, *17*(42), 1-10. Retrieved from http://nsuworks@nova.edu

Juris, J. S. (2012). Reflections on# Occupy Everywhere: Social media, public space, and emerging logics of aggregation. *American Ethnologist*, *39*(2), 259-279. doi:10.1111/j.1548-1425.2012.01362.x

Kaplan, A. M. (2012). If you love something, let it go mobile: Mobile marketing and mobile social media 4x4. *Business horizons*, *55*(2), 129-139. doi:10.1016/j.bushor.2011.10.009

Kim, A. J., & Ko, E. (2012). Do social media marketing activities enhance customer equity? An empirical study of luxury fashion brand. *Journal of Business Research*, *65*(10), 1480-1486. doi:10.1016/j.jbusres.2011.10.014

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal*, *79*(1), 1-14. doi:10.1007/s10708-013-9516-8

Kornbluh, M. (2015). Combatting challenges to establishing trustworthiness in qualitative research. *Qualitative Research in Psychology, 12*, 397-414. doi:10.1080/14780887.2015.1021941

Kranz, J., Kolbe, L. M., Koo, C., & Boudreau, M. C. (2015). Smart energy: where do we stand and where should we go?. *Electronic Markets*, *25*(1), 7-16. doi:10.1007/s12525-015-0180-3

Kraska, T. (2013). Finding the needle in the big data systems haystack. *IEEE Internet Computing*, *17*(1), 84-86. doi:10.1109/mic.2013.10

Labrinidis, A., & Jagadish, H. V. (2012). Challenges and opportunities with big data. *Proceedings of the VLDB Endowment*, *5*(12), 2032-2033. doi:10.14778/2367502.2367572

Laroche, M., Habibi, M. R., & Richard, M. O. (2013). To be or not to be in social media: How brand loyalty is affected by social media?. *International Journal of Information Management*, *33*(1), 76-82. doi:10.1016/j.ijinfomgt.2012.07.003

Laroche, M., Habibi, M. R., Richard, M. O., & Sankaranarayanan, R. (2012). The effects of social media based brand communities on brand community markers, value creation practices, brand trust and brand loyalty. *Computers in Human Behavior*, *28*(5), 1755-1767. doi:10.1016/j.chb.2012.04.016

Laurila, J. K., Gatica-Perez, D., Aad, I., Bornet, O., Do, T. M. T., & Miettinen, M. (2012). The mobile data challenge: Big data for mobile computing research.

In *Pervasive Computing*, 1-8 (No. EPFL-CONF-192489). Retrieved from https://infoscience.epfl.ch

Lazer, D., Kennedy, R., King, G., & Vespignani, A. (2014). The parable of Google flu: traps in big data analysis. *Science*, *343*(6176), 1203-1205. doi:10.1126/science.1248506

Lee, C. S., & Ma, L. (2012). News sharing in social media: The effect of gratifications and prior experience. *Computers in Human Behavior*, *28*(2), 331-339. doi:10.1016/j.chb.2011.10.002

Lewis, S. (2015). Qualitative inquiry and research design: Choosing among five approaches. *Health promotion practice*, *16*(4), 473-475. doi:10.1177/1524839915580941

Lim, M. (2012). Clicks, cabs, and coffee houses: Social media and oppositional movements in Egypt, 2004–2011. *Journal of Communication*, *62*(2), 231-248. doi:10.1111/j.1460-2466.2012.01628.x

Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*, *29*(4), 446-454. doi:10.1016/j.giq.2012.06.003

Lo, A. Y. (2013). The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. *Global Environmental Change*, *23*(5), 1249-1257. doi:10.1016/j.gloenvcha.2013.07.019

Loeser, F. (2013). Green IT and Green IS: Definition of Constructs and Overview of Current Practices. *Americas Conference on Information Systems Proceedings*, 1-13. Retrieved from http://aisel.aisnet.org/

Lohr, S. (2012). The age of big data. *New York Times*, *11*. Retrieved from http://www.nytimes.com/

Lovejoy, K., & Saxton, G. D. (2012). Information, community, and action: How nonprofit organizations use social media. *Journal of Computer-Mediated Communication*, *17*(3), 337-353. doi:10.1111/j.1083-6101.2012.01576.x

Madden, M. (2012). Privacy management on social media sites. *Pew Internet Report*, 1-20. Retrieved from http://www.pewinternet.org/

Madden, S. (2012). From databases to big data. *IEEE Internet Computing*, *16*(3), 4-6. doi:10.1109/mic.2012.50

Magno, M., Polonelli, T., Benini, L., & Popovici, E. (2015). A low cost, highly scalable wireless sensor network solution to achieve Smart LED light control for green building. *IEEE Sensors Journal*, *15*(5), 2963-2973. doi:10.1109/jsen.2014.2383996

Malhotra, A., Melville, N.P., & Watson, R. T. (2013). Spurring impactful research on information systems for environmental sustainability. *MIS Quarterly*, *37*(4), 1265-1272. Retrieved from http://aisel.aisnet.org

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., and Byers, A. H. (2011). *Big Data: The Next Frontier for Innovation, Competition, and Productivity*. McKinsey Global Institute, Seoul.

Maxwell, J.A. (2013). *Qualitative Research Design: An Interactive Approach*. Thousand Oaks, CA: Sage Publications.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: The management revolution. *Harvard Bus Rev*, *90*(10), 61-67. Retrieved from https://hbr.org/

Miles, M., Huberman, A.M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook.* Thousand Oaks, CA: Sage Publications.

Mills, E. (2003). The insurance and risk management industries: New players in the delivery of energy-efficient and renewable energy products and services. *Energy Policy*, *31*(12), 1257-1272. doi:10.1016/s0301-4215(02)00186-6

Mills, E. (2009). A global view of insurance industry response to climate change. *The Geneva Papers*, *34*(3), 323-359. doi:10.1057/gpp.2009.14

Moorhead, S. A., Hazlett, D. E., Harrison, L., Carroll, J. K., Irwin, A., & Hoving, C. (2013). A new dimension of health care: systematic review of the uses, benefits, and limitations of social media for health communication. *Journal of medical Internet research*, *15*(4), e85. doi:10.2196/jmir.1933

Moosavian, S., Rahim, N., Selvaraj, J., & Solangi, K. (2013). Energy policy to promote photovoltaic generation. *Renewable and Sustainable Energy Reviews*, *25*, 44-58. doi:10.1016/j.rser.2013.03.030

Morelli, J. (2013). Environmental sustainability: A definition for environmental professionals. *Journal of Environmental Sustainability*, *1*(1), 1-10. doi:10.14448/jes.01.0002

Murdoch, T. B., & Detsky, A. S. (2013). The inevitable application of big data to health care. *JAMA*, *309*(13), 1351-1352. doi:10.1001/jama.2013.393

National Aeronautics and Space Administration (NASA). (2016). Global climate change: Vital signs of the planet. Retrieved from http://climate.nasa.gov/effects

North Carolina State University (NCSU). (2017). Tree Facts. Retrieved from https://projects.ncsu.edu

Neff, G. (2013). Why big data won't cure us. *Big data*, *1*(3), 117-123. doi:10.1089/big.2013.0029

Padhy, N., Mishra, D., & Panigrahi, R. (2012). The survey of data mining applications and feature scope. *International Journal of Computer Science, Engineering and Information Technology*, *2*(3), 43-58. doi:10.5121/ijcseit.2012.2303

Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). Thousand Oaks, CA: Sage. Retrieved from https://us.sagepub.com/

Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big Data*, *1*(1), 51-59. doi:10.1089/big.2013.1508

Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. *Health Information Science and Systems*, *2*(1), 3. doi:10.1186/2047-2501-2-3

Rahim, M., Zukni, R., Ahmed, F., & Lyndon, N. (2012). Green advertising and environmentally responsible consumer behavior: The level of awareness and perception of Malaysian youth. A*sian Social Science*, *8*(5), 46-54. doi:10.5539/ass.v8n5p46

Rainie, L., Smith, A., Schlozman, K. L., Brady, H., & Verba, S. (2012). Social media and political engagement. *Pew Internet & American Life Project*, 1-13. Retrieved from http://www.pewinternet.org/

Reilly, A. H., & Hynan, K. A. (2014). Corporate communication, sustainability, and Social media: Its not easy (really) being green. *Business Horizon*, 1-12. doi:10.1016/j.bushor.2014.07.008

Ryoo, S., & Koo, C. (2013). Green practices-IS alignment and environmental performance: The mediating effects of Coordination. *Information Systems Frontiers*, *15*(5), 799-814. doi:10.1007/s10796-013-9422-0

Sarkis, J., Koo, C., & Watson, R. T. (2013). Green information systems & technologies-This generation and beyond: Introduction to the special issue. *Information Systems Frontiers*, *15*(5), 695-704. doi:10.1007/s10796-013-9454-5

Sashi, C. M. (2012). Customer engagement, buyer-seller relationships, and social media. *Management decision*, *50*(2), 253-272. doi:10.1108/00251741211203551

Scholtz, B., Burger, C., & Zita, M. (2016). A social media environmental awareness campaign to promote sustainable practices in educational environments. In J. Marx Gomez et al. (Eds.), *Advances and New Trends in Environmental and Energy Informatics* (355-369). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-23455-7_19

Shirkhorshidi, A. S., Aghabozorgi, S., Wah, T. Y., & Herawan, T. (2014). Big data clustering: A review. *In International Conference on Computational Science and*

Its Applications (707-720). Springer International Publishing. doi:10.1007/978-3-319-09156-3_49

Snijders, C., Matzat, U., & Reips, U. D. (2012). "Big Data": Big gaps of knowledge in the field of internet science. *International Journal of Internet Science*, *7*(1), 1-5. Retrieved from http://www.ijis.net

Stephen, A. T., & Galak, J. (2012). The effects of traditional and social earned media on sales: A study of a microlending marketplace. *Journal of Marketing Research*, *49*(5), 624-639. doi:10.1509/jmr.09.0401

Stocker, T. F., Qin, D., Plattner, G. K., Tignor, M., Allen, S. K., Boschung, J., & Midgley, P. M. (2014). Climate change 2013: The physical science basis. 1-9. doi:10.1017/CBO9781107415324

Swaim, J. A., Maloni, M. J., Napshin, S. A., & Henley, A. B. (2014). Influences on student intention and behavior toward environmental sustainability. *Journal of Business Ethics*, *124*(3), 465-484. doi:10.1007/s10551-013-1883-z

Talanquer, V. (2014). Using qualitative analysis software to facilitate qualitative data analysis. *Tools of Chemistry Education Research, 83-95*. doi:10.1021/bk-2014-1126.ch005

Tergesen, A. (2008) Insurance goes green, *Business Week*, March 6, 72-73. Retrieved from http://www.businessweek.com

Tessier, S. (2012). From field notes, to transcripts, to tape recordings: Evolution or combination? *International Journal of Qualitative Methods*, *11*, 446-460. Retrieved from https://ejournals.library.ualberta.ca/

Tilman, D., & Clark, M. (2014). Global diets link environmental sustainability and human health. *Nature*, *515*(7528), 518-522. doi:10.1038/nature13959

Treem, J. W., & Leonardi, P. M. (2013). Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. *Annals of the International Communication Association*, *36*(1), 143-189. doi:10.1080/23808985.2013.11679130

Trotter, I. (2012). Qualitative research sample design and sample size: Resolving and Unresolved issues and inferential imperatives. *Preventive Medicine, 55*, 398-400. doi:10.1016/j.ypmed.2012.07.003

Tufekci, Z., & Wilson, C. (2012). Social media and the decision to participate in political protest: Observations from Tahrir Square. *Journal of Communication*, *62*, 363-379. doi:10.1111/j.1460-2466.2012.01629.x

Watson, R. T., Boudreau, M., & Chen, A. J. (2010) Information systems and Environmentally sustainable development; Energy informatics and new directions for the IS community. *MIS Quarterly*, 23-38. Retrieved from http://www.jstor.org

Watson, R. T., Lind, M., & Haraldson, S. (2012). The emergence of sustainability as the new dominant logic: Implications for Information Systems. International Conference on Information Systems, 1-16. Retrieved from http://aisel.aisnet.org

Whiting, A., & Williams, D. (2013). Why people use social media: a uses and Gratifications approach. *Qualitative Market Research: An International Journal*, *16*(4), 362-369. doi:10.1108/qmr-06-2013-0041

Willis, B. (2014). The advantages and limitations of single case study analysis. *E-International Relation Students*. Retrieved from http://www.e-ir.info

Wu, C. M., Chang, R. S., & Chan, H. Y. (2014). A green energy-efficient scheduling algorithm using the DVFS technique for cloud datacenters. *Future Generation Computer Systems*, *37*, 141-147. doi:10.1016/j.future.2013.06.009

Wu, X., Zhu, X., Wu, G. Q., & Ding, W. (2014). Data mining with big data. *IEEE transactions on knowledge and data engineering*, *26*(1), 97-107. doi:10.1109/tkde.2013.109

Xiaofeng, M., & Xiang, C. (2013). Big data management: concepts, techniques and challenges. *Journal of Computer Research and Development*, *50*(1), 146-169. Retrieved from http://crad.ict.ac.cn/EN/

Xie, K., Wu, y., Xiao, J., & Hu, Q. (2016). Value co-creation between firms and customers: The role of big data-based cooperative assets. *Information & Management*, *53*(8), 1034-1048. doi:10.1016/j.im.2016.06.003

Yang, Z., Sun, J., Zhang, Y., & Wang, Y. (2016). Peas and carrots just because they are green? Operational fit between green supply chain management and green information systems. *Information Systems Frontiers*, 1-19. doi:10.1007/s10796-016-9698-y

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, *20*(2), 134-152. Retrieved from http://nsuworks.nova.edu

Yin, J., Lampert, A., Cameron, M., Robinson, B., & Power, R. (2012). Using social media to enhance emergency situation awareness. *IEEE Intelligent Systems*, *27*(6), 52-59. doi:10.1109/mis.2012.6

Yin, R. K. (2014). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Zhang, Q., Sun, Y., Xu, W., & Zhu, D. (2014). Organic thermoelectric materials: Emerging green energy materials converting heat to electricity directly and efficiently. *Advanced Materials*, *26*(40), 6829-6851. doi:10.1002/adma.201305371

Zhang, X., Wu, Z., Feng, Y., & Xu, P. (2015). "Turning green into gold": A framework for energy performance contracting (EPC) in China's real estate industry. *Journal of Cleaner Production*, *109*, 166-173. doi:10.1016/j.jclepro.2014.09.037

Appendix A: Recruitment Letter

Recruitment Letter to Participate in the Study

Dear Potential Research Participant:

I would like to invite you as a renewable energy (green) professional on LinkedIn to please participate in my dissertation research study. I am a doctoral student conducting a research study to explore if social media can improve the use of green technology for environmental sustainment to reduce cost.

As you may know, environmental sustainment is now a critical issue because of the increasing production of greenhouse gases into the atmosphere from human activities, such deforestation, manufacturing, transportation, and electric use. These greenhouse gases, especially carbon dioxide, contribute greatly to global warming, which ultimately causes the climate change that affects temperature, sea levels, weather, habitats, and life forms adversely. This study is about exploring if social media can be used to make more people use more green technology in order sustain the environment and reduce cost.

The research interview will be about 20 minutes over the phone or on Skype (no video) and it will be about what green energy professionals think about the effectiveness of using social media to improve green technology use. If you are interested in the study, please reply to the consent form email by clearly stating that you give consent to be interviewed for the study in the body of the email.

Sincerely,

Ehi Aimiuwu (Researcher)
Doctoral Student – Walden University

Appendix B: Interview Protocol

Interview Details:

Participant's Code Name _____

Interview Date/Time _____

Preliminary Actions:

1. **Explain the purpose of the interview. Provide a short background of the researcher's connection to the study**.
   I would like to take a few minutes to revisit the purpose and goal of the study is to explore if social media can increase the use of green technology for environmental sustainment to reduce cost.
   As you may know, environmental sustainment is now a critical issue because of the increasing production of greenhouse gases into the atmosphere from human activities, such deforestation, manufacturing, transportation, and electric use. These greenhouse gases, especially carbon dioxide, contribute greatly to global warming, which ultimately causes the climate change that affects temperature, habitats, and life forms adversely.
   I am conducting this study as part of my doctoral program. I have a background in Ecommerce and content management, but my experience has no bearing on my role as a researcher in this study.

2. **Explain participant rights**.
   Your response to my email invitation to participate in the study indicates your formal consent for this interview. Please note that all information will be held in the strictest confidence. This interview will be digitally recorded on audio and I will transcribe the interview. Please note that your involvement is voluntary and you may choose not to answer a question. Also, you have the option to stop the interview at any time. The interview should take about 20 minutes to complete. Thank you for agreeing to participate.

Interview Questions:

1. What are green energy professionals' understanding of using social media to improve green practices in their business processes?

   Probing Question: How does your firm use social media within the firm or how can social media be used?

2. What are green energy professionals' understanding of using social media to extend their green culture to customers in order to increase the use of green technology?

Probing Question: How does your firm use social media outside the firm or how can social media be used?

3. What are green energy professionals' understanding of using social media to enhance green innovation within their business and increase customer market share in the future?

   Probing Question: How can social media be used in the future?

4. What are green energy professionals' understanding of the cost-benefit of using green technology to sustain the environment, firms, and customers?

   Probing Question: What are the benefits of customers to use green technology?

Debrief:

Thank you for helping me with this research study. I would send you a summary of your interview to review and confirm that I have captured the essence of what you have shared with me or to identify where I did not understand so that I can correct the interpretation. Do you have any questions? Please contact me if you have any questions.

Thank you!