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Implementing Eco-Friendly Housing Techniques in Western Montana: Green Home Montana: Eco-friendly Housing and Living Practices - Final Capstone Portfolio

Nicolas Ray Ream

University of Montana, Missoula, nr108708@umconnect.umt.edu

Karlyn Roberts

University of Montana, Missoula, karlyn.roberts@umconnect.umt.edu

Savannah Willison

University of Montana, Missoula, savannah.willison@umontana.edu

Dylan Trent

University of Montana, Missoula, dylan.trent@umontana.edu

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Implementing Eco-Friendly Housing Techniques in Western Montana:

Green Home Montana: Eco-friendly Housing and Living Practices

Nicolas Ream, Karlyn Roberts, Dylan Trent, Savannah Willison

University of Montana



IMPLEMENTING ECO-FRIENDLY HOUSING TECHNIQUES	2
Abstract	3
Introduction	4
Literature Review	5
Introduction	5
Research Methods	6
Terminology	7
History	9
Local Elements	11
Building Characteristics	13
Global Building Aspect	16
Proposed Project Method	17
Project Implementation Plan	18
Findings and Analysis	19
Conclusion	21
Reflection	22
Prompt #1:	22
Prompt #2:	24
Prompt #3:	25
References	27
Appendices	29
Appendix A	29
Appendix B	30
Appendix C	32
Appendix D	33

Abstract

While the green building movement is common practice in the commercial realm, it is not yet widely popular with residential buildings. We considered the question “How can residents of western Montana adopt eco-friendly housing practices that are locally appropriate and relevant?” There is an opportunity to increase green living practices among renters and homeowners in western Montana through retrofitting, gardening, composting, and similar behaviors. By considering climatic factors relevant to the region, suggestions for relevant eco-friendly practices can be made available to homeowners and renters alike. We will research green living practices used in other countries with similar climatic factors as western Montana. We will then make a website to help streamline locally relevant information catered to help residents take action towards their sustainability goals. We will survey a sample of residents throughout western Montana to inform the materials provided on the website. For example, these materials may include, but are not limited to, sustainability project demonstration videos, links to local builders, history, blogs, global initiatives, and links to other resources. We expect this website to be relevant and increase accessibility to western Montana renters and homeowners.

Introduction

Sustainable practices are something that everyone has the ability to partake in. Whether it is their diet, their home, their lifestyle, the clothes they wear, or the stores they shop at, one can strive to be more sustainable. Climate change is gaining traction in the media along with politics/policies, and there has been an increased push towards being more sustainable. While recent attention has focused on big corporations to become more sustainable, something that can be done immediately is individual action. Adopting sustainable housing practices is something that renters and homeowners can accomplish. Sustainable housing is a way to protect the environment and save money on housing/energy costs. Eco-friendly housing practices are a multifaceted conservation method that helps more than just the environment.

Accessibility of information on how to be more sustainable in one's home is limited. This is a large reason why eco-friendly housing practices have not been widely adopted. Another issue as to why these methods are not as widely spread is because of the relevance of information specifically catered towards one's local environment. When expensive solar panels are advertised to someone who lives in a cloud-covered area, there is not a likely chance that someone will adopt the technology. With this in mind, we want to figure out how to make these practices more widely accepted, while keeping these factors in consideration. As this is a large task, we will look specifically at western Montana for our project. In addition to making more information available to western Montanans, we want to make the information relevant to the environment that they live in, to help them improve sustainability.

Literature Review

Introduction

Homes can be sacred; they protect us from the elements, they are the center of daily life activities and are a location in which we spend much time. Whether one is a homeowner or a renter, nearly every person has a place to call home. This means there are millions of homes worldwide. These homes come at a significant cost.

In the greater scheme of things, we have another home. It is a home that inhabits all living creatures and organisms and it happens to be our Earth. Homes demand immense amounts of resources that ultimately end up degrading the Earth. These resources are being quickly depleted around the world. Given the need for housing *and* the scarcity of the required resources, humans are going to have to start relying on more sustainable techniques when building and updating their homes. This way we can improve our day to day homes while improving the quality of the Earth. Implementing eco-friendly housing practices is one way that we as humans can help stop the degradation of the Earth and its resources and start turning towards a cleaner, greener future. But how do we get others to change their homes, to adopt these practices? How can we make eco-friendly housing adaptable?

Through this research, we are hoping to come to a conclusion on how to make eco-friendly housing practices adoptable and more relevant for homeowners and renters.

Research Methods

This review is composed of research from peer-reviewed journal articles, personal interviews, and reliable Internet sources. Journals were found through the comprehensive search tool, OneSearch, developed by the University of Montana. Those interviewed were chosen based on their relevant experience, skills, and certifications with green housing. Websites referenced are either government-operated or a collection of professional publications.

Search terms were chosen based on the research explained in the following section, “Terminology.” Upon finding the relevant words and phrases to our topic, we used these buzzwords in OneSearch to find information pertinent to our project. These search terms include green building, eco-friendly housing, energy-efficient, low carbon lifestyle, high-performance homes, and sustainable lifestyle.

Each section of the paper includes information crucial to our subject. “Terminology” explains the relevant words and phrases that will allow us to find information regarding green building. “History” provides necessary background information on the green building movement and explains where the movement currently stands. “Local Elements” provides information on the locality of regions. It explores and defines the role of location in relation to green building. The “Building Characteristics” section identifies categories essential to the structure of a home. The building characteristics were chosen by comparing and contrasting variables used by various green building standards. The categories were also dictated by ensuring the language used would be understandable to a lay audience. The “Global Building Aspect” section examines the global facet of the project since western Montana is just the beginning. There are other successful sustainable housing initiatives across the globe. The section begins the examination of the

questions: “What are other communities doing?,” “Are those initiatives relevant here?,” and “How might our initiatives apply to other communities?.”

This project also includes a surveying portion. There are many different styles of surveying including digital and personal. Some of the pros of online surveys include being able to get a wider sample, and not being bound by location. An in-person survey is beneficial because one can have more conversations surrounding the topic that is being surveyed. With an in-person survey, people who may not utilize the Internet have the ability to participate (Radh, n.d.). Since the people we are obtaining information from do not necessarily have access to the Internet, we decided an in-person survey would be best. While in-person is more time consuming and requires traveling, we have the ability to reach a demographic that would otherwise not participate. We do not have access to many of the people in the areas we are surveying without meeting them in person. In-person surveys create more trust and this will help us to create a connection with our desired demographic. An in-person survey will also give us the opportunity to discuss our plans and create a dialogue with our potential users.

Terminology

How we communicate with others has one of the strongest impacts on the way we think and act. By thinking deliberately about the words we use and the context surrounding those words, we have the ability to create a productive dialogue. For this project, we are creating a deliverable that will hopefully reach a diverse group of Montanans. Montanans have differing views on climate change; thus, we have to choose our words wisely and be deliberate about the conversation we are starting. To make sure we are using the most effective language possible, we

looked at several different sources and compiled a word bank to choose terms.

Most of the sources we examined are not targeted towards getting others to invest in sustainability, they are simply informative. In the article, “Eco-Self-Build Housing Communities: Are They Feasible and Can They Lead to Sustainable and Low Carbon Lifestyles?” by Steffie Broer and Helena Titheridge (2010), words and phrases “low carbon lifestyles,” and “sustainable lifestyle” are often used and identified as some of their keywords. These words were chosen as a way to measure the amount of sustainability that the specific area was doing. Since this article was a report on the feasibility of an eco-self-building community, the language that was used was not meant to attract someone to participate in this type of housing. It was simply used to reflect on a project that was already happening and where participants had already agreed to participate.

The article, “Sustainable House,” outlines several different options on how to make a home more sustainable. There are sections outlining the process of geothermal heating, solar panels, rainwater collectors, greywater systems and several other forms of creating an eco-friendly home. Some of the keywords that came out of this article were “environmental sustainability,” “sustainable house,” and “sustainable energy.” This language was used as a way to convey information purely for the purpose of communicating different types of house alterations. The language they used appeals to someone who has already decided on house alterations.

Our main goal is to appeal to a group of people who would not normally invest in green development and ideologies that are normally aligned with green and sustainable development. Much of the phrasing and the wording of the sources we have been looking at used language that

is typical and recognizable to someone who invests in the environment and is familiar with the issues. What we are doing is using language that appeals to those who do not converse about the environment on a regular basis and do not normally have the health of the environment as their top priority.

Through the terminology research, we found keywords to use, for example, *Low carbon lifestyle*, *high-performance homes*, and *sustainable lifestyle*. Our list is subject to change as we come across more literature and as we interact with more people during our survey process. From the literature, we have read so far, we have determined that these words are best suited for the audience we are reaching out to and the message we are wishing to get across.

History

Every movement, such as the green building movement, has a story to tell. Investigating the entire story of a movement is necessary to understand its development. It is impossible to judge success, growth, or achievement if there is no beginning point for comparison.

The story of green building is not new. In fact, it is quite old. Remnants of green building techniques date back to ancient civilizations. For example, Native Americans in the southwest U.S. would use solar energy to heat their pots and water. They also caked their homes in mud to moderate temperature. Both ancient Roman and Greek civilizations would orient their buildings to capture the exact amount of the desired sun. Other communities even created wind tunnels as a cooling system (Kumar, 2015). The concept of using natural resources to improve the quality of life has been evolving since the creation of communities.

The mid-1800s is the start of the more modern green building movement. Building in this

time accomplished green architecture through a suite of green building techniques, such as ventilation systems, deep-set windows, and retractable awnings. During the industrial boom of the 20th century, many green-building techniques were abandoned for the large scale production of buildings. There was a resurgence of the movement again in the 1970s along with the Environmental Movement. At the 1987 UN Conference, the first definition of Sustainable Development was written. Under President Clinton's administration, a large project was undertaken to "green" the white house. The project was a major success and sparked the greening of other federal buildings across the country. Eventually, the U.S. Green Building Council (USGBC) came to fruition and has been tackling eco-friendly housing since ("White Paper on Sustainability," 2003).

Eco-friendly housing has a rich history behind it. All of these milestones have built up to the current state of the movement. Recently the United States Environmental Protection Agency, EPA, has officially defined green building as, "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction" ("Green Building," 2016). Additionally, the movement has slowly been gaining traction since the aforementioned conception of the USGBC. This group established international competencies for green building known as LEED, or Leadership in Energy and Environmental Design. These building standards are becoming standard practice in commercial buildings across the U.S.

Green building has been evolving for thousands of years now. It started with simple designs to manipulate sun intensity and has grown to an engineered field. The movement has

come a long way throughout its lifetime and has gained federal traction, but it has not fully infiltrated residential housing. The next step in this story is to take these techniques and make them available to residential buildings.

Local Elements

Location plays a critical role in the success of energy-efficient homes. There are many different tiers of location to consider ranging from the home site itself to a regional view.

Questions that must be addressed on a home site are: Is the plot even and durable? Is it in a safe neighborhood? Is it in a desirable part of the city? What are the regional weather patterns and characteristics of the area? What political boundaries does the property fall within? While these are all necessary questions to consider, we will focus on the broad-scale question of regionality.

Allen Ream, a Certified Green Professional and a Certified Graduate Builder, identified some climate factors that must be accounted for in homes in Montana. These include snow-loading, seismic activity, and ground temperatures. These require attention regardless of location in Montana or “green” certifications (Ream, 2019). Ream also identified factors that require special attention to achieve high-performance standards. These include temperature range, monthly diurnal averages, illumination, radiation, sky cover, and wind velocity ranges, dry bulb by relative humidity, dry bulb by dew point, and sun exposure (Ream, 2019; UCLA, n.d.). These are all factors that differ drastically depending on the region of the world. For the research, one must understand the temperature range, humidity, sun exposure, snow-load, seismic activity, and ground temperatures. Therefore, it is necessary to determine regional characteristics before moving forward with these methods.

The region of western Montana is influenced by a mix of maritime and continental weather patterns, Pacific Coastal Climate. The climate in western Montana is mainly composed of hot and dry summers and long and cold winters. Western Montana is a semi-arid climate, meaning that it gets mainly dry summers and not much rainfall (Annual Rainfall of 15”), due to the lack of rainfall and long winters most of the water comes from snowpack in the summers. In early summer, thunderstorms and cool temperatures are common. Western Montana, which is outlined in Region 1, as seen in Map 1 in Appendix A, is mountainous and the climate varies much due to topography in the region (Topography Ranges from 600m-4000m). There is a difference in the climate between the mountains and valleys. In Missoula, Montana, there are generally warmer winters and less snow. However, for example in the Flathead Valley, there are colder winters and more snow (snowstorms). In the summer, there are wildfires due to the prolonged periods without moisture reaching the ground and fuels drying up, making it easier for wildfires to start. From the wildfires, there is an increased amount of smoke in the area which harms air quality. Due to an expected increase in hot days (days > 90 degrees Fahrenheit), which have been steadily increasing throughout the last century, the ecosystems are going to change in the upcoming century (Pederson, Gregory, et al., 2009). There will be an increasing amount of time in active fire season, and a decreased amount of water available in the summer, due to snowpack in Montana declining at a 33% significance; much of the water during the summer comes from snowpack (Mote, Philip, et al., 2018).

Some characteristics that should be considered in western Montana sustainable homes are an increase of heating and cooling due to an increase of extreme temperatures requiring more money to be spent on energy; thus making sustainable housing more practical when considering

the environmental effects of our energy consumption.

Some regions in the world that will be examined due to a similar climate, for example, semi-arid climates, are Utah, the Great Basin area in Nevada, areas in Canada, Newfoundland, Russia, Europe, Greenland, and northern Asia.

Homeowners and renters will visit the eco-friendly housing website, where they will read definitions of the various climates, to determine the climate where they live. The website users will need to know minimal information, for example, “Approximately how much rain does the area receive?,” “Does the area receive snow?,” and “What is the average temperature in the area?.” At first, the website will be designed for western Montana, so there will be minimal selecting of options required. However, as the website includes more locations, the website users will select options, which will compile sustainability information for their region pulled from techniques from around the globe.

Building Characteristics

There is much that can be done to a home to increase eco-friendliness. There are multiple organizations that oversee the verification and certification of energy-efficient homes. While the research is examining aspects taken from around the world, the research must follow a logical order. Thus, the categorical buckets for energy efficiency standards must be examined.

“ENERGY STAR® is the [United States] government-backed symbol for energy efficiency, providing simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions” (Energy Star, n.d.). Energy Star has criteria for four types of residential homes including, new construction single-family, new construction

multifamily, manufactured, and undergoing gut rehab. Energy Star recognizes that certain aspects of energy-efficient construction may not be in the scope of a home renovation. Energy Star focuses on categories with specific information, for example, window insulating value as a U-factor (lower U-factor equals better insulation). The categories used by the ENERGY STAR® Residential New Construction Program are “Envelope, Windows, and Doors,” “Water Heating Equipment,” “Thermostats and Ductwork,” “Heating and Cooling Equipment,” and “Lighting and Appliances” (Energy Star, n.d.). Many homeowners know that heating and cooling is a significant aspect of energy efficiency in homes. Aspects can be pulled from around the world, to determine ways to have efficient heating and cooling in the western region of Montana.

A different variation on determining building characteristics is “The Whole-House Approach” used by the U.S. Department of Energy with the categories of “Site Conditions,” “Local Climate,” “Appliances and Home Electronics,” “Insulation and Air Sealing,” “Lighting and Daylighting,” “Space Heating and Cooling,” “Water Heating,” and “Windows, Doors, and Skylights” (U.S. DOE, n.d.). Similar to the Energy Star approach, “The Whole-House Approach” includes a category for heating and cooling, appliances, and windows and doors. “The Whole-House Approach” considers site conditions and insulation, which the Energy Star criteria does not consider. While site conditions are typically used in new construction, the research can use the category of site conditions with information, such as actions from around the world, that are outside of the home using the environmental landscape.

A third set of groupings as used by the US Green Building Council’s LEED - Homes program are “Integrative Process,” “Location and Transportation,” “Sustainable Sites,” “Water Efficiency,” “Energy and Atmosphere,” “Materials and Resources,” “Indoor Environment

Quality,” “Innovation,” and “Regional Priority” (USGBC, n.d.). The LEED - Homes criteria does include sustainable sites, like “The Whole-House Approach uses.” However, the LEED - Homes criteria has the category of integrative process, which is more applicable in new construction or a professional remodel, per se.

“Energy Star,” “The Whole-House Approach,” and “LEED - Homes” categories include ‘Envelope, Windows, and Doors,’ ‘Insulation and Air Sealing,’ and ‘Indoor Environment Quality,’ respectively. The category of ‘Envelope, Windows, and Doors,’ clearly includes the physical objects that are openings on a house, per se. However, the category by Energy Star does not include insulation in the category, which is an aspect that will be considered in the research. “The Whole-House Approach” includes ‘Insulation and Air Sealing.’ The “LEED - Homes” criteria include ‘Indoor Environment Quality,’ which includes the ideas used by Energy Star and “The Whole-House Approach,” but the term ‘Indoor Environment Quality’ may not be fully understood by a lay audience. A term that encompasses the ideas depicted by “Energy Star,” “The Whole-House Approach,” and “LEED - Homes” categories is ‘Indoor Comfort Variables.’

For the purposes of the research, the categories will be combined from Energy Star, the U.S. Department of Energy, and the U.S. Green Building Council to provide the most useful information. When choosing the items to use as categories, one must ensure the information is described in a way that makes sense to a layperson. Research categories include: “Heating and Cooling,” “Home Site Location,” “Windows and Doors,” “Appliances,” and “Insulation”.

Global Building Aspect

Western Montana is just the beginning. There are other successful sustainable housing initiatives across the globe. The research will examine the questions: “What are other communities doing?,” “Are those initiatives relevant here?,” and “How might our initiatives apply to other communities?.” The research will pull from regions around the globe. Techniques used in similar regions to western Montana, for example, a region with a semi-arid climate, will be used for choosing sustainability strategies.

The study, “Natural Building Materials in Mainstream Construction: Lessons from the U.K.” (2008), says there is a “perception that these materials [natural building materials] are low-tech and have poor performance. This perception, however, is changing. There is a growing body of research that is quantifying the performance of natural building materials and showing that they can compete with conventional building materials.” For example, successful integrations in the United Kingdom have included, “straw bale panels by ModCell; a hemp-line composite called ‘hemcrete’ and marketed by Tradical; and, rammed earth and unfired clay bricks” (Colin MacDougall, 2008). These techniques are environmentally sustainable ways of building a home while still being a financially sustainable way to create a home. This study also shows how the techniques can compete with traditional ways of building a home and the strategies can be combined with conventional use that still benefits sustainable housing in residential and commercial buildings. According to Allen Ream of Montana Heritage Home Builders, Inc. (2019), “Glo European Windows” from Poland is a high-performance product that can be used to improve sustainability.

Proposed Project Method

Our ultimate project is to create a website that will provide information and resources about green building and living in western Montana. Information we intend to include on this website includes, but is not limited to: what the concept is and why people should care about sustainability, how people can adopt greener practices, global green housing initiatives, a mini video series of how to implement green behaviors in everyday life, history of green building, resource links, and a blog section. Figure 1 in Appendix B is a rough prototype for the outline of our website.

To better inform the presentation of information on our website, we will conduct a survey throughout western Montana to determine where there is a lack of understanding about green housing and living. We have chosen to collect qualitative data through informal, in-person surveys. This will allow for better feedback and give participants a better opportunity to elaborate on their experiences with green housing. The basic survey questions we will use to guide our conversations are displayed in Survey 1 in Appendix C. To ensure we have a comprehensive sample of western Montana, we will survey in Missoula, Hamilton, Arlee, Kalispell, Libby, and Seeley Lake. We have already received permission from the University of Montana Institutional Review Board, IRB, to conduct this research.

Lastly, we will need to build the website. We intend to use GLI funding or personal funds to secure a domain name for our website. We will then use website design templates to guide the layout and creation of the website on a content management system, for example, WordPress or Cascade. To complete the video series portion of the website, we will network with local

professionals and those with experience in the sustainability field to create a short series of ways everyone can implement green habits into their daily lives. Upon completion of the website, we will prepare to present our project at the University of Montana Conference on Undergraduate Research, UMCUR.

Project Implementation Plan

There are many tasks that must be accomplished for our group to finish our project and prepare our presentation by April 24th. We must conduct our surveys, examine the collected data, design our website, produce mini video series to include on the website, and prepare our final presentation. We will accomplish this between January 13th, 2020 - April 24th, 2020.

Figure 2 in Appendix B shows our estimated breakdown of work over the course of the semester. It is planned out so there are not more than two tasks being completed at once. Additionally, Table 1 in Appendix B highlights important deadlines we must observe. Group members will work together to complete the outlined tasks throughout Spring 2020. We will meet weekly over the course of the semester to ensure the group is staying on track and assigned tasks are being completed in a timely fashion.

In addition to our timeline, we must also respect our outlined budget to successfully complete our project. We intend to use funds to secure a unique domain name and for the transportation costs of conducting our surveys. The budget breakdown is shown in Table 2 in Appendix B. By respecting both our proposed timeline and budget, our project should feasibly come to fruition before our final presentation at UMCUR.

Findings and Analysis

The research found that 62% of those surveyed practice some form of eco-friendly habits at home, while 38% do not. Per the conducted survey, 62% own a home, while 38% rent. Additionally, it showed that 33% of those surveyed use eco-friendly appliances, 45% recycle, and 22% have a different sustainability practice (i.e. composting, gardening, solar panels, etc.). The majority of those that practice eco-friendly habits said they do so because they are cost-efficient. The majority of those who do not currently practice any eco-friendly habits said they would consider adopting new practices if information about these actions was more readily available to them. The results from this survey led us to focus on other sustainability practices such as composting and gardening. Additionally, it helped us frame our resources in a way that would persuade our target audience to take action.

The project is feasible given our resource limitations. The most expensive cost of the project was getting started with the Green Home Montana website pages. Time was a limiting factor, as was human resources. However, our project was purposefully designed with a narrow scope (western Montana) and with specific goals that could be achieved by four people over the course of three months. While we achieved what we set out to do, there is still much potential for future work on Green Home Montana.

Moving forward, the project can be continued by expanding the research and resources (example currently on our website is Figure 1 in Appendix A) on Green Home Montana, and by expanding the project to have multiple websites for other locations. The website was implemented using the self-hosting service, Bluehost, and built using the content management system, WordPress.org. The plan that was purchased for Bluehost allows for the hosting of

multiple websites and custom email addresses, without paying more money. Thus, the website could be expanded using subdomains; an example of a subdomain is

“takeaction.greenhomemontana.com.” Or, the information could be placed on separate websites.

For example, we could create a similar site, GreenHomeIdaho.com, and have links between all of the sister websites. The most significant cost of expanding and diversifying the information and resources is the time to research the other regions, such as Canada, Idaho, or eastern Montana.

The process that was used for GreenHomeMontana can be used in future region expansions around the world. Additionally, the continuation of this project to expand to other regions would require a small group of motivated students willing to develop the project for 3+ months.

The Green Home Montana page could also continue to be developed over time. The blog feature is an opportunity for advancement, and additions to the YouTube channel would strengthen the connection to local resources. Additionally, the website could also benefit from more statistics for people to see.

Implementation challenges included conducting the survey to determine the project, and then what to include on the website - this was mainly due to weather conditions, season, and limited time and resources. Another implementation challenge was creating a website. The website was difficult to implement because there are advanced features on the website, such as “Accelerated Mobile Pages” (AMP), “Progressive Web Apps” (PWAs) technology, code that was new to the team, and implementing TrustedSite Secure.

Conclusion

Sustainability in western Montana is another tool to help preserve the Earth's climate and our local ecosystem. By being more sustainable through using techniques relevant to the local ecosystem, and by taking practices from other places in the world, we can see a decrease in energy consumption and an increase in home comfort. Our group decided to embark on sustainable practices and wanted to make them more relevant to western Montanans so they can apply them in their homes.

Our project is aimed towards local homeowners and renters of western Montana. We have examined past and current sustainability practices in homes to give the viewers the most relevant information on how to live sustainably. We decided to design a website, thinking this would be the most effective way to reach a large number of residents in western Montana. We identified what information is lacking about green living and housing through our survey. The survey found that the majority of people want to do more eco-friendly actions, but they do not know how to do it or are concerned about the associated costs. So, we came to the conclusion to enhance the information provided on eco-friendly living. We can then use this information to better cater our information towards the needs of western Montanans in the hopes of increasing their sustainability practices. For example, we highlighted information about composting, home gardening, and recycling since those are cost-effective activities with a positive impact on the environment. The website will be an effective tool to help western Montana residents be more sustainable in their homes. Our website has tabs that are applicable and easy guidelines for people to follow to help people increase sustainability and comfort in their homes and western

Montana as a whole. Appendix D has links, including to our final artifacts - the GreenHomeMontana.com website and YouTube series channel, plus our University of Montana Conference on Undergraduate Research (UMCUR) presentation.

The next steps for the project include continuing to develop the existing website, promoting Green Home Montana, and expanding our model to other regions. The next logical expansion for the website is to expand with information for the entire state of Montana. The website can continue to be developed with information for all regions around the globe, plus it can continually be updated as new innovative information becomes available and new research is conducted. Green housing and living is a rapidly developing, global industry. Our project is more relevant than ever and can evolve with the green housing and living movement.

Reflection

Prompt #1:

In what ways do you feel your project represents a multidisciplinary effort? What were the challenges and benefits of working across disciplines?

Our project represents a multidisciplinary effort at the heart of it. While we are all connected through our pursuit of the Global Leadership certificate, we all have different backgrounds. Nicolas is a business student working towards a degree in Management & Entrepreneurship and a degree in Marketing. He will also receive certificates in Digital Marketing, Entrepreneurship and New Venture Creation, and Entertainment Management. Karlyn is pursuing two degrees; one is in Biology with a concentration in Ecology and

Organismal Biology and the other in Environmental Studies. Dylan majors in Forestry. Finally, Savannah has a major in Resource Conservation and a minor in Ecological Restoration. Because of this diversity on our team, we were able to look at things from many perspectives. We continually developed our project through a scientific lens, business lens, technological lens, and social lens. This allowed us to produce a comprehensive and inclusive end product. The project was designed from a perspective of helping others, the sciences, and how to best market the project. Group members studying the natural sciences had background education in the ecological issues related to sustainable housing and were able to tackle the issue from a scientific and environmental perspective. They were also able to contribute connections with resources in Montana. Our business student contributed the necessary technical experience in WordPress and building websites. He also connected us with the building industry and provided key insights into the business of high-performance home building. The combination of these passions and previous experiences helped us to produce a project that appeals to all of our interests, and therefore it has the ability to reach others who also have a wide variety of interests.

The challenges of working with a multidisciplinary team were coming to a cohesive decision and hashing out a project idea early on. It was challenging to find a topic that peaked everyone's interest and would continue to be interesting for a full year. The benefits of working across disciplines were endless since each team member brought something new to the table: a different perspective, different knowledge, and different skills.

Prompt #2:

Explain the challenges your group faced in designing and carrying out the substance of the project. For example: How did you attempt to address these challenges? How did the project change after the proposal stage? How might you do things differently?

One of the early challenges our group faced was conducting our survey to determine what to highlight on our website. This proved difficult due to time constraints, unpredictable weather, a lack of human resources, and unwillingness to participate. We attempted to address this challenge by continuing to conduct surveys around our selected area and extended our surveying period. Additionally, we recognized that any information was better than no information, and that people's defiance to participate was a strong indicator that a conversation and resource around the subject was necessary. Another challenge we faced in designing and carrying out the substance of the project was the features of the website. We had grand ideas for what our ideal website would look like, but none of us are professional web designers. Nicolas overcame this obstacle for us by spending countless hours developing our website pages and learning the necessary code.

Our project evolved over time to include an increased focus on green living and not solely focus on housing. Ultimately, we created a balanced project between green living and green housing.

In retrospect, we should have conducted the survey during the summer or early fall semester so that bad weather was not a factor in determining if people wanted to talk to us. This would also allow us more time to collect responses. Also, we could have come to a project idea

sooner. This would have given us a few extra weeks to better prepare ourselves for the project implementation in the spring.

Prompt #3:

How did considering the global context of the problem your group identified influence your thinking, the project, and the complexity of your work? What challenges did you encounter and how did you resolve them? What would you do differently if you were to repeat this process?

The global context of our problem was a crucial piece of our project. It required us to continually reexamine the interrelatedness of Montana and the global community. We continually looped our discussions back to ensure we were maintaining our global element. The global aspect helped shape the project by including “Global examples” on the website, plus designing the project so it could be replicated for people around the globe. The idea was that what we created is a localized global project specific to western Montana, but someone in any other region of the world could follow our methods and compile the same resources for their local community. The global context added an extra layer of complexity to our project and continually challenged us.

One challenge we encountered was determining the factors that we would use to compare other regions to Montana. We solved this problem by pinpointing specific, quantitative conditions to consider. By establishing very specific parameters, it was easier to compare and contrast global regions.

If we were to repeat this project, it would be crucial to start sooner. Establishing our topic in the summer would have allowed more time to better implement all the elements of our website. Additionally, we should have spent more time doing literary research on global conditions and examples in the fall semester. This would have freed up time during the spring to further develop website content.

Ultimately, our project maintained a global theme at its core. We put much time and consideration into our project to ensure the final product was relevant to other geographic areas, maintained multiple perspectives from various fields, bridged the gap between local and global efforts, and suggested solutions based on global examples.

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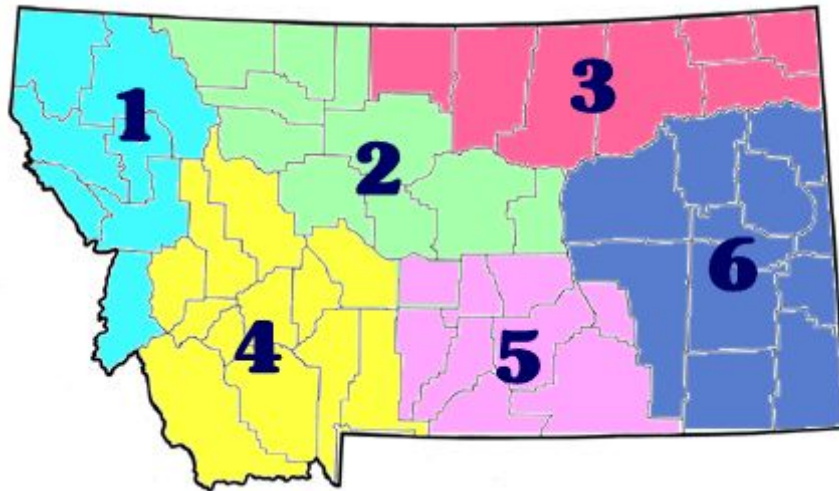
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Appendices

Appendix A

Map 1: Map of Climate Regions



Source: Montana State University (n.d.).

Figure 1: Defining green building from 3 different perspectives



Graphic adapted from the information provided on the Environmental Protection Agency's website on the "Why Build Green?" page.
Found at <https://archive.epa.gov/greenbuilding/web/html/whybuild.html>

Appendix B

Figure 1: Prototype of website organization



Figure 2: Breakdown of work to be done over the course of Spring 2020

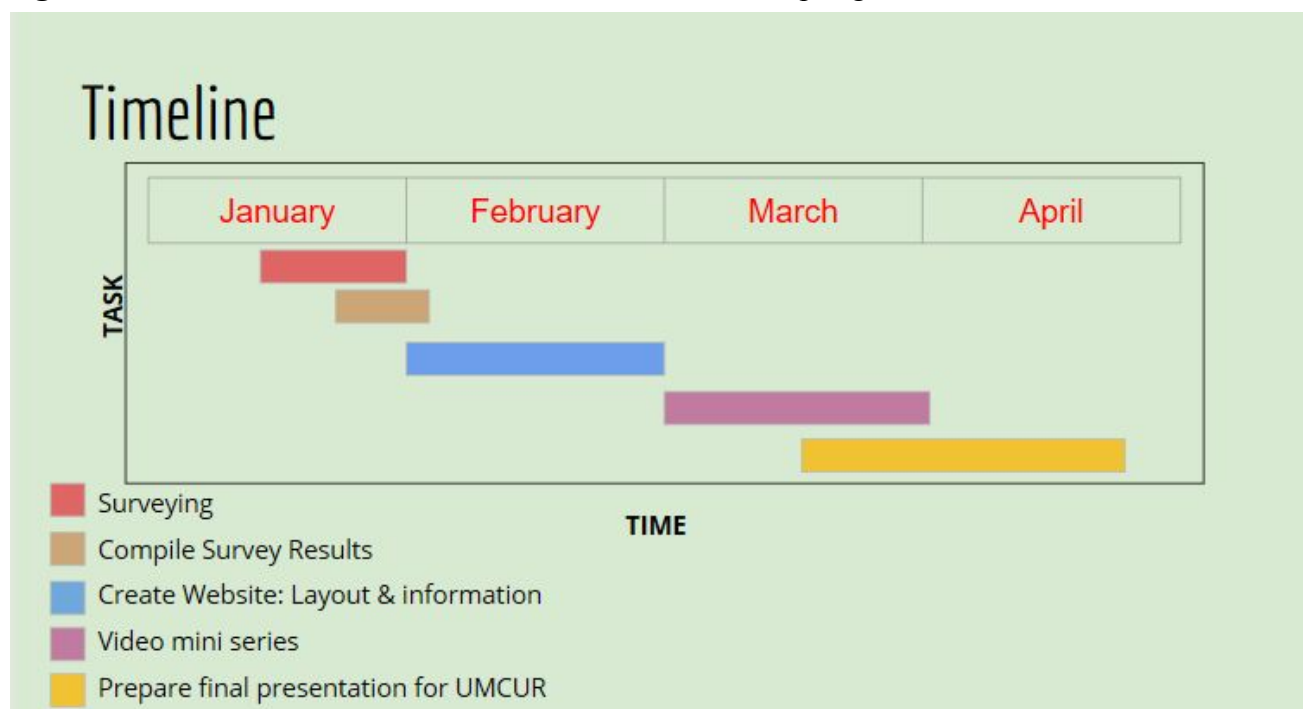


Table 1: Important deadlines to observe in Spring 2020

Task	Deadline
Have domain name secured & paid for	Friday, January 23rd
Submit UMCUR Abstract	Friday, February 14th
UMCUR	Friday, April 24th

Table 2: Budget**Budget**

Expense	Quantity	Cost	Total
Domain Name	Secure domain name for minimum of 2 years	\$15/year	\$30.00
UM vehicle rental	4 days, total mileage of ~465 miles	\$9/day + \$0.44/mile	\$240.60
TOTAL REQUEST			\$270.60

Appendix C

Survey 1: This is the general survey outline we will use while conducting our research.

1. Do you own a home or do you rent?
2. Do you currently practice any environmentally sustainable/eco-friendly/high-performance housing techniques (i.e., water/energy-efficient appliances, rain barrels, alternative energy sources, composting, etc.)?
 - a. If so:
 - i. What are they?
 - ii. Why?
 - b. If not:
 - i. Have you considered the idea?
 1. If not, what would you consider are the major barriers?
 - ii. Would you be open to the idea if you were provided more information?

Appendix D

The final artifacts, including the GreenHomeMontana.com website, offline HTML saves of the website, TrustedSite Secure website information, and YouTube Series can be accessed through the University of Montana's ScholarWorks.

Final Artifacts ScholarWorks: <https://scholarworks.umt.edu/utpp/283/>

GreenHomeMontana.com Website: <https://greenhomemontana.com/>

Green Home Montana YouTube Series Channel:

<https://www.youtube.com/channel/UCUYYOAwMHWgBnyavyw7Nhmg>

University of Montana Conference on Undergraduate Research (UMCUR) Presentation:

<https://scholarworks.umt.edu/umcur/2020/gli/4/>