A Stakeholder Study of the US Carbon Offset Market

A Study of the US Carbon Offset Market and Development of a Stakeholder Analysis Template to help Conceptualize a Carbon Offset for Carbon Capture Storage in Taiwan

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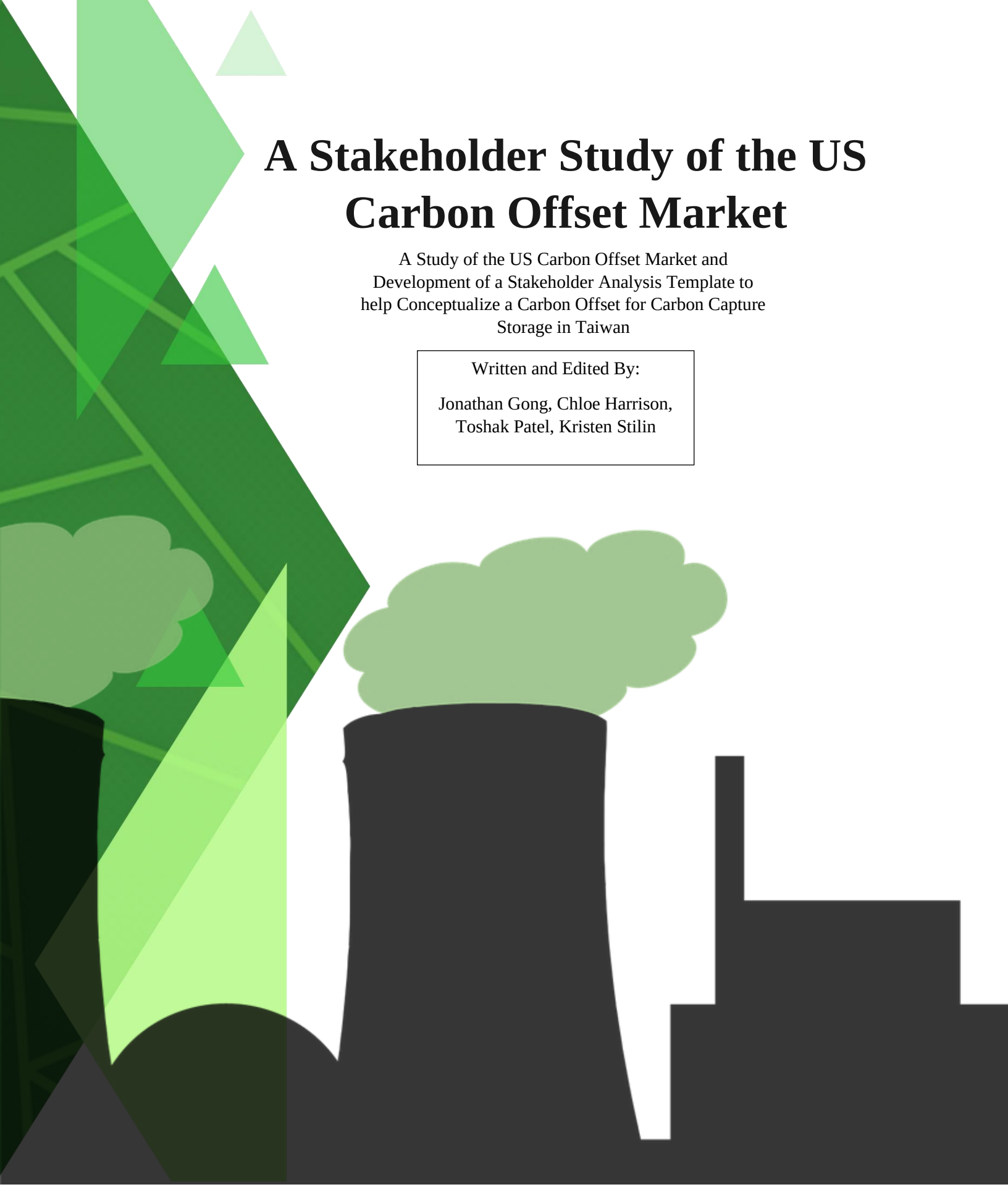

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WPI

A Stakeholder Study of the US Carbon Offset Market

An Interactive Qualifying Project
submitted to the faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the
degree of Bachelor of Science

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April 30, 2022

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Abstract

The Taiwan Institute of Economic Research is attempting to conceptualize a new carbon offset for Carbon Capture Storage (CCS) in Taiwan but has limited knowledge on the US carbon offset market. The team interviewed and surveyed US stakeholders to learn more about CCS, the current carbon offset market, and to gauge public opinion of it. Findings revealed that stakeholders wanted carbon offsets to improve on transparency with where offsets are coming from, and accountability to avoid double counting. The team did not receive enough responses for a stakeholder analysis and therefore pivoted to developing a stakeholder analysis template. Our sponsor can use this template to do a full stakeholder analysis of the US carbon offset market in the future.

Acknowledgement

Our team would like to thank the following people for their contributions to this project:

- Our project collaborators Yenhaw Chen and Jie-li Chen at the Taiwan Institute of Economic Research for taking their time to provide us with guidance on this project, setting up interviews, and sending us documentation to better understand the literature.
- Our project advisors Grant Burrier and Melissa Butler for their support, critiques on our paper, and guidance throughout the project process.
- Our project directors Jennifer Rudolph and Wen-hua Du for their support in our project's initial stages and providing us the opportunity to work in Hawaii.
- All our interviewees for providing us with useful information on CCS and carbon offsets.
- All the respondents who took the time to fill out our survey.

Executive Summary

Introduction and Background

Since the 1950s, there has been an exponential increase in global carbon emissions which could be extremely detrimental to life as we know it. At the current rate, the global average temperature will likely increase by 3 degrees Celsius, causing mass ecosystem collapse (Climate clock, 2022). In October of 2021, the Science-Based Targets initiative (SBTi) published a net-zero framework, pushing governments to employ greener policies and technologies, and increasing investment in the energy sector (SBTi, 2021).

The global switch to renewable energy is a positive step toward combating climate change, but companies have pushed for carbon mitigation technologies to attempt to counteract the increasing emissions. A promising new technology for this is Carbon Capture and Storage (CCS). Companies first employed CCS in the 1970s using carbon separation methods from the 1920s, where it was initially used in Enhanced Oil Recovery (EOR), to boost oil production (IEAGHG, 2013). In recent years, there has been an increase in the use of CCS plants on coal-fired power facilities to mitigate their emissions (Loria, P., Bright, M. 2021). CCS takes place in 3 steps: capture, transportation, and storage, and can be extremely costly to employ (Global CCS Institute). The US is the leader in CCS technology, with 13 plants in operation and 30 under construction (Beck, L. et al, 2021). Within the US, the government has implemented several methods to motivate the widespread use of CCS. These methods include the implementation of the Bipartisan Infrastructure Law in 2021, and the introduction of the 45Q tax credit (Congressional Research Service, 2021).

Another method used to combat climate change is carbon offsets, which policymakers came up with during the 1980s. Today, they represent “one metric ton of carbon dioxide equivalence reduction” (Aldrich, 2021) and companies use them to invest in “projects that remove carbon from the atmosphere” (Patch, 2021). Two markets exist for carbon offsets: the compliance market and the voluntary market. Compliance offsets are government regulated and are priced based on supply and demand. Third-party vendors verify offsets for the voluntary market, allowing companies to invest in offsets outside the regulatory market. (CORE, 2020).

Methodology

The goal of our project was to provide TIER with a series of recommendations on the US carbon offset market, and a stakeholder analysis template, to assist them in developing a Carbon Offset for Carbon Capture Storage in Taiwan. There were two objectives to complete this goal:

1. Investigate US stakeholders’ involvement with CCS and their opinions on the Carbon Offset market.
2. Analyze US stakeholders’ power and interest in the development of a Carbon Offset for CCS.

To accomplish these objectives, our team researched the US carbon offset market, conducted interviews/surveys with US stakeholders, and developed a stakeholder analysis template. We interviewed 9 US stakeholders and received 9 total responses from the survey.

The first objective was completed by doing archival research on CCS implementation and how the US carbon offset market operates. Our team identified four states of interest from our research, which included California, Indiana, Texas, and Wyoming. Next, we interviewed and surveyed US stakeholders within four categories we determined: internal partners with state/local government, potential partner agencies, non-governmental organizations (NGOs), and general populations. Interviews were sent to stakeholders with more involvement with CCS and carbon offsets. Surveys were sent to those with less involvement to help with gathering data for our stakeholder analysis template.

Results

Interviews

Conducting interviews with industry experts revealed more information about two different parts of our project, the first being the current carbon capture storage (CCS) implementation in the US. Out of our 9 interviewees, only 3 had knowledge of CCS. Regarding the issue of public perception of CCS, Professor Kipp Coddington of Wyoming's School of Natural Resources told us that most CCS plants are retrofitted and that all CCS projects face a certain amount of public backlash. However, in Wyoming, their statewide surveys found that the public is, "quite receptive to these types of projects" (K. Coddington, interview, 30 March 2022). We also learned that the 45Q tax credit, which makes a company eligible for a $50 tax credit per ton of COO2 captured, has been responsible for much of the recent investments and interest in CCS (K. Coddington, interview, 30 March 2022). Asides from CS perception, there are two main issues with current CCS implementation: leakage and the possibility of induced seismicity (M. Celia, interview, 21 March, 2022). To solve the problem of storage, one of the most promising storage options is injecting carbon into deep saline aquifers, as they have large storage capacity and are less likely to be drilled into.

The information we received from interviews also talked about the pros and cons of the carbon offset market. We learned that the carbon offset market is growing and evolving and is crucial for reaching climate goals because it creates demand for carbon removal projects. Despite these pros, there is still potential for fraud when third-party verifiers do not vet offsets properly (S. Allen, interview, 24 March 2022). In addition, relying too heavily on offsets may allow companies to perform business as usual and continue purchasing offsets instead of reducing their actual emissions (M. Densmore, interview, 21 March 2022). These cons lead towards improvements suggested by the stakeholders in the carbon offset market, the biggest of which is transparency. There could be more transparency around where offsets are coming from and how they are generated (M. Densmore, interview, 21 March 2022). Less transparency can lead to confusion about pricing information for offsets (K. Coddington, 30 March 2022).

Surveys

Our team distributed surveys to 98 individuals and received responses from 8, which is an 8% response rate, the majority of which are from NGOs. The main survey question inquired about the effects of the development of a carbon offset for CCS on five different factors: finances, ability to work with larger legislation groups, ability to perform business as usual, ability to meet environmental goals, and reputation with the public.

Out of the groups who identified as NGOs, two said they had no influence, and one rated their influence 8 out of 10. The two groups who identified as a partner agency rated their influence as 5 out of 10 and no influence respectively. The group that identified as an internal partner said they had no influence. To reiterate, these results were the building blocks of a full stakeholder analysis and are not representative of the carbon offset market.

Stakeholder Analysis Template

To complete the second objective, our group developed a stakeholder analysis template that our sponsor can interpret for future guidance when developing a Carbon Offset Market for CCS. We opted to develop the Power-Interest Grid for our Stakeholder Analysis template, as it can be easily developed in a short time, while still providing meaningful results. The group used the literature to streamline the stakeholder analysis process into three core steps: Identification, Prioritization and Visualization, and Engagement. Using these three steps as a guideline, our group determined that the tool should accept a list of identified stakeholders, visualize the stakeholder rankings, and design a template that organizes engagement practices for project developers.

Our group began the development of the template by establishing a weighting algorithm. To ensure that our tool remained versatile, our group wanted to enable any user of the tool the ability to prioritize certain stakeholder groups over more peripheral stakeholders. To establish this, an algorithm that converted a ranking system into a percentile, used several calculations as a weighted multiplier. These weights also served to remove the heteroskedastic trends, helping our group ensure that the tool produces accurate results.

Our group used these weighting techniques when developing the Power and Interest metrics – two weighted numbers that were used as coordinates to plot stakeholders on the Power-Interest Grid. The Interest metric would weigh different stakeholders based on the impacts of the project's development on the stakeholder. The Power metric would weigh different stakeholders based on their ability to impact the project's development. These two metrics passed through unique Boolean logic gates that would output numbers that could be averaged together to quantify either the Power or Interest metric. The tool generated weighted numbers that ranged between 0-1. The tool uses both numbers in conjunction as coordinates, to plot stakeholders onto the Power Interest Grid as shown in figure 0.1.

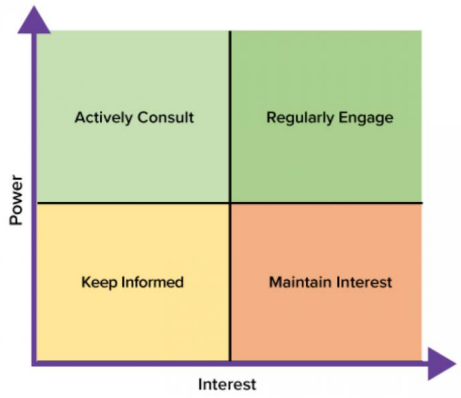

Figure 0.1: An Example of a Power-Interest Grid (Murphy, 2008)

The placement of each stakeholder onto the Power-Interest Grid can then help project developers design engagement practices with the identified stakeholders. This directly translates into a Stakeholder Communications table, where the tool automatically ranks the stakeholders by their placement on the Power-Interest Grid. A project developer can fill these grids with information based on how the project developers choose to interact with the different stakeholders. Table 0.1 shows a sample of a Communication Table.

Table 0.1: An Example of a Communications Table (SPARC, 2008)

Communications Objectives – Objective A, Objective B, Objective C, Objective D							
Overriding Key Messages – Message A, Message B, Message C, Message D							
	Expectations/ Issues	*Priority*	*Specific Key Messages*	*Communication Tactics*	*Who*	*Budget*	*Measurement*
Stakeholder Group A		1				$	
Stakeholder Group B		1				$	
Stakeholder Group C		1				$	
Stakeholder Group D		2				$	
Stakeholder Group E		2				$	
Stakeholder Group F		3				$	
Stakeholder Group G		3				$	
Quarterly Calendar							

Application

Our team chose to apply the template developed earlier to meet the second objective to produce a preliminary set of results, based on the interview and survey data our group collected. We streamlined the interviewees and survey respondents as identified stakeholders completing the first part of the stakeholder analysis.

The tool processed these identified stakeholders producing both a Power-Interest Grid and the following Communications Table encapsulating the results of this particular application

Table 0.2: Communications table of Stakeholders Interviewed and Surveyed by the team

Stakeholder	Power/Interest Grid Placement
[REDACTED]	Regularly Engage
Center for Communication Action and Environmental Justice	Regularly Engage
University of Wyoming's School of Energy	Regularly Engage
Hawaii Pacific University	Regularly Engage
[REDACTED]	Regularly Engage
[REDACTED]	Regularly Engage
American Carbon Registry	Regularly Engage
Microsoft	Regularly Engage
ECOSLO	Regularly Engage
Powder River Basin Resource Council	Actively Consult
National Parks Conservation Association	Actively Consult
Cool Earth	Actively Consult
City of Battle Ground	Maintain Interest
[REDACTED]	Maintain Interest

Our group synthesized the information given to us by our sponsor, the list of identified stakeholders and the literature to generate a generalized list of stakeholders for climate change and Carbon Offsets. This list was again used to generate a unique Power-Interest Grid and Communications Table that served more as a recommendation to our sponsor as to which groups to continue to incorporate in their development process Table 0.3 illustrates the results of this application.

Table 0.3 Communications Table for Subcategory Stakeholder Analysis

Stakeholder	Power/Interest Grid Placement
Hospitals, health clinics	Regularly Engage
State/Federal/Government Agencies	Regularly Engage
Environmental Organizations	Regularly Engage
Energy Companies	Regularly Engage
Public Health Advocacy groups	Regularly Engage
Universities and Academic Research Groups	Regularly Engage
Environmental Advocacy groups	Regularly Engage
Public Health	Actively Consult
Healthcare Workers	Keep Informed
Emergency Management	Keep Informed
Environemental Justice Group Representing a Population	Keep Informed

Conclusion

Limitations

The main drawback of our project was the lack of responses to the interviews and surveys, having received low response rates for both interviews (16.1%) and surveys (9.18%). These results led to our team pivoting to a stakeholder analysis template as our main deliverable instead of a full stakeholder analysis. There was also subjectivity in how the power and interest were judged for each stakeholder. Fewer responses also meant a lack of representation within the four stakeholder groups and the four states of interest our team identified. In addition, most of the interviewees only worked in the voluntary carbon offset market, meaning we could not get much information on the compliance market aside from our archival research.

Recommendations & Future Work

As our sponsor works towards developing a new offset for CCS, we recommend that they take the pros and cons that our interviewees discussed into consideration. This includes issues like high pricing and fraud with third-party verifiers. Our sponsor should also utilize the stakeholder analysis template that we made, as it will help them perform a full stakeholder analysis.

Any IQP group continuing this project should focus on reaching out to more US stakeholders, specifically in the groups that we got the least responses from, general population representatives and internal partners. If a future IQP group collects enough data, they can complete a full stakeholder analysis, although this is a lengthy process.

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Authorship Pages

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1.0 Introduction

At the current rate of carbon emissions, life as we know it will no longer be feasible by 2100. With no action, the global temperature will rise 3-4 degrees Celsius, resulting in catastrophic weather events and eventual mass extinction (Climate clock, 2022). On October 28th, 2021, the organization, Science-Based Targets initiative (SBTi), launched "the first science-based framework for companies to set net-zero targets" (SBTi, 2021). SBTi developed the framework to provide a "common, robust, science-based understanding of net-zero decarbonization plans […aligned with] climate science." With this framework in place, communities, local governments, and nations have ramped up their effort to develop more innovative and creative green practices and technologies. This push has positively impacted investment in the current energy market, as well as the financial sector.

To spur greater investment in carbon-cutting technology, some countries have Energy Attribute Certificates (EACs), which show that "1 MWh of electricity was generated from renewable sources" (First Climate, 2022). If a third-party organization can verify the energy claim is valid, organizations can sell a certificate to individuals or companies to offset their emissions. An EAC provides the company with legal proof of their offsetting efforts, which can help bolster public perception and achieve energy compliance goals.

However, renewable energy is not the only way of reducing emissions. A promising technology carbon companies are developing is Carbon Capture Storage (CCS), which companies implement in large carbon-producing plants by recapturing and storing emitted carbon (Saukas, 2019). The carbon companies either pump the carbon underground for permanent storage or reuse them for more efficient oil recovery efforts, making CCS technology a useful tool for oil-driven

power plants (DoE, 2013). To facilitate investments in this new technology, a new market is developing in the US for carbon offset credits, which is a type of EAC. The carbon offset market operates similarly to EACs, where a carbon emissions reduction project provides offsets that common standards verify. Sellers of carbon offsets select projects, and these companies reinvest profits back into the projects. The offset credit market offers a unique financing option to companies and businesses at all stages of development. These projects will generate offset credits that companies can reimburse, supplementing efforts to meet any government-mandated sustainability quotas.

The Taiwan Institute of Economic Research (TIER) is Taiwan's premier think tank for research and analysis on promoting economic growth and energy reform. The organization is working on promoting CCS implementation in Taiwan and plans to conceptualize a carbon offset that CCS power plant owners can provide to the market. To achieve this goal, TIER first needs to conduct a stakeholder analysis to identify parties necessary for the project to determine their level of interest and power. Finishing a comprehensive stakeholder analysis early in the development of a product can "turn many of these [individual companies] into avid supporters of [the] initiative" (ProductPlan, 2021).

The goal of this project was to provide TIER with a series of recommendations on the US carbon offset market and a stakeholder analysis template to assist them in conceptualizing a carbon offset for carbon capture storage in Taiwan. Our primary focus was on the United States carbon offset market because it is the main point of interest for TIER and represents a market where they have less in-house research. The methods we used to achieve this goal included doing archival research on the implementation of CCS and carbon offsets, interviewing and surveying US stakeholders on carbon offset usage and influence on the market, and developing a stakeholder

analysis template to determine power and interest in the market. The data collected from our interviews and surveys, particularly how the respondents and interviewees rated their power and interest, was highly instrumental in creating our stakeholder analysis template and allowed us to create a short example analysis to present to our sponsor. This template is the first step toward TIER pushing for more CCS implementation in Taiwan and eventually developing a carbon offset for CCS. The template will allow TIER to determine which stakeholders have the most power and influence in the carbon offset market, and who they should contact in the development of a new one. CCS is one of the best options for Taiwan to reduce its emissions as the energy matrix is heavily dependent on coal, and a carbon offset market will help Taiwan promote investment in CCS technology and encourage progress towards reducing carbon emissions.

2.0 Literature Review

The purpose of this literature review was to investigate CCS and carbon offsets in the United States and establish the circumstances that promote investments in carbon offsets for CCS. The literature review begins with a review of current carbon capture storage technology and the carbon offset market focusing on CCS technology, the successes and failures of the carbon offset markets, and public perception of CCS projects. After describing the background information, we continue with an overview of the stakeholder analysis and outline the metrics used to define individual stakeholders' interests and influence on the project. Our background research into CCS implementation and the carbon market showed that while CCS implementation in the US is not widespread, there has been continued investment in the field to grow it. The carbon offset market has been growing alongside CCS and will continue to drive investment in carbon emission reduction projects.

2.1 Carbon Capture Storage Technology and Funding in the US

Companies initially utilized the capture technology used for CCS in the 1920s to separate carbon from marketable gases such as methane (IEAGHG, 2013). However, it wasn't until the 1970's that Environmental engineers introduced Carbon Capture and Storage (CCS) and employed it at a gas processing facility in Texas in a process known as Enhanced Oil Recovery (EOR). Interest in the boost in oil recovery drove the first wave of CCS from the 1970s to 2010, which came along with the EOR. The second wave followed the American Reinvestment and Recovery Act (2009) and saw several carbon companies retrofitting new CCS plants on coal-fired power facilities. Currently, there are 38 projects in development around the world, with the major factor

driving this growth being the increased urgency in achieving net-zero emissions (Loria, P., Bright, M. 2021).

CCS takes place in 3 steps: capture, transportation, and storage. The capture process involves the separation of carbon dioxide from the other gases produced at “large industrial process facilities such as coal and natural-gas-fired power plants, steel mills, cement plants, and refineries.” (Global CCS Institute). Following the capture, the CO2 is compressed and chilled into a fluid and transported to suitable storage sites via pipelines, trucks, or ships. The CO2 is then injected into rock formations at depths below 1 km, or into saline aquifers (Global CCS Institute). CO2 can be captured in several ways, with the main ones being post-combustion, pre-combustion, and oxyfuel. In post-combustion capture, carbon dioxide is separated from the exhaust produced during combustion. Pre-combustion capture involves gasifying the fuel and separating the carbon dioxide which cannot be retrofitted onto existing plants. Oxyfuel capture involves burning the fuel in a nearly pure oxygen environment, creating a purer stream of carbon dioxide, which is easier and cheaper to capture (Resources for the Future, 2022).

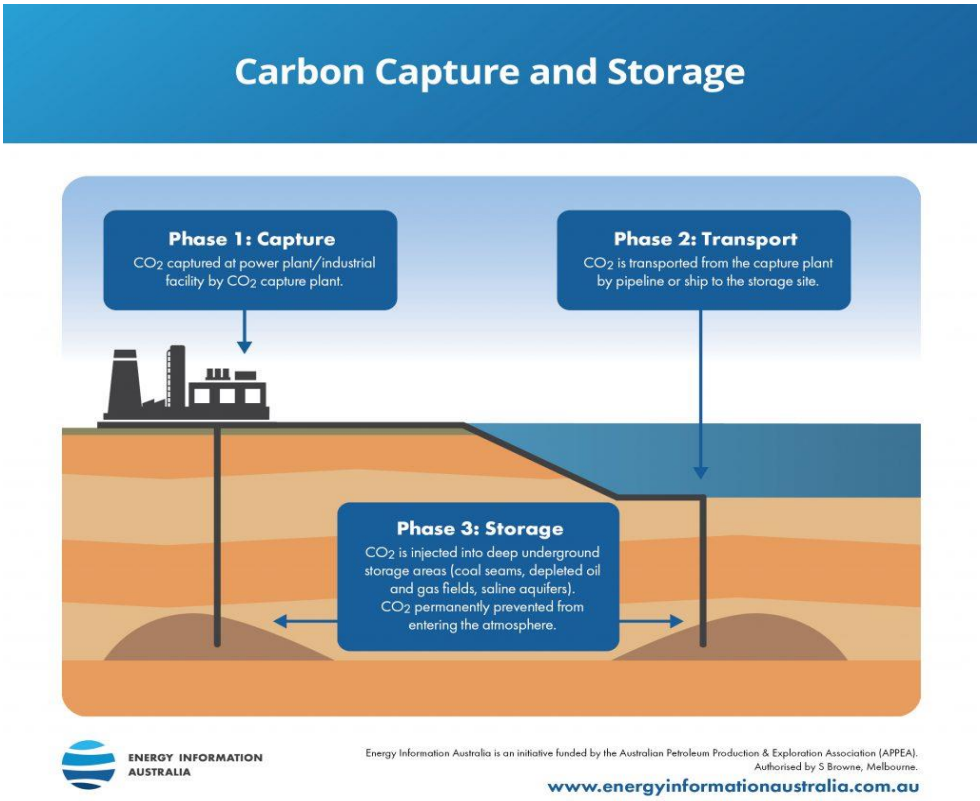


Figure 2.1: Image detailing the CCS process (Energy Information Australia, 2022)

The US is the leader in CCS technology with 13 CCS plants currently operating in Texas, Louisiana, Kansas, Oklahoma, Illinois, Michigan, North Dakota, and Wyoming (Resources for the Future, 2022), and 30 more under construction (Beck, L. et al, 2021). These states constructed coal-burning plants in remote areas where there is enough real estate for the plant foundation and below-ground sequestration. These plants have demonstrated success that would allow for near-term roll-out of CCS technology that may provide significant cost reduction. (Bec, L., 2019). To promote carbon mitigation, the federal government first implemented tax credits for carbon sequestration in 2008, and in 2021 Congress passed the Bipartisan Infrastructure Law, which put aside $3.5 billion dollars (Johnson, K. et al, 2021) for funding CCS projects (Resources for the

Future, 2022), including the 45Q tax credit to promote investment (Congressional Research Service, 2021).

2.1.1 States of Interest

Some states have more extensive CCS implementation than others, whether this is because of their current carbon emissions, energy matrix, or state laws. Based on these characteristics, the important US states our team identified for this study are Wyoming, Indiana, California, and Texas. All four states have relatively high annual carbon emissions per capita (as shown in Table 2.1), as well as current CCS implementation.

Table 2.1: Characteristics of four US States

Characteristics	Wyoming	California	Texas	Indiana
Population (millions)	0.6	39.4	29.4	6.8
GDP (billions $)	36.2	3,091.9	1,759.7	372.6
Annual Carbon Emissions (million metric tons)	63.7	363	701.9	191.2
Annual Carbon Emissions per Capita (million metric tons)	106.2	9.2	23.9	28.1
Percent of Energy Matrix that is Coal, oil, or natural gas (percent)	65.4	52.6	59.6	82.6
Number of proposed and Operating CCS Plants	2	4	12	1

Despite its much smaller population, Wyoming has a disproportionally high carbon emissions rate with an annual carbon emissions per capita rate of 106.2 million metric tons, the highest of the four states. Aside from Wyoming's cleaner energy needs, the state overall is a strong candidate for new CCS sites due to its favorable geology and multitude of policy, legal, and

infrastructure aspects (Phillips, E. et al 2018). These policy/legal aspects include laws that provide a certification procedure for CO2 incidentally stored during enhanced oil recovery (EOR) (id. §30-5-502), as well as establishing permitting procedures for CCS sites (id. § 35-11-313) (Phillips, E. et al, 2018). While Indiana only has one active carbon capture storage plant, the Regional Carbon Capture Deployment Initiative's research highlights "the potential for Indiana to capture over 12 million metric tons" given that it is "the largest coal producer and second-largest coal consumer. (RCCDI, 2018). In addition, their state government passed House Ball 1209 into law March 2022, providing the mechanism for underground CCS storage (Indiana General assembly, 2022). California is also a strong candidate for CCS sites because of its climate policies as well as its goal to be carbon neutral by 2045. The state is a leader in climate change reduction and is thus a great candidate for CCS (Environmental Defense Fund). Texas is currently the country's highest emitter of carbon dioxide due to its high population, and thus has the largest carbon footprint (Marshall, E., Thompson, J. 2019). Table 2.1 shows Texas as having 10 million fewer individuals than California, yet they release almost twice as much carbon, making them an excellent candidate for CCS as it would provide a way to mitigate their high emissions. To combat carbon emissions, Texas passed house Bill 1284 giving the Texas Railroad Commission, "sole jurisdiction over Class VI Injection Wells and carbon capture, use, and sequestration… indicative of strong support in Texas for the deployment of CCUS projects" (Liskow and Lewis, 2021). Texas' passed legislation supporting CCS and high emissions make it a strong state of interest for our project.

2.1.2 Positive and Negative Impacts of CCS

CCS will be crucial to decarbonizing the US' current energy sector. Despite the trend away from coal energy, it "still provides over half of the electricity in eight states" (Center for Strategic and International Studies, 2021) including Indiana and Wyoming. Coal energy plants will not go

away in the near future, and CCS is the only technology that can swiftly curtail the carbon emitted from these plants. In addition to its climate mitigation benefits, the process of implementing CCS technology the economy benefits as employing CCS technology requires workers for the construction of CCS facilities and carbon pipelines. To achieve IEA's Sustainable Development Scenario to reach net-zero emissions by 2050, IEA estimates that 2,000 CCS facilities would need to be fully operational by 2050, which would require 70,000 to 100,000 construction workers and 30,000 to 40,000 capture facility operators globally (Townsend, A., Raji, N., & Zapantis, A., 2020). Creating new jobs stimulates the economy and creates new opportunities in the infrastructure for CCS projects and the development of the technology.

Despite the benefits of climate mitigation technology, CCS still comes with several risks. Most risks stem from leakages that occur when storing the CO2 in the ground. When this happens, it can lead to "groundwater contamination such as the pollution of drinking water" and "damage to the ecosystem" (Wennersten, Sun, Q., & Li, H., 2015). In rare occurrences, there can be leaks, which also affect the surrounding air quality and can lead to suffocation (Wennersten, Sun, Q., & Li, H., 2015). Aside from potential risks, a deterrent for CCS is the inability of existing technologies to achieve 100% efficiency. While 90% efficiency is considered the worldwide baseline, few projects have exceeded 95% efficiency. In addition, when plants reach the 90% mark, there are diminishing returns; improving efficiency past this point is more expensive and complicated engineering-wise (MIT, 2021). The limited efficiency of these plants makes net-zero an impossible goal with just CCS technology, requiring CCS and other renewable energy technologies implemented together.

Another barrier to a CCS project is cost. Estimating the cost of implementing a CCS plant is difficult because the retrofitted plant type, capturing the carbon, transporting it, and storing it all

play a part in the final cost. To provide a baseline, the Petra Nova in Texas started operating in 2016 and cost around $1B to implement on an existing plant (Carbon Capture and Sequestration Technology @MIT, 2016). This cost of $1B does not include the cost of upkeep and transporting the carbon, but they also do not reflect the cost-saving measures Congress has passed, like the 45Q. Despite these measures starting a project can often be cost-prohibitive and may prove to be a barrier to CCS development in the US.

2.2 US Carbon Offset System and Criticisms

In the late 1980s, policymakers came up with the concept of carbon offsets to combat climate change (CORE, 2020). Today, they represent "one metric ton of carbon dioxide equivalence reduction" (Aldrich, 2021) and companies use them to invest in "projects that remove carbon from the atmosphere" (Patch, 2021). There are currently two markets for carbon offsets: compliance and voluntary, and each differ in cost and verification.

Compliance offsets "are regulated by national, regional, or provincial law and mandate emission sources to achieve compliance with GHG (Greenhouse Gas) emission reduction requirements" (CORE, 2020). They typically have commodity pricing, meaning the price of a compliance offset is based on supply and demand, regardless of the project. The voluntary market is where "businesses, governments, nonprofit organizations, universities, municipalities, and individuals offset their emissions outside a regulatory regime" (CORE, 2020). Unlike compliance offsets, voluntary offset prices vary from project to project and therefore tend to be cheaper. A project must meet different standards before it "can be certified for use as carbon offsets", which include the Verified Carbon Standard (VCS), Climate Action Reserve (CAR), Gold Standard, and the American Carbon Registry (ACR) (Patch, 2021). These standards approve methodologies for each project, which are "framework document[s] that defines the quantification and parameters

that are required to generate carbon offsets throughout the life of a project" (Priddy, 2021). The CAR oversees many independent third-party verifiers, who verify carbon offsets issued by these standards (Patch, 2021).

2.2.1 Criticisms of Carbon Offsets

While carbon offsets have their benefits, there are unavoidable loopholes. Currently, there are two main criticisms about the use of offsets for the environment: the usage of the credits, and concerns about the quality of the credited carbon offset (SEI, 2020).

The first criticism is that investment in carbon offsets inherently allows polluters to continue polluting instead of forcing more environmentally friendly changes. Greenwashing is the "act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service" (UL, 2022). The carbon offset system provides companies the opportunity to cover up the negative environmental consequences of their operations by publicly displaying the monetary investment they are making elsewhere in the world. The other concern stems from how the "credits do not represent valid GHG (Greenhouse Gas) mitigation, [instead acting as a…] substitute for real climate action" (SEI, 2020). In a recent study, two of the world's largest programs for carbon offsets – the Clean Development Mechanism and the Joint Implementation programs – suggest that "up to 60-70% of their offset credits may not represent valid GHG reductions" (SEI, 2020). When evaluating the effectiveness of carbon offset markets, any group pursuing offsets should consider these concerns.

Along with loopholes in the carbon offset market, there are several flaws with the offset market's operation. The first flaw is the lack of carbon removal projects, which poses a significant challenge for companies that see carbon removal as essential to their environmental mission. From Microsoft's published Carbon Removal report: "The global carbon credit economy as it exists

today was not set up for carbon removal, and instead has an undifferentiated focus on avoidance of emissions" (Microsoft, 2021). Underdevelopment and lack of carbon removal projects can make it difficult for companies like Microsoft (who has a 2030 carbon-negative goal) to reach their own environmental goals. In carbon markets, another important aspect of offsets is permanence. For offset credits, ideally, carbon would remain stored for 30-100 years, meaning there was a permanent reduction in emissions. When a forestry project provides offsets to companies but then burns down in a wildfire five years later, the carbon is again released back into the atmosphere. This event negates the originally sold offset, where it never removed carbon emissions. Issues of carbon leakage are also possible when storing for a long period of time, requiring "burdensome and complex legal and administrative maneuvers by market administrators and government agencies" (Miltenberger, O., Jospe, C., & Pittman, J., 2021). Fixing the issue of permanence would require stricter administration of offset credits but would result in a more credible market.

2.3 Impact of Public Perception on CCS

Public perception of CCS technology in the United States suffers from a combination of both unfamiliarity with the technology and uncertainty of whether it is an effective solution. A 2018 poll revealed that "57% of respondents declared that they have never heard about CCS before taking [the] survey, 24% were not sure and only 19% stated that they [had] heard about CCS before" (Pianta, S., Rinscheid, A., & Weber, E, 2021). When asked questions about the safety of CCS, most respondents with no previous CCS awareness felt it had an average negative impact on the environment and safety. However, those who previously knew about CCS felt it was beneficial to the environment and society, with less negative impact (See figure 2.2). In another survey, despite most respondents having no prior knowledge of CCS, most of the respondents still showed support for CCS "after being presented with a basic explanation of its purpose and function"

(Krause et al., 2014). These results show how a stakeholder can shape the public's opinions in favor of CCS if prior outreach is done. US companies may be more inclined to use CCS technology as many people display an increase in willingness after being educated on it show a willingness towards supporting the technology.

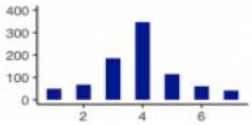
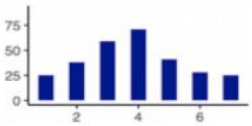
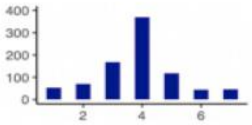
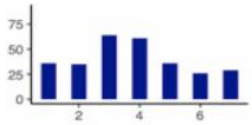
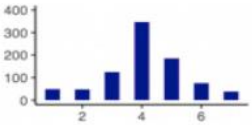
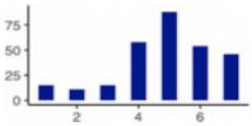
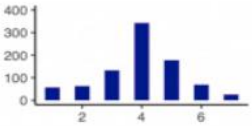
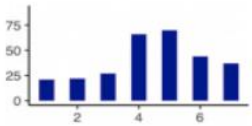
Survey Questions	Distribution of values for respondents with no previous CCS awareness	Distribution of values for respondents with previous CCS awareness
Q1. "To what extent do you think that CCS has a negative impact on the environment?"		
Q2. "To what extent do you think that CCS has a negative impact on your safety? "		
Q3. "To what extent do you think that CCS entails benefits for society? "		
Q4. "To what extent do you think that CCS is a good solution to the challenge of climate change? "		

Figure 2.2: Table of the survey results from the poll (Pianta, S., Rinscheid, A., & Weber, E, 2021). The responses were based on the Likert scale, with 1 representing no impact to 7 meaning a high impact

Another issue is uncertainty about whether CCS is a viable mitigation strategy. Some of this uncertainty comes from the potential risks that come from implementing CCS, as discussed earlier in section 2.1.2. Hearing about these safety concerns can deter the public from supporting CCS, especially when those concerns can directly affect people's quality of life.

Another factor influencing public perception is NIMBYism, which stands for "not in my backyard". The idea is that regardless of status, people will generally not support the large-scale infrastructure projects within their community. In a study done in coal-intensive states, such as Indiana or Wyoming, researchers found that most respondents' negative responses to CCS

stemmed from interviewers asking about its implementation within their community, while most of the positive responses came from CCS implementation "somewhere in the U.S" (Krause et al., 2014). This study supports the claims that NIMBY sentiments may block future CCS projects, but opposition is spatially confined. Another consideration is that as most CCS plants are retrofitted, the NIMBY phenomenon still affects plants that were already operating before CCS implementation.

One recent study done in 2019 on residents in Indiana found "participants who chose to use more fossil fuel resources reported wanting to protect jobs and the economy" (Miniard, & Attari, S. Z., 2021). However, this group was in the minority as most participants preferred to see more renewable energy and less coal being implemented (see Figure 2.3), with the main reason of wanting less hazardous effects on the environment (Miniard, & Attari, S. Z., 2021). Considering the potential risks of implementing CCS, public knowledge and acknowledgment of these risks may cause hesitation in supporting it.

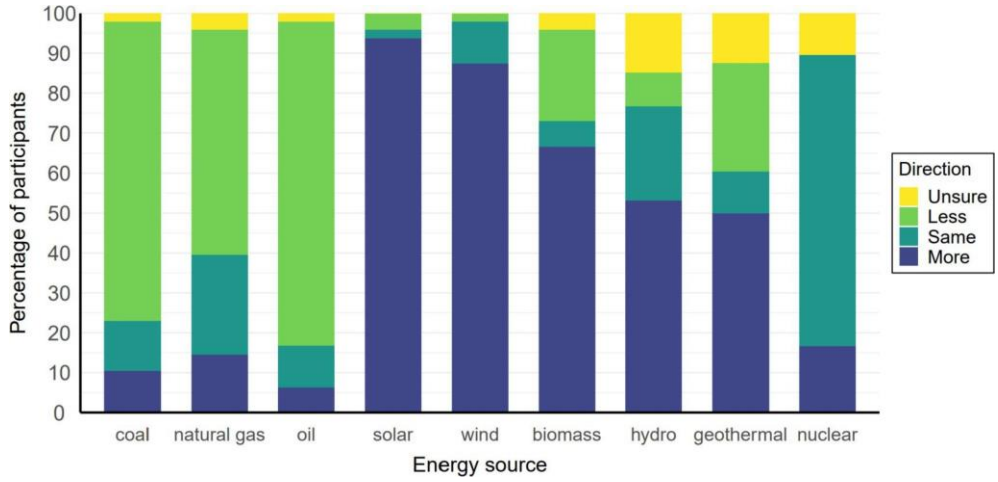


Figure 2.3: Results from the survey showing public opinion on energy preference in Indiana (Miniard & Attari, S. Z., 2021).

Public perception is crucial regarding the development of CCS projects. Companies can use public engagement "to raise public awareness... or foster trust in experts, developers, or

government" (Xenias, & Whitmarsh, L., 2018). With an engaged and aware public, there is reduced opposition towards projects which can benefit the local government and assure that they consider more opinions in a final decision. If the public is aware of CCS technology and how it reduces carbon emissions, there is less likely to be opposition to a project. A crucial step towards public engagement would be identifying the stakeholders affected or involved with the project. This step includes identifying those who live close to the proposed CCS development or voters. Ensuring stakeholders are involved and aware of the development of a CCS project allows for more opinions to be involved in the project and can help with getting public acceptance of another similar project in the future. A more engaged and accepting public means companies will be more inclined to propose and develop CCS projects, and in turn push the technology forwards in the US.

2.4 Stakeholder Analysis

Since its conception in the late industrial revolution, project developers have used stakeholder analysis to design outreach programs for the most instrumental external partners. Studies conducted as early as the 1930s show that management theory and the study of how "stakeholders [that] will be affected by a company's direction can guide the organization in a responsible direction while also mitigating risk" (SustainNet, 2020). Many groups have formed differing definitions for the overarching process of stakeholder analysis. One of the most common interpretations of the stakeholder analysis is derived from a book written by R. Edward Freeman, titled *Strategic Management: A Stakeholder Approach*. Freeman describes "stakeholder theory [as] an idea about how business really works", stating that "for any business to be successful it has to create value for customers, suppliers, employees, communities and financiers, shareholders, banks and other people with the money" (Freeman, 1984). This book elaborates heavily on the business model, using an imaginary business to further develop stakeholder theory. Freeman

argues that businesses that do not find stakeholders who try "to make a business more innovative […] whose employees don't want [to use] a hundred percent of their efforts", or even businesses that don't actively attempt to be "good [citizens] in the community" (Freeman, 1984) are all clear signs of businesses and enterprises that are ignoring the value and power of its external partners. This ignorance will spiral, leading to a business that fails at recognizing "what makes capitalism tick" (Freeman, 1984). Stakeholder theory, and capitalism by nature, runs entirely on the premise that "shareholders and financers, customers, suppliers, employees, [and] communities can together create something that no one of them can create alone" (Freeman, 1984). Thus, there is a heavy emphasis on the stakeholder analysis as a tool to holistically introduce any new product into a capitalist market.

A more commonly accepted definition of Stakeholder Analysis is the "process of identifying [groups of people] before a project begins, grouping them according to their levels of participation, interest, and influence in the project" (ProductPlan, 2021). The primary strategic purposes of conducting a stakeholder analysis like this would be to "enlist the help of key organizational players [, …] gain early alignment among all stakeholders on goals and plans [, …] and to help address conflicts or issues early on" (ProductPlan, 2021). Freeman's discussion on Stakeholder Theory aligns well with these three strategic goals, as the identification of all stakeholders can prove instrumental in the development or support of the project.

This definition also highlights an important aspect necessary to completing any stakeholder analysis: the need to rank stakeholders to determine which ones qualify as key organizational players. Different studies have worked in determining measures to quantify stakeholders based on their value towards a project. One study calls for a "normative theory of stakeholder identification" seeking to explain under what conditions any class of entity can be considered a stakeholder

(Mitchell et. al., 1997). This research explored several definitions generated from 1963 through 1995, all similarly describing stakeholders as any group or body that has a claim in another firm, organization, or business venture. Most stakeholder analysis guides place stakeholder identification as the first step in completing any stakeholder analysis (ProductPlan, 2021, Schienke, n.d., LucidChart, 2021, Martin, 2022, Sinnaps, n.d.). For Climate Change and Natural Disasters, the literature often separates the stakeholders into 4 broad subcategories to help with the prioritization process: State and Local Governments, Partner Agencies, Non-Governmental Organizations, and General Populations (Morphy, 2015). Given the nature of our topic, and its association with mitigating the effects of climate change, these are the groups we will focus on in the development of the stakeholder analysis template later in this project. These groups will be involved with the development of this technology in some capacity, whether through policy making, or research.

Following the identification of any stakeholders for a given project, one must prioritize them to determine which stakeholders quantify as key and which are periphery to the project. This process is often done concurrently with a visualization technique called stakeholder mapping. Different studies explore mapping techniques, generating unique metrics or attributes (used interchangeably in the literature) to plot different groups. Three broad terms are thus defined to properly gauge and identify stakeholders: power, influence, and interest. Power is “the authority stakeholders have over the project [or its] ability to influence the work” (Usmani, 2021, Imperial College London, n.d.). Similarly, Influence is defined as any ability of a stakeholder to “affect project outcomes” (Usmani, 2021). Influence and Power are often interchangeable terms and will be used interchangeably for the purpose of this study. It is worth noting however that the literature does differentiate these attributes at times, with power taking the primary role of quantifying the

stakeholder's authority on project development and influence encompassing the stakeholder's ability to shape project outcome. Some articles also define Influence as the direct impact of one stakeholder on another, in the context of a given project (Morphy, 2008). Interest is defined as "the stakeholders' level of concern about the project or their desire to be involved" (Morphy, 2008).

2.4.1 Power-Interest Grids

Once project developers identify stakeholders, they use mapping techniques to visualize and prioritize the stakeholders to better focus outreach resources on stakeholders that hold the most power, interest, and influence over a project's success. The first mapping technique takes the three common stakeholder metrics and plots them on a 2D grid. The most common form of this 2D mapping technique is the Power-Interest Grid, which plots Power on the vertical axis and Interest on the Horizontal axis (Usmani, 2021, Morphy, 2008).

Figure 2.4: An example of a Power-Interest Grid (Morphy, 2008)

For graphs such as these, there are 4 possible categorizations. Table 2.2 describes these 4 categories and their significance. The quadrant where one places a stakeholder determines the stakeholder's rank.

Table 2.2: Categorization that results from using the Power Interest Grid (Usmani, 2022)

Ranking	Engagement Level	Description
High Power High Interest	Regularly Engage	These Stakeholders have high power and are highly interested in the project. Overlooking this group will have adverse effects on the project. Their high level of interest is an opportunity that must be maximized for the benefit of the project
High Power Low Interest	Actively Consult	These Stakeholders have high power but are not very interested in the project. Low interest indicates poor involvement, but actively consulting this group will be in the project's best interest as a long-term investment.
Low Power High Interest	Maintain Interest	These stakeholders have low power, but due to their high interest, can be considered strong project supporters and can be very helpful in the long run. Their interest should be maintained to continue their support
Low Power Low Interest	Keep Informed	With low power and low interest, these stakeholders are of lower priority, and thus should be kept informed through some measures, but are not a requirement for the success of the project.

Other iterations of this practice include the Power-Influence Grid, used to plot power against influence as a replacement of interest. However, this model is much less popular due to the resemblance between power and influence (Usmani, 2021). Power-Interest-Influence Grid are another variation of the common Power-Interest Grid, where Power and Influence are interpreted as unique metrics and are used to rank the Stakeholders, and then illustrate the complex interactions between the identified stakeholders.

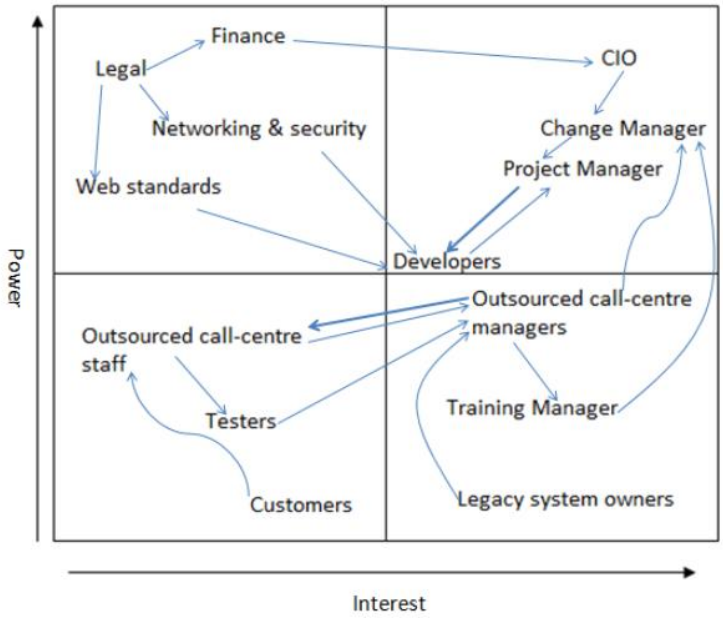


Figure 2.5: An example of the Power-Interest Grid with Influence Markers (Morphy, 2008)

In this variation, the different stakeholders on the Power-Interest Grid are connected by their influence on each other, providing a context where developers can further their understanding to fabricate a meaningful and impactful product. The lines of influence can also "identify stakeholders within a particular quadrant that needs special attention (Morphy, 2008), visualizing corollary organizations that could be directly impactful to keeping key stakeholders satisfied.

The pros of this kind of mapping are that project developers can quickly develop these maps and that they require relatively simple parameters. Power-Interest Grids help "better understand where to focus energy and time" (MBA Knowledge Base, 2019) while allowing the developing team to quickly categorize and identify key stakeholders. However, the scope of importance of any stakeholder – mainly any legitimacy in influencing the project, the urgency to have a project completed, or attitude towards the project's success – can be limited by generalizing these stakes into their power and interest. Regardless, the simplicity and speed at which enterprises

can complete this form of stakeholder mapping make this technique highly accessible to any group seeking to complete a stakeholder analysis. Our research group considered other mapping techniques, such as the Salience model and the Stakeholder cube, but due to the high subjectivity involved in the creation of those products and a large amount of time needed to develop those models, our group abandoned them for the simpler Power-Interest Grid. For a deeper discussion on the Salience Model and the Stakeholder Cube Model, see Appendices N and O.

2.4.2 Stakeholder Engagement

Once the project developers have identified, categorized, and mapped the stakeholders, the developers can then employ engagement techniques for each stakeholder category to maintain key stakeholders and keep more peripheral ones informed. There is not one set definition for Stakeholder Engagement, but a wide range of schools of thought (Morphy, 2015). Stakeholder Engagement is a "process used by an organization to engage relevant stakeholders for a purpose to achieve accepted outcomes" (AccountAbility, 2008) or a "continuous process between a company and those potentially impacted" (International Finance Corporation, 2007). The literature outlines different engagement approaches based on the organization's influence, power, or interest in a given project.

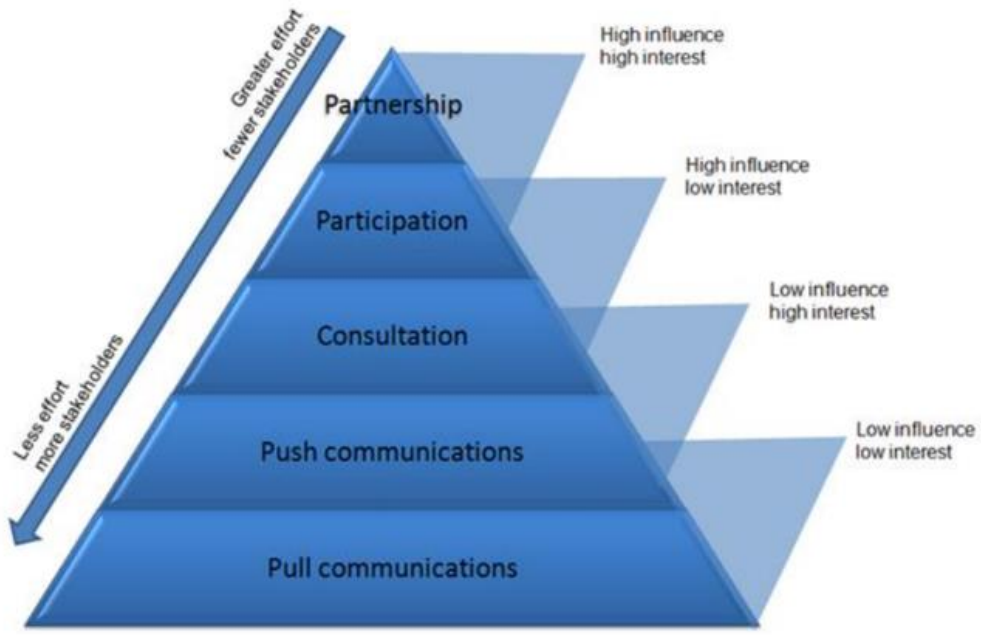


Figure 2.6: Stakeholder Engagement Rankings (Morphy, 2015)

Based on any given stakeholders ranking after prioritizing and visualizing, a project developer will need to determine an engagement approach for each stakeholder, and then determine appropriate communication methods. Table 2.3 outlines these engagement approaches and elaborates on the different engagement approaches shown in Figure 2.6. The approaches are ranked from high to low, with high engagement approaches representing a high amount of collaboration between the developer and the stakeholder, and low engagement approaches indicating that less rigorous communication methods can be employed.

Table 2.3: Engagement Approaches for Different Stakeholder Groups (Morphy, 2015)

Engagement Approach	Description
Partnership	Shared accountability and responsibility. Both the enterprise and their partners will make decisions, take actions, and develop the project together
Participation	Engaged as a part of the team, delivering tasks, and sharing responsibility over a limited area/activity.
Consultation	Involved, but not responsible and not having any influence over the project direction outside of consultation. The organization will ask questions of the consultants, who will provide answers.
Push Communications	One way Engagement; Organization will broadcast information to all stakeholders or particular groups through various channels
Pull Communications	One way Engagement; Organization will make information available through different means, and the stakeholders can choose whether to engage with it.

After determining which groups of stakeholders qualify for the engagement practices outlined above – accounting for a project's available resources – the project developers should employ these different techniques to engage with the different groups. These methods vary from source to source, but a general summary of the different communication methods our group investigated can be found in Appendix P. Using a multi-method communication strategy, a project developer can develop a communication strategy that uses more time-intensive communication techniques for higher approach Stakeholders.

A communications table allows project managers to visualize stakeholders, their assigned ranking, and if there is any overlap in engagement methods (LucidChart, 2021). Communications Tables can include a multitude of different information markers that can highlight key information about the stakeholder, ranging from their engagement level based on stakeholder mapping

placement to their attitude towards the project (Morphy, 2015, OGC, 2008). Commonly, Communications Tables include the frequency at which the developer should engage with the stakeholders, the communications methods that will be most effective, and any key contacts that developers can use to deliver the requested information (LucidChart, 2021, Imperial College London, n.d.). Table 2.4 shows an example of a Communications Table highlighting the purpose of these columns in identifying important aspects of the different stakeholders. There is an emphasis on flexibility in the development of a communications table, as many programs experience scope creep and evolving project objectives (LucidChart, 2021). The Communications table should reflect this change so that it can continue to act as a guide for developing projects and outreach programs within burgeoning organizations.

Table 2.4: Sample Communications Table (Lee, 2008)

Type of Communication	Purpose of Communication	Owner	Audience	Frequency	Documentation
Project Status Meeting	Update Work Plan, Issue Resolution, Project Status	Project Manager	Project Team	Weekly	Meeting Minutes
Issues Log	Issue Monitoring	Project Manager and Project Team	Project Team	Ongoing	Issues Log Database
Ongoing Project Status	Show project schedule/status as a whole	Project Manager or Team Lead	Project Team	As needed	Report
Formal Project Status	Show project status as a whole	Project Manager/ Team Lead	Stakeholders, Sponsors, Steering Committee	Every 3 weeks or as determined in Communications Plan	Report
Stakeholders, Sponsor(s) Project Status Meeting	Establish if project is on track and is meeting expectations	Project Manager	Stakeholders. Project Sponsor(s), Project Team	Every 4 weeks or as determined in Communications Plan	Report for Stakeholders / Sponsors
Lessons Learned	Evaluate the project	Project Manager or Mediator	Project Team	At the end of each project phase, or at the half-way point of the project and at the end of the project	Lessons Learned database

3.0 Methods

The goal of this project was to provide TIER with a series of recommendations on the US carbon offset market, and a stakeholder analysis template to assist them in developing a Carbon Offset for Carbon Capture Storage in Taiwan. Our team identified two objectives to achieve this goal:

1. Investigate US stakeholders' involvement with CCS and their opinions on the Carbon Offset market.
2. Analyze US stakeholders' power and interest in the development of a Carbon Offset for CCS.

Our team completed these objectives by doing archival research into CCS implementation and understanding the current US carbon offset market. We researched stakeholders in coal-intensive states including Wyoming, Indiana, Texas, and California, which were all states of interest to our sponsor. We then attempted to conduct interviews and surveys within these states to get a more accurate picture of stakeholders' beliefs and values. Using the information gathered from interviews and surveys, we made an excel sheet to generate a power-interest grid and communication table, both of which are components of a stakeholder analysis.

3.1 Archival Research

Understanding how CCS works allowed us to build stronger arguments when writing the literature review and assisted in communicating the strengths and weaknesses of CCS in reducing aggregate carbon emissions. Additionally, knowing the drawbacks of CCS helped us to acknowledge these limitations, understand the stance of groups that oppose this technology, and gain insight into public perspectives that assisted with building criteria for our stakeholder analysis. The research also provided the information necessary to construct both our interview and

survey questions to ensure they were well-informed. The project's focus was on a US stakeholder analysis, so our research centered around the US market.

We conducted our archival research by looking through sources available through the library, online databases, and documents received from TIER. TIER provided us with articles on topics relating to our project such as background on CCS implementation in Taiwan. We used online databases such as JStor, Oxford Academic, and Science Direct to locate sources, all of which were available at the Worcester Polytechnic Institute Gordon Library. Searches that included "Carbon Capture Storage" and "Carbon Offsets" were useful throughout our research. To prevent selection bias, we used different types of credible resources, including multiple peer-reviewed sources and scientific articles, to triangulate information.

An advantage of this method is that it is cost-effective as articles and resources are available online through the databases. In addition, archival research, "can be virtually unobtrusive" (Lune and Berg, 2017, Chapter 11). When performing research, all the information is found free on the internet, and there is no need to interview or have people complete surveys. Despite the ease of this type of research, the weakness of archival research is that it is, "limited to examining already recorded messages. The unobtrusive nature of work is that we rely on existing content rather than generating our own" (Lune and Berg, 2017, Chapter 11). When a group is actively researching, preexisting records can be limited, therefore finding new, unknown information is not possible. New information is found by combining content archival research with interviews, providing more empirical depth and rigor, and allowing the project to grow and evolve.

3.2 Stakeholders' Opinions on Carbon Offset Usage

Our team contacted stakeholders through interviews and surveys to understand opinions on carbon offset usage. This mixed-method approach allowed us to make the most of our limited

time and encourage responses from stakeholders, while also receiving information about CCS and carbon offsets. We decided to interview respondents that had extensive knowledge of the CCS industry and the carbon offset market to help supplement our research and compile recommendations on the carbon offset market. Surveys were sent to stakeholders without direct relation to offsets and CCS to help develop our stakeholder analysis. The stakeholders we chose to survey or interview were found by doing research into CCS and carbon offsets. Our team then determined the best companies or organizations to contact in each of our stakeholder groups, and whether they should be interviewed or surveyed based on their involvement with CCS. To contact companies and organizations for interviews, we used the contact page on their website to reach out to a representative. For some companies, we found a specific person's email who worked in a department that related to CCS or Carbon Offsets to contact. If we received no response, we made a follow-up phone call.

3.2.1 Interviews

Conducting interviews with U.S. stakeholders gave us a more in-depth understanding of CCS, the carbon offset market, and its usage, as well as gauging stakeholder interest and influence on CCS projects. As detailed in our literature review, we grouped stakeholders into four broad groups to ensure we covered a wide variety of stakeholders. The four groups we identified were internal partners with state/local government, potential partner agencies, non-governmental organizations (NGOs), and general populations. These four groups represent companies, non-governmental organizations, and governmental groups that would contribute or be affected by the development of a carbon offset for CCS. Potential partner agencies include groups and organizations that work with governmental services but are independent. Examples of potential partner agencies included emergency management, universities, or advocacy groups. Initially, our

group identified around 40 subcategories under these groups which we condensed in consultation with our sponsor. Due to time constraints, it was not feasible for us to contact a stakeholder in every subcategory, so we also removed those subcategories from our list that we believed would be more difficult to contact.

The questions we asked detailed the interviewee's involvement with CCS technology, and their opinions on the carbon offset market. Questions varied depending on where the interviewee's expertise lay (all interview questions are included in Appendix E-M), but the stakeholder analysis questions for each interview remained the same. We asked all interviewees to describe how the development of carbon capture storage influences their group's finances, environmental goals, ability to perform business as usual, ability to influence policy, and public reputation. We asked them to rate how much influence their group would have on the development of carbon offsets with CCS on a scale of 1-10 (1 meaning no influence and 10 meaning very high influence). Our group used these responses to determine a numerical representation of stakeholder influence, which was inputted into our spreadsheet to produce a power-interest grid and communication table.

We conducted interviews virtually during the stakeholder's corresponding work hours. With our team being remote and based in Hawaii, we had to consider time differences when scheduling interviews with US stakeholders. At the beginning of the interview, we informed the interviewee that their responses were confidential and that we could use pseudonyms to protect their names in the research report. One team member took notes during each interview that we could use for future reference. Microsoft Teams offers recording features during meetings, so if the interviewee gave permission, we recorded the interview. We used these recordings to supplement our notes in case we missed information and kept them in protected files on our laptops until the project concluded. As shown in Table 3.1, our team contacted 56 organizations/companies

for interviews but only nine responded. A majority of these interviewees were either largely involved in the national carbon market or based in one of the four states of interest. Our research group recognized that general population representatives would not have any substantial information to offer about either the carbon offset market or carbon capture storage but will still be influential in the success of a carbon offset for carbon capture storage. With this rationale, our group chose to exclude general population representatives from interviews, but still chose to send them the survey to collect data on their power and interest in the concept.

Table 3.1: Table of Companies contacted for Interviews and their Stakeholder Groups

	NGOs	Partner Agencies	Internal Partners	General Population	Total
No. groups contacted	8	31	7	0	56
No. groups interviewed	4	5	0	0	9

The main benefit of doing interviews is that people tend to be honest when face-to-face, meaning that you are likely to not get any misleading information (Lune & Berg, 2017, Chapter 4). However, despite the inherent honesty that comes with this interview format, they may not share everything they know (Lune & Berg, 2017, Chapter 4). Sharing some information may go against a stakeholder's best interest, so we were careful about self-reported data because we did not know if we would get the full picture or part of the story.

3.2.2 Surveys

We designed the survey in Qualtrics to help generate a set of criteria that we could use to develop metrics to gauge different stakeholders based on their interest in CCS and the power of influence they have on CCS projects. Our group sent the surveys out using an email link to the

select stakeholders within our states of interest. We developed our list of stakeholders by locating groups that fell into each of the stakeholder groups online and filtering those that were in the 4 states identified above, obtaining their contact information through their respective websites. We started sending surveys out in the second week of our project and continued through the fourth week. These surveys were sent to stakeholder groups that were not directly involved with CCS, or those that did not/were unable to participate in our interviews. Stakeholder groups without direct involvement in CCS were non-environmentally associated NGOs such as public health advocacy groups and general population representatives/advocates, for example, community centers. Our research group determined that we cannot assume each stakeholder groups would have the necessary knowledge about CCS to make any informed decisions. This information led our group to use a short survey as the best way to brief these groups on the subject while still receiving the information we needed. Sending surveys allowed us the potential to collect more responses within our limited time and encouraged busy respondents to respond.

Our survey had an informed consent question at the beginning including a description of our project and project objectives. This section of the survey gave respondents a more descriptive overview of our project and informed them of what steps our group would take to protect their identity if needed. The only identifying question on the survey was the name of the organization or company to help us keep track of which stakeholders responded to our survey, but this was made optional in case they preferred to stay anonymous. At the beginning of the survey, we asked groups/companies to categorize themselves into one of our four stakeholder groups to ensure we correctly identified them. The next set of questions asked the respondents to rank the influence a carbon offset for CCS would have on five different fields: finances, ability to work with larger legislation groups, ability to perform business as usual, ability to meet environmental goals, and

reputation with the public. Respondents would rank influence as 1-10, with 1 being no influence and 10 being high influence (survey questions are shown in Appendix B). With each ranking question, we asked them to elaborate upon their answers allowing us to better understand their involvement in offsets and the reasons for their ranking, but this question was kept optional in case they did not want to give additional information.

Table 3.2 Table of Companies contacted for Surveys and their Stakeholder Groups

	NGOs	Partner Agencies	Internal Partners	General Population	Total
No. groups contacted	54	14	4	26	98
No. groups surveyed	5	2	1	0	8

Surveys generally "encourage more respondents to respond" (Lune & Berg, 2017, p. 61) because there is a shorter time commitment than with interviews. If a respondent chooses to remain anonymous (which they can in our survey), they may also feel freer to respond to specific questions that they would otherwise feel uncomfortable skipping during an interview. However, there is no guarantee that the respondent understood the question or read it carefully before answering. A respondent could have taken their time to think through each question or rush through the survey without much thought, which affects the quality of our responses. The best we could do was to ensure our questions were clear and concise to increase the likelihood of accurate responses.

4.0 Discussion of Results

Through our research, the team learned about US stakeholder involvement with the development of CCS and the current issues it is facing. Partner agencies and Non-Governmental Organizations gave us their opinions on the pros and cons of the US carbon offset market along with the status of selling offsets from CCS projects. Using the information from the interviews and surveys, we conducted a pseudo-stakeholder analysis (more information in chapter 6) by filling out our template to generate the power-interest grid and communications table.

4.1 Interview Results

Our team interviewed nine people, four of whose organizations are NGOs and five of whose organizations are partner agencies. In addition, only two of the nine stakeholders we interviewed were in our states of focus (Wyoming and California) due to limited responses. The other seven interviews were of companies or organizations located in other states, but our group believed these individuals were experts in their respective fields of either CCS or carbon offsets and still useful to interview. Of the nine total interviews conducted, only three were with stakeholders knowledgeable of CCS. These three interviews helped us understand the improvements CCS technology has made, which would affect the carbon offset market for this technology. The interviews confirmed our initial research that in general, CCS implementation is still not widespread in the US. Some states like Texas and Wyoming have significantly more CCS implantation than other states (for example Massachusetts) with less carbon emissions. Carbon companies typically retrofit the CCS plants currently in operation on existing facilities like cement plants or natural gas separation projects. All CCS projects still face a certain amount of NIMBYism or public backlash despite plants being retrofitted.

Our interviews provided us with better insight into the issue of public perception of CCS, and the process CCS projects must go through for carbon companies to implement them. To have approval for the construction of an energy project, developers need to have a social license which signifies an agreement with the local community. In an interview with Professor Kipp Coddington of Wyoming's School of Natural Resources, he said, "We've done statewide surveys [in Wyoming], we have found the public is quite receptive to these types of projects." Despite this, "Any carbon capture and storage project is going to face the same hurdles that any other large infrastructure project is going to face." Regardless of public perception of CCS, "it is one of the only technologies to enjoy bipartisan support" (K. Coddington, interview, 30 March 2022). Bipartisan governmental support is also evident in the development of the nationwide 45Q tax credit, which states a company is eligible for up to $50 tax credit per ton of CO2 captured if the plant operators follow correct procedures. The 45Q tax credit has been responsible for a lot of the recent investment and interest in CCS technology and continues to be one of the main driving forces for the advancement of CCS technology. The importance of the 45Q tax credit was also reiterated in another interview with an NGO.

One of the main issues with CCS currently is storing carbon. In our interview with Professor Celia of Princeton's Carbon Management Institute, he cites, "The usual issues that come up [with storage] are leakage… and the second is the issue of the possibility of induced seismicity." (M. Celia, interview, 21 March 2022). Storing carbon underground is not permanent, so there is no guarantee that the carbon will stay there for the intended period. In addition, when storing large amounts of carbon underground, you can pressurize the wrong parts of the subsurface, resulting in small earthquakes. To store carbon, the site must have the right geological characteristics and enough land. One of the most promising storage options is injection of captured CO2 into deep

saline aquifers. Saline aquifers have large storage capacity and usually have fewer legacy wells drilled into them, unlike oil and gas reservoirs. Those older wells could act as leakage pathways for CO2. for carbon and are untouched by drilling activity, unlike oil and gas reservoirs (M. Celia, interview, 21 March, 2022). Another issue echoed from our initial research is that CCS technology is still in the early phases, as Professor Allen of Hawaii Pacific University told us, "[CCS is] very much in the developmental stage" (S. Allen, interview, 24 March, 2022). With few plants in the operating stage (not development), it will take continued investment and time for CCS to become more widespread and more efficient.

4.1.1 The Current Carbon Offset Market and Possible Improvements

To properly provide recommendations to our sponsor, we utilized interviews with people in the field to gain expert insight into the current state of the offset market within the US, as well as ways it could be improved. We interviewed nine stakeholders in total, seven of whom knew the carbon offsets market. Presently, there are two different types of markets for carbon offsets: voluntary and compliance. The voluntary market allows companies or entities to invest in carbon offsets at their own volition, whereas the compliance market may be required and would be regulated (NGO representative, interview, 6 April 2022). This information is consistent with what our group found within our literature review. Overall, both markets function effectively, but they each have their faults. For example, the voluntary market lacks transparency with information such as pricing, and the compliance market has issues with the handing out of allowances of emissions (K. Coddington, interview, 30 March 2022).

Environmental organizations sell offsets verified by third-party organizations to companies and individuals aiming to reduce their carbon emissions. There are four main verification standards: Verra's Verified Carbon Standard (VCS), American Carbon Registry, Gold Standard,

and California Action Reserve (K. Coddington, interview, 30 March 2022). Each of these groups is either strictly or mainly involved with the voluntary market, as the compliance market has more governmental regulations and its system (NGO representative, interview, 4 April 2022). They also have different methodologies for verifying projects. For example, VCS would have their own developed, detailed procedures for crediting offsets as compared to the Gold Standard. The international carbon market is similar, with differing regulations and mechanisms between countries. While COP26's Article 6 lays out a plan for standardization of the carbon market, this goal is unlikely or far in the future because of differences in laws and regulations (K. Coddington, interview, 30 March 2022).

Each of the stakeholders interviewed was asked about the pros and cons that they saw in the US carbon offset market, however, only 6 of our 9 interviewees were able to provide an answer. One pro is that technological-based carbon offsets can be more reliable than nature-based offsets, since it is easier to accurately measure the amount of carbon being stored (M. Jaruzel, interview, 28 March 2022). Additionally, the market is still evolving and is vital for reaching global climate goals (M. Densmore, interview, 21 March 2022). A final pro is that offsets have led to an increase in demand for projects, such as CCS, which are needed to combat GHG emissions (Environmental organization representative, interview, 24 March 2022). This increase in demand for carbon removal projects will accelerate the implementation of these projects, bringing countries closer to their climate goals. One con of the carbon offset market is the potential for fraud existing when third-party verifiers are not doing their jobs properly (S. Allen, interview, 24 March 2022). Ongoing fraud issues could potentially result in project prices increasing which would be bad for the market as it could become inaccessible to some stakeholders. Other cons include relying too heavily on offsets, where companies will purchase offsets and continue with business as usual

rather than reducing emissions in parallel with deploying offsets on the difficult to decarbonize emissions (M. Densmore, interview, 21 March 2022). A final con mentioned by several interviewees was the high prices of CCS projects for carbon offsets. These high prices deter companies and organizations from investing in offsets from CCS projects, but prices might lower if there is more supply of CCS projects (Environmental organization representative, interview, 7 April 2022).

As part of our recommendation to TIER, we asked stakeholders we interviewed to provide possible improvements to the US carbon offset market. One common suggestion that they mentioned was improving the transparency within the voluntary carbon offset market. Currently, there must be transparency around where and how voluntary credits are generated (M. Densmore, interview, 21 March 2022). In the current offsets market, there can be uncertainty about where "credits are really coming from…because it is not regulated" (M. Densmore, interview, 21 March 2022). This unclear information is centered around the types of projects offsets are provided from (like CCS or forestry), and under which methodology those offsets were verified. Increased transparency about the projects where offsets are purchased from can clear up this uncertainty and interest more companies in investing in carbon offsets. Another improvement related to this transparency in the carbon offset market is clarity with pricing information (K. Coddington, interview, 30 March 2022). Stakeholders should also put more effort into educating customers on the enormous impact that large and multinational companies have on global emissions. This would lead to more informed consumers, and potentially help incentivize more investment in carbon offsets (Environmental organization representative, interview, 7 April 2022).

The carbon offset market also suffers from issues with accountability. As stated earlier, a con mentioned by one of our interviewees mentioned the potential for fraud in carbon offsets.

Offset verifiers are responsible for ensuring offset projects perform as predicted and are accurately reported, and when not done correctly, offsets may be double counted (Patch 2021). Double counting occurs when two parties attempt to register the same offset/emission reduction. To improve these issues, verifiers should ensure that all projects are accurately documented when monitoring their development, preventing organizations from being fraudulent and dishonest when reporting their offsets and emissions. This issue of double counting can also be prevented through Corresponding Adjustments, which deducts the organization's offsets from that of the host country (Compensate, 2021).

4.2 Survey Results

In total, we received eight survey responses, representing a response rate of approximately 8.18%, as we reached out to ninety-eight potential respondents overall. While this number is too low to establish the conclusions necessary to perform an encapsulating stakeholder analysis, we used the information collected from those that responded as the building blocks of a general template for our sponsor to use in their future stakeholder analysis.

Of the respondents, 62.5% classified themselves as NGOs, 25% as Partner Agencies, 12.5% as Internal Partners with State or Local Government Organizations, and 0% as General Populations. Our main question inquired about the effects of the development of a carbon offset for CCS on five different factors: finances, ability to work with larger legislation groups, ability to perform business as usual, ability to meet environmental goals, and reputation with the public. Of the respondents, only 6 answered this question. For finances, 50% said it would have minimal influence, 17% said a large amount of influence, and 33% said they were unsure. 34% of respondents said it would have little to no influence on their ability to work with legislative groups, 17% said it would have moderate influence, and 50% said they were unsure. 50% said it would

have minimal influence on their ability to perform business as usual and 50% said they were unsure. For environmental goals, 50% said the development would have little influence, 34% said it would have substantive influence, and 33% said they were unsure. Finally, 34% of respondents felt it would have minimal impact on their reputations, 17% said it would have moderate impact, 17% said it would have a large amount, and 33% said they were unsure.

Several respondents said they were unsure about the influence on each category, which was anticipated due to the subjectivity of the question. Again, only 6 respondents answered the question about their power in the development of a carbon offset for CCS. On a scale of 0 to 10 -- with 10 representing a large amount of power and 0 being none – survey respondents were asked, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage? With influence and power being interpreted as synonymous, 4 respondents said they had no power, 1 rated their power as average (ranking of 5 out of 10), and 1 rated their power as considerable (ranking of 8 out of 10). Of the groups that completed the question and identified themselves as NGOs, two said they had no power, and one rated their power 8 out of 10. One of the groups that identified as a Partner Agency rated their power a 5 out of 10, while the other said they had little to no power. Finally, the group that identified as an Internal Partner with State or Local Government Organizations said they had no power.

5.0 Designing a Stakeholder Analysis Template

Our group used the data collected from interviews and surveys to inform the design of our template. The template produces a power-interest grid and communication table, which will serve as a valuable template for future analysis of carbon offsets for CCS. Our goal with these deliverables was to provide our sponsor with the appropriate tools needed to further develop a carbon offset for CCS technology and identify specific groups that they should consider when developing projects.

5.1 Stakeholder Group Weighting

The Stakeholder Analysis Template weighs different categories based on their relevance. In a research paper written by the National Bureau of Economic Research, the authors elaborate on how weighting can help "achieve more precise estimates for correcting heteroskedasticity [a condition in which the error term in a regression model varies widely], achieve consistent estimates by correcting […] endogenous sampling, and […] identify average partial effects in the presence of heterogeneous effects" (Haider, Solon, Wooldridge, 2013). Our group designed a template using concepts of weighting to minimize heteroskedastic skews that would have occurred if groups remained unweighted. Keeping the stakeholder groups unweighted would result in a distribution that would not properly capture their importance to the development of a carbon offset for CCS. Asking a stakeholder group to different stakeholder groups, our team determined that this weighting system should be togglable. We calculated the weights by creating a percentile based on the number of stakeholder groups identified. The custom algorithm shown below is the variable table and algorithm used in explaining the rationale for having a math-based stakeholder group count vs a reality-based count.

Table 5.1: Table of Variables used when Designing Stakeholder Group Weighting

Variable table	
Stakeholder Ranking	**n**
# Of Stakeholder Groups	**x**
# Weighting Percent	**y**

Rank-to-Percentile Algorithm:

$$y = \frac{x-(n-1)}{x} * 100\% \qquad [1]$$

The formula written above allows individuals to input two variables: the total number of groups being considered, x, and the rank desired, n. The formula will create a percentile value based on the ranking provided, which can either be left as a decimal or converted into a percentage by multiplying the value by 100%, as shown above. Because the total number of stakeholders is always considered in the division, the algorithm will always evenly space the stakeholders along a 0-100 number line. The results from using this formula for 4 stakeholder groups is shown below.

Table 5.2: Reality-Based Model vs Mathematically Representative Model Results

Rank [n]	Weighting Percentage [y]
1st Rank	100%
2nd Rank	75%
3rd Rank	50%
4th Rank	25%

This algorithm works all ranking-to-weighting percentage calculations for the project. We designed the tool to accept up to 25 different stakeholders into each of its 4 groups as well, providing as much flexibility as possible on its interface. However, the power-interest grid itself is typically based on two separate, but dependent criteria: the interest and power metric. Our group identified that each stakeholder sourced would not only be at different levels of interest but also

have different abilities to influence this project based on their support or involvement. To achieve a metric that actualized this knowledge, our group introduced two additional weighting metrics.

5.2 Interest Metric

The interest metric weighs the different stakeholders based on their interests in the development of a carbon offset for CCS. A stakeholder's interest can be determined by their response to either verbal interview questions or virtual survey responses. Each stakeholder was asked if the development of Carbon Capture Storage technology impacts their organization in a multitude of ways. The responses sort the stakeholders into five broader interest groups: Financially Interested Partners, Environmentally Interested Partners, Non-Critically Interested Partners, Legislatively Interested Partners, and Reputationally Interested Partners. To properly weigh the interest metric, our group applied the rank-to-percentile algorithm to generate weighting percentiles for the 5 interest groups:

Table 5.3: Table of Interest Group Ranking and their Respective Ranking Percentile

Interest Group Ranking	**Weighting Number**
1st Rank	100%
2nd Rank	80%
3rd Rank	60%
4th Rank	40%
5th Rank	20%

Using this weighted number system, our group implemented a check-grid where each stakeholder could be counted up to 5 times based on the different Interest Groups:

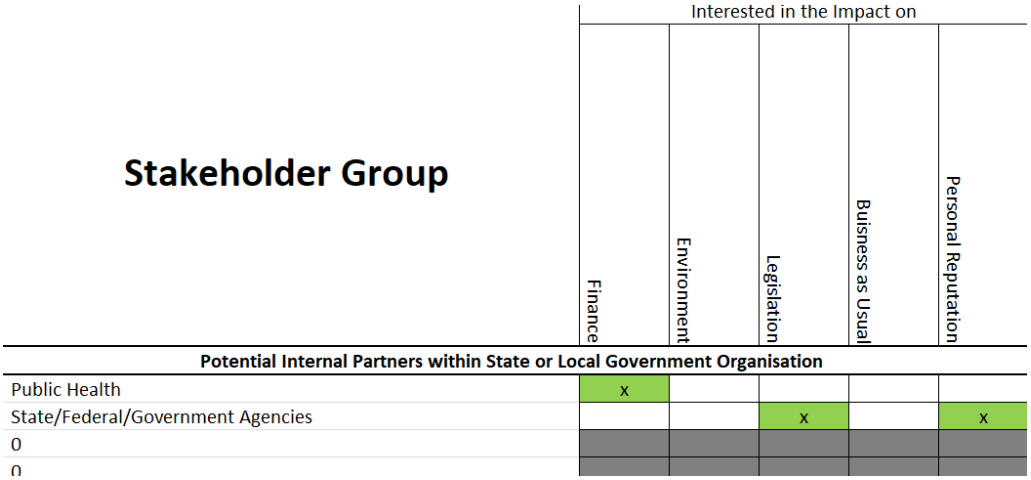


Figure 5.1: Stakeholder Interest Groups

This information was then processed in the following algorithm. Again, the variable table and equations that follow represent the interest metric calculations. The process elaborated below demonstrates the steps taken to normalize each of the considered factors: the Stakeholder Group weighting, the number of times a stakeholder is listed as interested, and the weights of each category.

Table 5.4: Table of Variables used when Designing Interest Group Weighting

Variable table	
Stakeholder Ranking	**N**
# of X's on Chart	**X**
Interest Count	**A**
Financially Interest Weight	**F**
Environmentally Interested Weight	**E**
Legislatively Interest Weight	**L**
Non-Critically Interested Weight	**nc**
Reputationally Interested Weight	**R**
Interest Category Average	**B**
Interest Metric	**I.M.**
# Weighting Percent	**Y**

$$n = Stakeholder\ Weight\ calculated\ earlier \qquad [10]$$

This value is taken from the original calculation completed by comparing the reality-based model vs the mathematically representative model.

$$a = \frac{x}{5} \qquad [11]$$

This value is a representation of the number of times any given sub-stakeholder group was listed to be interested in the development of our product.

IF [f is checked with an x] is TRUE
    f will equal the weighted f value based on interest group ranking
ELSE
    f will equal 0

IF [e is checked with an x] is TRUE
    e will equal the weighted e value based on interest group ranking
ELSE
    e = 0

IF [l is checked with an x] is TRUE
    l will equal the weighted l value based on interest group ranking
ELSE
    l will equal 0

IF [nc is checked with an x] is TRUE
    nc will equal the weighted nc value based on interest group ranking
ELSE
    nc will equal 0

IF [r is checked with an x] is TRUE
    r will equal the weighted r value based on interest group ranking
ELSE
    r will equal 0

$$b = \frac{f+e+l+nc+r}{5} \quad [12]$$

This value had to be determined using a true/false decision table based on the check-table. If an x was found in the box corresponding to any of the interest subcategories, that value would then be carried over and used in an overall average. If there was no X, the tool automatically assigned a value of 0 to the variable, and the average was still carried over. The average is then stored in the variable, b.

$$I.M = \frac{n+a+b}{3} \quad [13]$$

Once each weight was calculated, the interest metric could be calculated, by averaging each of the weighted factors.

5.3 Power Metric

The power metric was based on our group's gauge of each stakeholder's ability to influence the project. Our groups decided to use the interviews and surveys that we conducted to help determine influence, by asking each respondent how they believe their company would place on a scale of 1-10 where a "1" would mean their company had little to no power/influence and 10 meaning that their company had a high level of influence on a CCS project's development. These answers were then directly translated onto a scale of 0-100 and converted to a decimal. The following table and equations outline this process, which culminates in the power metric.

Table 5.5: Table of Variables used when designing Power Group Weighting

Variable Table	
Stakeholder Ranking	**n**
Assigned Power Number	**p**
Power Value	**pv**
Power Metric	**P.M.**

$$pv = \frac{p}{100} \qquad [14]$$

The power number that is inputted is divided by 100 to generate a decimal value that can be appropriately averaged with the stakeholder group weight

$$P.M. = \frac{pv * n}{2} \qquad [15]$$

Once the power value was calculated, the power metric could be calculated, by averaging each of the weighted factors.

5.4 Power-Interest Grid and Communications Table

By performing these calculations on the Interest and Power metrics, the template can standardize values for each metric between 0 and 1, allowing groups to be appropriately placed on the Power-Interest Grid without introducing heteroskedastic trends. Our group used the Power and Interest metrics as coordinates, with the interest metric acting as the x-coordinate and the power metric acting as the y-coordinate. The template then took the resulting coordinate system produced by the two weighting numbers from the interest and power metrics and overlayed them on top of a power-interest grid.

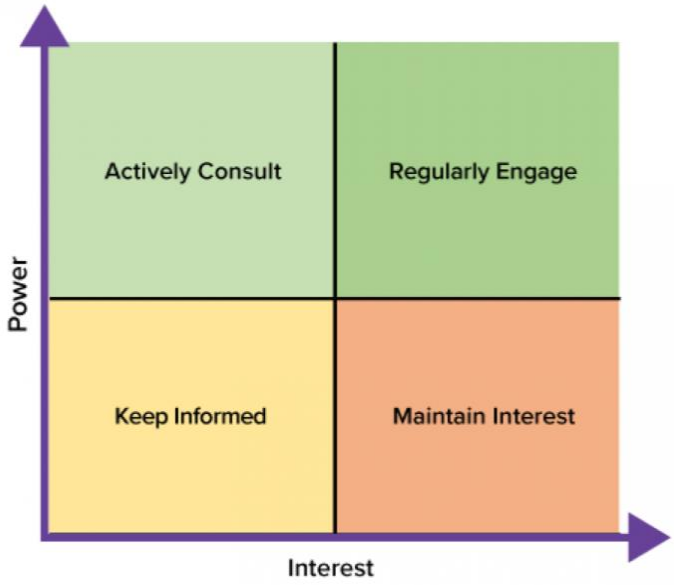


Figure 5.2: An Example of a Power-Interest Grid (Murphy, 2008)

After being categorized and ranked, the template would need to generate recommendations based on their engagement levels, in the form of a communications table. Because each x and y coordinate value falls between the values of 0 and 1, the template could employ a simple logic check to see whether the given values were calculated to be above 0.5. The logic used is shown in the pseudocode below:

Interest Check Helper Function

```
IF [I.M.] is greater than 0.5
        return TRUE
ELSE
        return FALSE
```

Power Check Helper Function

```
IF [P.M] is greater than 0.5
        return TRUE
```

ELSE

return FALSE

P-I Grid Placement Function

IF [Interest Check Function and Power Check Function] are TRUE

return Regularly Engage

ELSEIF [Power Check Function] is TRUE

return Actively Consult

ELSEIF [Interest Check Function] is TRUE

return Maintain Interest

ELSE

return Keep Informed

When the numbers for both the power and interest metric are generated, each value is checked to see if it is greater than 0.5. This Boolean check is stored for both metrics and is then compared. If both values return true, then the sub-stakeholder belongs in the "Regularly Engage" Category. Returning true for the Power Metric will return "Actively Consult", true for the Interest Metric will return "Maintain Interest" and False for both check functions will return "Keep Informed". This logic is applied to each sub-stakeholder on the analytics tool.

The different rankings of each stakeholder on the power-interest grid created the communications table. The stakeholder communications table outlines whom to prioritize outreach toward during the development of any product, the methods to use to access each engagement group, and the frequency of contact for each group. Our group compiled these communication types by researching different sample stakeholder analyses -- as outlined in the literature review -- and borrowing general communication trends between the samples.

Communications Objectives – Objective A, Objective B, Objective C, Objective D							
Overriding Key Messages – Message A, Message B, Message C, Message D							
	Expectations/ Issues	*Priority*	*Specific Key Messages*	*Communication Tactics*	*Who*	*Budget*	*Measurement*
Stakeholder Group A		1				$	
Stakeholder Group B		1				$	
Stakeholder Group C		1				$	
Stakeholder Group D		2				$	
Stakeholder Group E		2				$	
Stakeholder Group F		3				$	
Stakeholder Group G		3				$	
Quarterly Calendar							

Figure 5.3: An Example of a Communications Table (SPARC, 2008)

Stakeholder analysis has many strengths as a dedicated project development tool. When processing information on the influence of a project in broader markets, having pre-generated stakeholder maps not only helps categorize the different stakeholders based on their influence and interest but also helps the developers of any enterprise remain focused based on the resources available for the project (Blomquist, 2020). Having completed the design of the stakeholder analysis template, our group continued to use our template with the interview groups and survey responses.

6.0 Stakeholder Template Application

To ensure that our template was both accurate and precise in its results, the interviews and survey responses were taken and used to conduct a pseudo-stakeholder analysis. Any stakeholder interviewed was asked to respond to the questions asked in the survey, standardizing the results used to fill in the stakeholder analysis template. These questions were used to gauge the stakeholder's interest as described in section. These standardizations were then used to complete a broader stakeholder analysis, that ranked different subcategories of stakeholders on the Power Interest Grid, as a recommendation for TIER's outreach programs.

6.1 NGO/Partner Analysis and Generalized Stakeholder Analysis

Our group compiled the interview questions in Appendices E-M. General trends for interest and power metrics were taken from the interview and survey responses and compiled in the tables shown below. Due to low response rates from state groups and those representing the public (there was only one survey response from a State/Local Government), our group omitted generalizations for those groups from the tables. In the table below, the group summarized the interview results by holistically analyzing the answers each interviewee and survey responder provided. After compiling each answer, the 5 subcategories for interest were ranked from highest priority to lowest. The first number in each box lists the ranking used for the analysis. The template accepts these ranks -- as discussed in chapter 5 on the design of the template – to convert them into percentiles for weighting.

Table 6.1: Interest Metric Results

Stakeholder Groups	Interest Subgroups				
	Financial	Environmental	Legislative	Standard Business Practices	Reputation
Partners	2 Moderate Importance Some sellers see no impact, but a majority do	1 Large Importance All interviewees saw some impact as a result of CCS Development	4 Little Importance Most saw their ability to work with the US Legal sector as being unimpacted, unless in extenuating circumstances	5 No significant Importance Most of the carbon credit sellers noted that they would still be able to sell. Their scope would change, but nothing much else	3 Neutral Importance Public Perception is something that could be impacted
NGOS	5 No Significant Important Most Universities and other NGOs are not concerned about their finances, as they are non-profit in nature	2 Moderate Importance NGOs that work directly with environmental groups and assist their environmental goals saw impacts, but those working on their own goals saw minor impacts	3 Neutral Importance Interviewees showed a neutral reaction to their ability to interact with legal bodies. On one hand, research groups get their funding from governments, but on the other hand, being funded by the government means that they have already developed strong relationships with those they would be trying to impress	4 Little Importance The research groups will always need to continue with their research, and the non-profits will continue to support what they are designed to support. The development of an actual product to back will be positive in nature, but will not affect any NGO's ability to perform business as usual	1 Large Importance With no monetary gain, these NGOs having a strong reputation amongst their peers and in the public eye is of significant interest. The development of a product like a Carbon Offset Market for CCS or CCS technology, in general, would help greatly with these goals

The questions our group generated asking each stakeholder about their influence (synonymous with power for the purposes of this study, see section 2.4) were then compiled into Table 6.2. Since each interviewee and survey respondent were asked to respond to our question on a scale of 1-10, the answers for each subcategory were averaged, producing a ranking number that could then be used as an input into the template.

Table 6.2: Power Metric Results

Stakeholder Groups	Power/Influence
Partners	Average Rank: 7.6 Interviewees saw themselves as a strong contender in being able to assist this development, as they could be marketing these credits specifically to increase their exposure
NGOs	Average Rank: 6 Interviewees had varying opinions on the matter. Some non-profit groups identified themselves as being unable to significantly influence the project in any meaningful way. Other NGO groups like Environmental Research groups and Universities were confident that if they were to invest their resources in research verifying the legitimacy of the technology, then that would have staggering impacts on the project's progress and support

We would use these results later in the broader stakeholder analysis. Depicted below are the results taken from the interviews and survey responses. At the request of the stakeholders to maintain confidentiality, some names have been redacted.

Potential Internal Partners within State or Local Government Organisation	Potential Partner Agencies	Potential NGOs
City of Battle Ground	Microsoft	Powder River Basin Resource Council
	Sustainable Travel	ECOSLO
	[REDACTED]	Cool Earth
	American Carbon Registry	Center for Communication Action and Environmental Justice
		National Parks Conservation Association
		University of Wyoming's School of Energy
		Hawaii Pacific University
		[REDACTED]
		[REDACTED]

Figure 6.1: Total Interviews and Survey Responses Collected

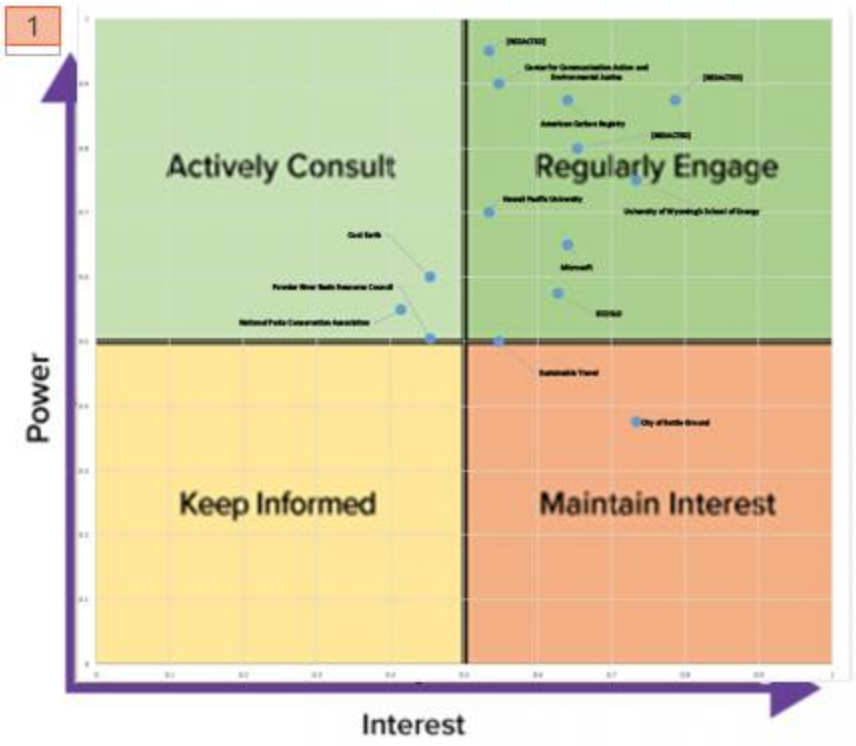


Figure 6.2: Power Interest Grid generated from Interviews and Surveys

Our group developed the above Power Interest Grid from the generalized information taken from the interviews and survey responses. The Power-Interest Grid we created demonstrates the majority of the stakeholders interviewed are shown to be categorized as “Regularly Engage”. These trends will be further interpreted in the following section and summarized in the following communications table template.

Stakeholder	Power/Interest Grid Placement
[REDACTED]	Regularly Engage
Center for Communication Action and Environmental Justice	Regularly Engage
University of Wyoming's School of Energy	Regularly Engage
Hawaii Pacific University	Regularly Engage
[REDACTED]	Regularly Engage
[REDACTED]	Regularly Engage
American Carbon Registry	Regularly Engage
Microsoft	Regularly Engage
ECOSLO	Regularly Engage
Powder River Basin Resource Council	Actively Consult
National Parks Conservation Association	Actively Consult
Cool Earth	Actively Consult
City of Battle Ground	Maintain Interest
[REDACTED]	Maintain Interest

Figure 6.3: Communications Table for Pseudo-Stakeholder Analysis

Following this, another Pseudo-Stakeholder Analysis, henceforth referred to as the subcategory stakeholder analysis was completed by our team to provide general guidance for TIER on who they should be reaching out to next to continue developing their carbon offset for Carbon Capture Storage. Using Table 6.1 and 6.2 as a guiding source for our NGO groups and Partner Agency groups, as well as information collected during our initial archival research phase on the different investors in CC technology, our group was able to identify 4 main stakeholder groups. The four stakeholder categories were broken into many different subcategories, which were then plotted to produce the subcategory stakeholder Power-Interest Grid and Communications Table.

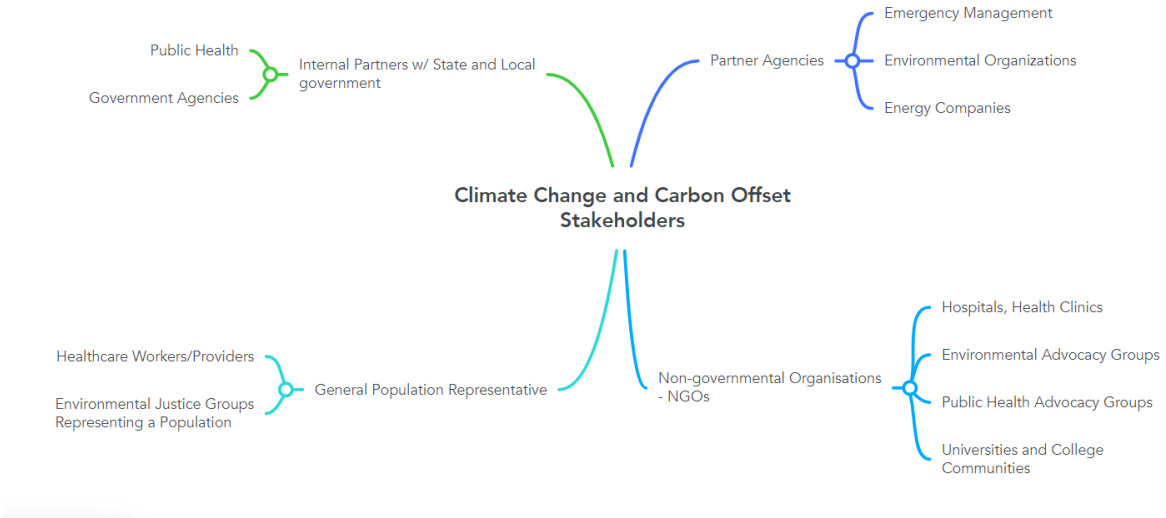


Figure 6.4: Climate Change and Carbon Offset Stakeholder Mind Map

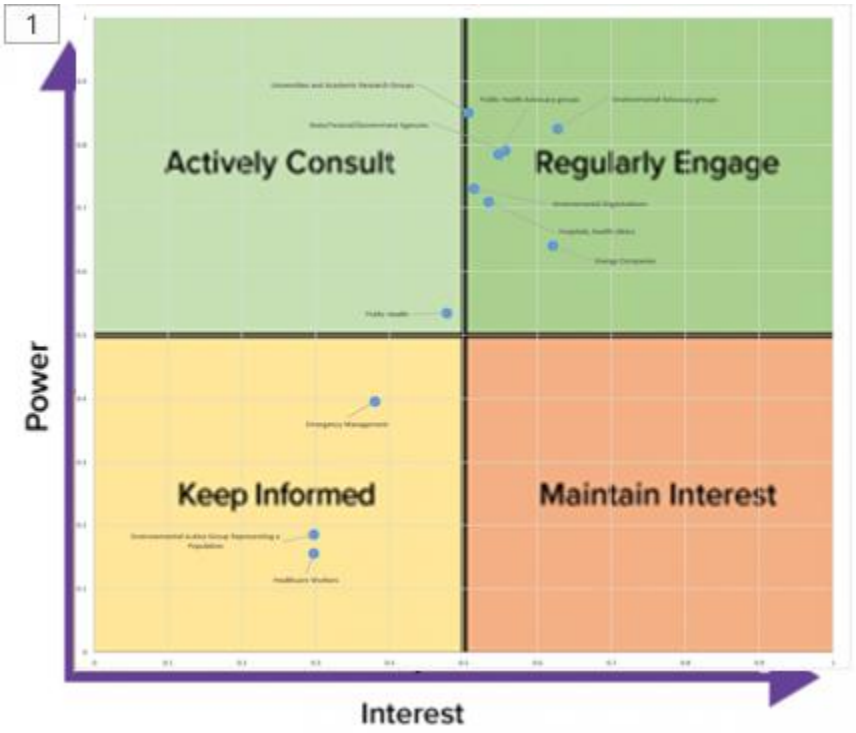


Figure 6.5 Power Interest Grid generated for the Subcategory Stakeholder Analysis

Stakeholder	Power/Interest Grid Placement
Hospitals, health clinics	Regularly Engage
State/Federal/Government Agencies	Regularly Engage
Environmental Organizations	Regularly Engage
Energy Companies	Regularly Engage
Public Health Advocacy groups	Regularly Engage
Universities and Academic Research Groups	Regularly Engage
Environmental Advocacy groups	Regularly Engage
Public Health	Actively Consult
Healthcare Workers	Keep Informed
Emergency Management	Keep Informed
Environemental Justice Group Representing a Population	Keep Informed

Figure 6.6 Communications Table for Subcategory Stakeholder Analysis

6.2 Interpreting Template

Using the different stakeholder placements, the communication methods outlined in Appendix P can be deployed to the stakeholders depending on their Power-Interest Grid placement. As discussed in Appendix P, some of the stakeholder communication techniques require significantly higher company investment to maintain, and should therefore be used sparingly, and with the highest-ranking stakeholders.

Having outlined this context, one can begin to analyze the trends generated by the stakeholder template. The first major takeaway from the template-developed products is that the usage of weighting in the template does mitigate heteroskedastic trends from dominating the data sets. When filling out the pseudo-stakeholder analysis, our group noticed that removing the weighting from either the broader stakeholders group rankings or the interest metric weights would result in most if not all the stakeholders being categorized as the highest engagement level. This trend continued when reapplied with the subcategory stakeholder analysis.

It is also worth noting that the pseudo-stakeholder analysis that was run with the survey respondents and interviewees is not representative, as the response rate from the sampling pool

was so small. Having higher responses would enable our group to develop a stronger template, and further, refine the weighting techniques used in avoiding heteroskedasticity. Our group discusses the implications of this, as well as the general themes discovered from the interviews and survey responses below.

7.0 Conclusion

The results from interviewing US stakeholders revealed more information on CCS and their opinions on the current carbon offset market. The main improvement mentioned was increasing transparency with voluntary offsets. The majority of the survey results were from NGOs, with no responses from the General Public group. Of the respondents, the majority stated they had no influence on a carbon offset for CCS, but with a lack of responses, the data is not representative. As a result, our team used this data as an example of what our stakeholder analysis template does instead of doing a full stakeholder analysis.

7.1 Limitations

Most of the limitations in this project stem from the lack of responses to interviews and surveys. We distributed surveys to 98 people and contacted 56 individuals for interviews, with a roughly equal representation of each stakeholder group for both methods. For surveys, our response rate was 8.18%, the majority of which classified themselves as NGOs. We had 9 interviews in total giving a response rate of 16.1%, five of whom were partner agencies and four NGOs (see table 3.1 for more information). This lack of response made a full stakeholder analysis unattainable, so the scope of our project was changed to a stakeholder analysis template that can be added upon by future IQP groups or TIER. Another limitation of this project stemming from the lack of response was the level of the subjectivity of stakeholders. This stakeholder analysis template relied on turning qualitative information received from surveys and interviews into quantitative data to make assumptions about the carbon offset market. Judging the power and interest of different stakeholders was entirely based on the stakeholder's view of themselves and our limited knowledge of the market. The lack of responses from different stakeholder groups

made judging and assigning a numeric value to the power and interest of different stakeholders difficult, if not impossible.

Representation was another limitation we encountered in this project, whether it be from our stakeholder groups, targeted states, the general public, and the type of offset market. With the lack of information for a full stakeholder analysis, some stakeholder groups had much higher response rates than others. NGO and partner agencies made up most of our interviews and survey responses, meaning our information for other stakeholder groups would be more skewed due to a lack of sample size from them. The lack of survey respondents also led to another representation-related limitation, which was not being able to focus on our targeted states. Originally, we reached out to individuals and companies in mainly California, Wyoming, Texas, and Indiana. We did not receive many responses from individuals or companies in these states, so we had insufficient information to make conclusions about CCS implementation and the carbon offset market in these states. One of our stakeholder groups, the general public, was also difficult to contact. Reaching out to the general public in the US to fill out a survey was not possible, and we instead had to rely on contacting environmental justice groups to represent this population. Furthermore, only one general population representative responded to our survey. A final representation limitation we encountered was related to the offsets market where our respondents operated. All our interview respondents operated strictly in the voluntary market, or a majority of their business was in the voluntary market. This meant that we were not able to learn much about the compliance market aside from what was already researched, as the stakeholders we contacted could only speak to the voluntary market.

In addition to the limitations regarding proper representation and lack of responses, another obstacle we encountered was truthfulness in interview responses. Different stakeholders have their

vested interests, and by extension will have different points of view on topics of interest. For example, large companies would have a more favorable view of carbon offsets as it allows them to offset their emissions, but the general public may have a less favorable view of offsets because they allow companies to keep polluting without substantially changing their policies. Due to this, during interviews, some stakeholders may have withheld information from us that would go against their best interest. It is impossible to tell if an interviewee is withholding information, so some information may have been withheld from us that resulted in a less complete recommendation and analysis for TIER.

A final limitation in our report is the lack of research into stakeholder groups other than the general public. Majority of the research conducted to expand upon our literature review focused on the public opinion of CCS or carbon offsets, compared to our other stakeholder groups like internal partners, potential partners, and NGOs. With the time limitation of the project our team was unable to put more research into the opinions internal partners, potential partners, and NGOs would have on CCS and carbon offsets. The insufficient research of all stakeholder groups leads to a less nuanced literature review and a weaker understanding of these stakeholder group's interview and survey responses.

7.2 Recommendations & Future Research

For our sponsor, we recommend that they look at the results from our interviews as they provide a small sample of the opinions that US stakeholders have on the US carbon offset market. Specifically, the pros and cons that the stakeholders brought up highlight what is currently working and what needs to be improved with the offset market, which is useful information for our sponsor to consider when developing their offset for CCS. One major point to consider is to be transparent with their offset, as this was a common improvement that was mentioned amongst the interviewees

(see chapter 4.1 for more details). In addition, chapter 2.2.2 outlines our team's research on the criticism of the US carbon offset market. The sponsor needs the standards of carbon offsets to be clear and should avoid double counting to keep their offsets' credibility. Our sponsor also has our stakeholder analysis template that will help them with completing a comprehensive analysis. Regardless of if they decide to work with another IQP group or not, they should use this template to develop the Power-Interest Grid and Communications Table, which will help with knowing which stakeholder groups to keep in contact with within the US. Since the market in Taiwan is different, our sponsor could compare the differences between Taiwan and US stakeholders to understand where the markets differ, as they are developing the offset for CCS within Taiwan.

Future IQP groups should continue reaching out to more US stakeholders. As mentioned in chapter 7.1, we were unable to do a full US stakeholder analysis, so another group would need to reach out to more US stakeholders to try and get more data. We suggest looking into other states like Illinois and Louisiana, as they are also strong candidates for consideration for future CCS research, but we lacked both the time and resources to investigate them properly at this time. We recommend future groups try calling instead of emailing stakeholders due to our lack of email responses. In addition, group members should utilize any contacts they have in the stakeholder groups to increase the chances of getting responses. Specifically, they should focus on the general population group as we had a 0% response rate for our survey. From our research on stakeholder analysis, we recognize that it is a lengthy process, so it could take multiple groups to conduct a full stakeholder analysis. Finally, we suggest that the next IQP group try conducting a Sentiment Analysis[1] to combat the subjectivity of the power metric. The idea is to create a scheme that can take input in the form of websites or sources of various stakeholders that the team determines as

[1] See this link for more information on Sentiment Analysis: https://monkeylearn.com/sentiment-analysis/

good. For example, it could be the number of times that “carbon offsets” appears on a website. From there, you can compare the initial search to others, with those matching being more powerful than others.

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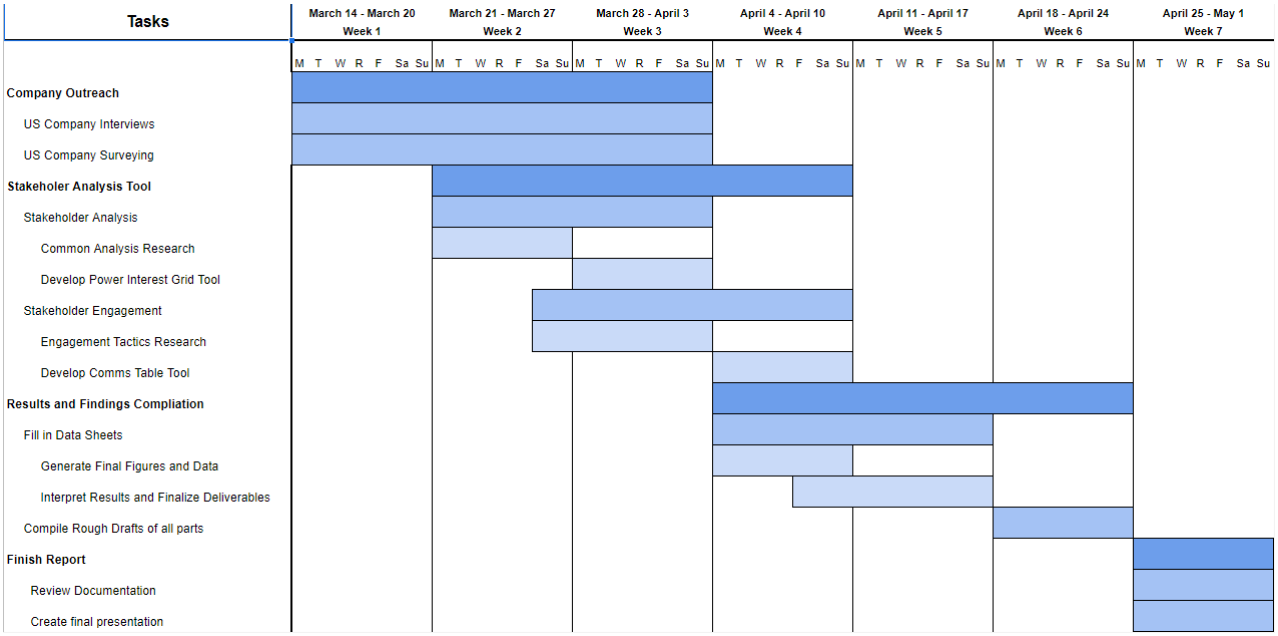
Appendices

Appendix A: Program Schedule



Appendix B: Survey Questions

Informed Consent

Hello, we are a team of students from Worcester Polytechnic Institute conducting a stakeholder analysis of the CCS market in the US. This information will then be compared with a stakeholder analysis of the Taiwanese market in collaboration with the Taiwan Institute of Economic Research (TIER). The data gathered from these questions will be published, but no personal information will be released. Would you like to proceed?

- Yes
- No

1. What is the name of your company/institution?
2. To the best of your ability, how would you categorize your company/institution?
    - Internal Partner with State or Local Government Organization
    - Partner Agency
    - Non-Government Organization (NGO)
    - Vulnerable Population
3. For our project, and our stakeholder analysis in particular, we are attempting to generate a power-interest grid and a communications table for our sponsor, TIER. One of our hopes with these interviews that we are conducting is to generate a series of criteria that we can use to help develop metrics on which we can gauge the different stakeholders based on their interest in CCS and their power to influence these projects. These next questions are based on helping us build this criteria.

On a scale of 1 to 10, how much does the development of Carbon Offsets in relation to Carbon Capture Storage influence your company's:

- Finances?
- ability to work with larger legislation groups?
- ability to perform business as usual?
- ability to meet their environmental goals?
- reputation with the public?

If possible, please explain your answers to the previous question.

4. On a scale of 0 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Please explain your answers to the previous question.

Appendix C: Email Template to Stakeholders

Purpose: We will need to reach out to companies via email to conduct interviews for stakeholder analysis

Subject: [*insert subject name*]

Dear [*insert name of representative*],

We are a team of students from Worcester Polytechnic Institute (WPI) currently working on a project in collaboration with the Taiwan Institute of Economic Research (TIER). One of TIER's interests is in EACs, specifically for Carbon Capture Storage (CCS) technology to reduce emissions. Part of this research includes reaching out to stakeholders in the US like your company, (*insert name of organization*).

We would love to hear your opinions on the current state of the carbon offset market and any other thoughts on CCS technology. We were wondering if you would participate in a brief interview that should take no longer than 30 minutes on an online platform of your choice.

Participation in this research is voluntary and there is no obligation to do so. We appreciate you taking the time to read through this email, and we hope to hear from you soon!

Best,

Jonathan Gong, Chloe Harrison, Toshak Patel, Kristen Stilin

Appendix D: Informed Consent for Interviews

Hello, thank you for taking the time out of your day to interview with us and help us collect our research. We are a team of students from Worcester Polytechnic Institute conducting a stakeholder analysis of the CCS market in the US for a project. This analysis will then be compared with a stakeholder analysis of the Taiwanese market in collaboration with the Taiwanese Institute of Economic Research. The data gathered from this interview will be published, but no personal information will be released. This interview should only take 30 minutes, and if there are any questions you do not want to answer they will be skipped. Are there any questions before we begin?

Appendix E: Interview with Professor Celia (Princeton's Carbon Management Institute) Questions:

1) As mentioned earlier, the primary focus of our project is the implementation of Carbon Capture Storage, and specifically, the documentation that companies can invest in to verify that the energy they invest in comes from green sources such as CCS technology. As someone who has been doing research in this area, we were curious to hear your opinions on the pros and cons of this technology.
2) You had written a paper in 2019 specifically on your field of interest – carbon leakage from sequestration wells. With our project being developed for usage near an island, are there any details that we should be looking out for?
3) Moving forward a little bit, we would love to hear more about your involvement in the Carbon Mitigation Initiative, and their role in the development of CCS.
4) Is the Carbon Mitigation Initiative involved at all in the Carbon Offset System? Has this group, or Princeton University purchased any carbon offsets?
5) How much does the development of Carbon Capture Storage influence the Carbon Mitigation Initiative's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?

6) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix F: Interview with Maris Densmore (American Carbon Registry) Questions:

1) How does the American Carbon Registry associate with carbon capture storage? Do you verify offsets for this technology?
2) How does the verification process work? We are aware that there are two different markets for carbon offsets: compliance and voluntary; are you involved with both of these markets?
3) What is the idea behind Early Action Offset Projects, and does it have any effect on the carbon offset market?
4) Do you believe that investing in carbon offsets is beneficial economically? What pros and cons do you see in the system right now?
5) How does your organization ensure that carbon offsets are not double counted, and are properly cancelled? Are there any issues with this system now?
6) Would you prefer to have one singular carbon offset market in the US (as opposed to compliance and voluntary markets)? What aspects would you like to see in a new carbon market?
7) How much does the development of Carbon Capture Storage influence the American Caron Registry's:
    - Financial Sector?
    - Legal sector?
    - Ability to perform business as usual?
    - Public reputation?

8) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?
9) Are there any more contacts you may have in relation to carbon offsets and CCS that would be useful for us?

Appendix G: Interview with Professor Allen (Hawaii Pacific University)

Questions:

1) As mentioned earlier, the primary focus of our project is the implementation of Carbon Capture Storage, and specifically the documentation that companies can invest in to verify that the energy they invest in comes from green sources such as CCS technology. We were curious to hear your opinions on the pros and cons of this technology.
2) We are wondering if you know of any research groups at HPU that are focusing on Carbon Capture Storage or carbon offsets?
3) We noticed you had a particular interest in something called the "Built Environment". Could you elaborate in your own words what the built environment is?
4) We recognize that CCS technology would be considered a piece of the built environment, what is the public reception of the built environment as it stands, and do you think that CCS technology might run into the NIMBY Phenomenon in its development?
5) How much does the development of Carbon Capture Storage influence the Hawaiian Pacific University's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?
6) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix H: Interview with Environmental Organization A Questions:

1) On your website, you list projects that reduce carbon emissions like wind farms and forestry projects. How are they chosen? Is CCS included with any of these projects? If not, do you plan to invest in it in the future?
2) Who verifies the carbon offsets you provide? Is this the only organization that verifies for you? How are their standards compared to other organizations?
3) How are prices determined for your carbon offsets? Is there a standard for this?
4) How does offsetting travel help an everyday person, what incentives are there?
5) What pros and cons do you see in the carbon offsets market right now? Are there any changes and improvements you would like to see?
6) How much does the development of a carbon offset for Carbon Capture Storage influence your group's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?
7) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix I: Interview with Professor Coddington (University of Wyoming's School of Natural Resources) Questions:

1) Are majority of CCS projects happening nowadays those retrofitted on plants, or new plants entirely? We assume you are familiar with NIMBYism, is this an issue even for retrofitted plants?
2) As mentioned earlier, the primary focus of our project is the implementation of Carbon Capture Storage, and specifically the documentation that companies can invest in to verify that the energy they invest in comes from green sources such as CCS technology. As someone who has been doing research in this area, we were curious to hear your opinions on the pros and cons of this technology:
3) We saw a paper that you helped write on the 45Q tax credit, could you talk more about what exactly this is? Do you feel it has had the desired impact of pushing companies to invest in CCS?
4) Moving forward a little bit, we would love to hear more about your involvement in the University of Wyoming's Carbon Management Institute, and their role in the development of CCS. What changes have you made in this field in Wyoming?
5) What pros and cons do you see in the carbon offset market system right now? What improvements would you like to see in the future?
6) Do you see a global carbon market happening in the future?
7) How much does the development of a carbon offset for Carbon Capture Storage influence UW's School of Natural Resources:
    - Financial Sector?
    - Legal sector?

- Environmental goals?
- Ability to perform business as usual?
- Public reputation?

8) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix J: Interview with Clean Air Task Force Questions:

1) We had noticed when looking through some of the work that the CATF had been doing that you had held an FAQ on Carbon Storage underground in Europe. We were wondering if you could tell us some more on CATF's opinion of this method of sequestration in such a dense area like Europe. Have you seen any public backlash from these sorts of initiatives?
2) Would the CATF recommend any sort of Carbon Capture Storage/Sequestration anywhere along the ring of fire?
3) The CATF's Carbon Management Tracker will likely prove to be a great resource for our research and the development of our final product. We were wondering if you were planning on expanding this tool to other regions, specifically East Asia.
4) What do you know about the carbon offset market for CCS, and can you speak to pros and cons of this?
5) How much does the development of a carbon offset for Carbon Capture Storage influence UW's School of Natural Resources:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?
6) On a scale of 1 to 10, how much influence do you believe your company has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix K: Interview with Environmental Organization B Questions:

1) The document you sent us refers to a "high-impact methodology" that supports the reduction of emissions by CCS. Is this a verification process, and how would Verra go about this? Is this methodology in existence yet?
2) The VCS program (verified carbon standard) is one of the main programs run by your organization. How did you determine the rules for a project to be certified against? Once a specific project is verified, does that mean all future offsets from that project is verified, or is there some type of recertification process?
3) Do the majority of organizations/companies that sell carbon offsets use Verra's VCS program for verification? Are there any other verifying carbon standards?
4) We are aware that there are two different markets for carbon offsets: compliance and voluntary; are you also involved in the compliance market?
5) Do you believe that investing in carbon offsets is beneficial economically? What pros and cons do you see in the system right now?
6) Would you prefer to have one singular carbon offset market in the US (as opposed to compliance and voluntary markets)? What aspects would you want to see in a new carbon offset system?
7) How much does the development of a carbon offset for Carbon Capture Storage influence your organization's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?

- Public reputation?

8) On a scale of 1 to 10, how much influence do you believe your organization has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix L: Interview with Research Institute Questions:

1) We would love to hear more about the LCRI (Low carbon research initiative) Initiative that you are working on. Our project is based on the development of a Carbon Credit for Carbon Capture Storage, so the document posted on your website is of great interest to us.
2) You mentioned some Dual Land Solutions in our initial email exchange. We would love to hear more about your groups plans in regard to carbon sequestration, and how we can multipurpose areas fit for sequestration.
3) One of the areas that we are looking to continue doing research into is how carbon capture and sequestration affects vulnerable populations. We were curious to hear how the your group is working to ensure that its technology innovation continues to accommodate for these groups. We identified your "Transmission and Disease: Environmental Issues" research as one that might do this work, but are there any others?
4) We noticed that yesterday, you had actually launched a Net-Zero Commitment across your organization's operations. We offer our congratulations and best wishes for this new initiative and are curious if this plan includes investing further into the carbon offset market available in the United States.
5) What are some of the pros and cons that your company sees in the carbon offset market as it currently is. We are aware that there are two different markets that companies can invest in, (being compliance and voluntary), and are curious to hear if your organization prefers one over the other, and why?
6) Would you prefer to have one singular carbon offset market in the US? What aspects would you want to see in a new carbon offset system?

7) How much does the development of a carbon offset for Carbon Capture Storage influence your organization's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?
8) On a scale of 1 to 10, how much influence do you believe your organization has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix M: Native Interview Questions

1) Are the projects listed on your website ones that provide carbon offsets for your companies? Is the money then reinvested back in the project?
2) How are your provided projects chosen? Is CCS included with any of these projects? If not, do you plan to invest in it in the future?
3) Help Build is one program mentioned on your website, where customers buy long-term offsets from smaller projects. Are we understanding this correctly, or could you provide any more insight into this program? Are all the offsets you sell Help Build offsets?
4) Are all the projects you provide verified by the VCS? Does the organization who approve the offset influence whether you will provide it to customers?
5) How are prices determined for your carbon offsets? Is there a standard for this?
6) How does offsetting emissions help an everyday person, what incentives are there?
7) What pros and cons do you see in the carbon offsets market right now? Are there any changes and improvements you would like to see?
9) How much does the development of a carbon offset for Carbon Capture Storage influence your organization's:
    - Financial Sector?
    - Legal sector?
    - Environmental goals?
    - Ability to perform business as usual?
    - Public reputation?

8) On a scale of 1 to 10, how much influence do you believe your organization has as a stakeholder in the development of an Energy Attribute Certificate for Carbon Capture Storage?

Appendix N: The Salience Model

The Salience model is a 2D mapping technique that borrows from traditional Venn Diagrams to prioritize and visualize stakeholders. Salience is defined as “the quality of being particularly noticeable, important, or prominent (Usmani, 2015). Mitchell et. al. quantifies each of the stakeholder’s power, legitimacy, and urgency by an adapted set of stakeholder attributes. Power is defined as “a relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done” (Mitchell et. Al, 1997). Legitimacy is defined as “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, or belief definitions" (Weber, 1947, Mitchell et. al. 1997), works closely with power, and can sometimes be seen to have overlapping values. Mitchell et. al. adapted Weber’s interpretation of authority, stating that “legitimacy and power are distinct attributes that can combine to create authority”, elaborating that “an entity may have legitimate standing [...] or claim on [a] firm, but unless it has the power to enforce its will in the relationship [...] it will not achieve salience for the firm’s managers (Weber, 1947, Mitchell et. al. 1997). Thus, legitimacy and power are given independence from each other to achieve this salience. Urgency is given by the study and other sources as “the degree to which stakeholder requirements call for immediate attention” (Usmani, 2015, Mitchell, et. al. 1997). A unique definition is adapted by Mitchell et. al. making Urgency a metric that would only be considered present if a stakeholder had any form of “time sensitivity [or] criticality” (Usmani, 2015, Mitchell. Et. al, 1997). This would mean that any group that could be considered to have Urgency would need to be working on a time constraint for the project's completion or would need to have the project completed to prevent significant damage to the project (Mitchel, et. al. 1997).

The salience model is a three-category Venn diagram, with each circle rrepresenting the different attributes described above – power, legitimacy, and urgency. The intersection of the circles indicates unique stakeholder categories.

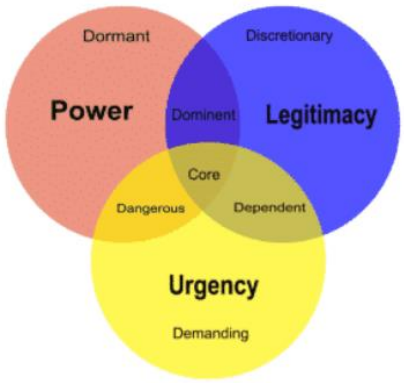


Figure N.1: Figure depicting the general structure of the Salience Model, first proposed by Mitchell et. Al. (Usmani, 2021)

For this model, there are a total of 7 different stakeholder groups, each of which is described below. The seven groups can be restructured into three broad categories of groupings based on the number of metrics any stakeholder holds. The placement on the Venn diagram directly corresponds to a stakeholders rank for this model.

Table N.1: Definitive Stakeholders: Stakeholders that have three attributes and require the most attention

Ranking	Engagement Level	Description
Power + Legitimacy + Urgency	Core	All three key metrics are met here, and thus maintenance of this group should be the highest priority.

Table N.2: Expectant Stakeholders: Stakeholders that have two attributes. These stakeholders will be active and will have expectations of the project

Ranking	Engagement Level	Description
Power + Legitimacy	Dominant	Ranked just below core group, as their urgency is not high, but they have interest and can heavily impact projects with their power. Falls under “Authority” definition
Power + Urgency	Dangerous	Vulnerable group: can be violent and can create trouble for your project if not managed cautiously.
Legitimacy + Urgency	Dependent	Not much attention will be held to this group, as they do not have power to act on either their legitimacy or urgency. Their needs will be monitored and met as possible.

Table N.3: Latent Stakeholders: These stakeholders have one attribute. Power will remain the most important of these

Ranking	Engagement Level	Description
Power	Dormant	Capable of impacting project, manage carefully
Legitimacy	Discretionary	Project should fulfill their requirements, as they have legitimate claims. NGOs and Charity organizations fall here
Urgency	Demanding	Usually vocal and can influence other stakeholders if not managed.

For the salience model, a much more comprehensive review is conducted on any of the stakeholders, giving key insights into each group and their motivations. (Usmani, 2015) With a more detailed product, salience mapping produces a system that can save company resources, time, and effort by guiding outreach groups. Focusing the outreach groups and clearly outlining the patterns of concern will help developing teams complete the projects with minimal obstruction

(Usmani, 2015). Despite achieving higher classification criteria, creating a Salience model will require more time and effort to generate, and the process to create one is cited by different groups to be subjective, which can incur bias in opinion, influencing effectiveness (Usmani, 2015, Mitchell, et. al., 1997). The model also makes a key assumption that the attributes being studied are either present or absent, ignoring the possibility that the presence of each attribute within stakeholders of the same category can vary to differing degrees. While more time-consuming, this mapping technique produces a strong model that creates a clear roadmap for organizations looking to engage with the most critical stakeholders for a project.

Appendix O: The Stakeholder Cube Model

The stakeholder cube is a three-dimensional stakeholder representation. The stakeholder cube borrows the concepts of power and interest – attributes introduced as generalizations, used to describe Power-Interest-Influence Mapping techniques. Interest and Power both maintain the same definitions as prescribed earlier for this mapping technique (Usmani, 2021). The third dimension used for this mapping pattern is given by the attribute of Attitude, which is defined in literature as "the disposition of the stakeholder for or against the project" (Usmani, 2021, PMBOK, 2021). An important distinction needs to be formed between interest and attitude, as some stakeholders that show interest in the project may be interested as blockers, while others may not have high interest, but have a strong positive attitude about the project.

The Stakeholder Cube as shown below is broken into 8 quadrants. Depending on which attribute is present or not, a stakeholder will be placed into its respective sub-cube.

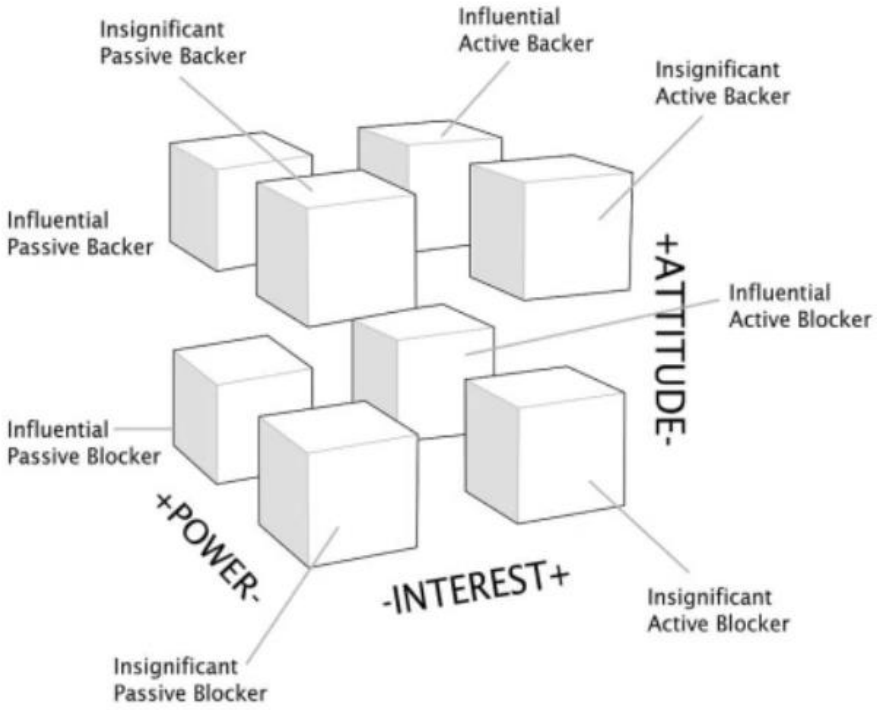


Figure O.1: Figure depicting the general structure of the Stakeholder Cube Model (Usmani, 2021)

The ranking employed to interpret the stakeholder cube associates its categorization with one-word descriptions that describe the behavior of any stakeholder that falls under any given sub-cube. Table 2.6 shows the ranking of the different sub-cubes, from most important to least important for engagement.

Table O.1: Table describing categorization that can result from using the Stakeholder Cube (Murray-Webster & Simon, 2006, Usmani, 2021)

Ranking	Engagement Level/ Alt. Names	Description
High Power, High Interest, Positive Attitude	Influential Active Backer/ "Savior"	Need to engage with this group to develop project goals and meet their needs. They have the authority, urgency, and attitude to help see the project through.
Low Power, High Interest, Positive Attitude	Insignificant Active Backer/ "Friend"	Need to engage with this group to use them as active confidants or consultation on project development
High Power, High Interest, Negative Attitude	Influential Active Blocker/ "Saboteur"	Need to engage with this group to prevent them from using their power to sabotage the project. Learn their concerns to convert them to allies
Low Power, High Interest, Negative Attitude	Insignificant Active Blocker/ "Irritant"	Need to be engaged with to prevent them from eating up resources
High Power, Low Interest, Positive Attitude	Influential Passive Backer/ "Sleeping Giant"	Need to engage with this group in order to "awaken" their power
Low Power, Low Interest, Positive Attitude	Insignificant Passive Backer/ "Acquaintance"	Need to be kept informed and communicated with on a transmit only basis
High Power, Low Interest, Negative Attitude	Influential Passive Blocker/ "Time Bomb"	Need to understand this group to prevent them from using their power against the project
Low Power, Low Interest, Negative Attitude	Insignificant Passive Blocker/ "Trip Wire"	Need to be understood so that the project developers can avoid being "tripped"

Similar to the Salience Map, the Stakeholder Cube provides a much more thorough review of stakeholders and their influences on the project. This review provides developing groups and project managers with a much clearer direction on how and where to focus outreach resources, giving the project a much faster completion time. However, with the increased complexity again

comes the issue of developing the stakeholder cube. The stakeholder cube also suffers from subjectivity and a lack of nuance in the different stakeholder sub cubes – analysts cannot tell the difference between stakeholders in the same sub-cube based on the differing amounts of any of the three attributes used to place them in said sub cube. The literature on the stakeholder cube is also lacking due to the complexity and subjectivity of creating and applying one in real life.

Appendix P: Communication Methods Pros and Cons

Table P.8: Table of Different Engagement Methods for Stakeholders (LucidChart, 2021, O'Haire et. al., 2011)

Communication Method	Proposed Frequency	Strengths	Limitations
Check-Ins	Weekly	Quick Engagement Method with high frequency. Useful for engaging important stakeholders.	With the high level of engagement, can be a turn off for some stakeholders to have to commit a large amount of time to the project
Focus Groups.	Bi-Weekly	Asks participants to draw from personal experience to guide discussion. Flexible, giving participants the chance to either engage in a wide variety of topics or focus in a particular field	Can be difficult to coordinate and carry out. Group Dynamics may inhibit meaningful discussion, and interviewees can be influenced by the phrasing of issues by the interviewer. Can produce divergent views, where consensus can be hard to find.
Formal Presentations/ Conferences/ Symposiums	Monthly/ One Time	Can allow for a large number of stakeholders to be engaged on a wide variety of topics and overarching themes. Validity of research priorities can be checked by informant interviews conducted at these large gatherings	Difficulty in planning, coordinating, and funding large scale events such as these. The sample collected may not be representative based on which stakeholders show and engage with the discussion. Vocal Minorities can dominate priority identification
Surveys / Questionnaires	One Time	Ability to include individuals from a range of socioeconomic and professional backgrounds and can be easy to complete with a wide variety of formats. Stakeholders do not need to be present to complete the survey. Anonymity in surveys can even enable stakeholders to	Low response rate can lead to unrepresentative samples. Anonymity can also lead to low levels of accountability. Consensus between stakeholders can also be difficult to establish when accessing such a wide variety of individuals and groups.

		share views without concern for the reaction of others.	
Project Dashboards	Continually Updated	Removes the burden of engaging with stakeholders from the project group, making information that needs to be made public available for all. Stakeholders can then pull information from the dashboard as the engagement method	Assumes that stakeholders will engage with the information platforms. Low Interest / Low Urgency/ Negative attitude Stakeholders may not actively use the dashboards, thus removing the purpose of this form of passive information distribution
In-Person/Virtual Interviews	One Time	Effective for capturing community/individual perspectives and can be relatively low cost if limited by geographic dispersion. Easy way to facilitate collaboration and identify priorities with decision makers	Sample size can be too small to support any statistical analysis of differences in perspectives. Results are often not generalizable. Time consuming if looking to engage with many stakeholders. Consensus can be difficult to establish between the different stakeholder interviews.
Scoping Study (Literature Review done in collaboration with Key Stakeholders and Focus Groups)	One Time	Blends two existing methodological approaches, Literature review and interviewing to generate a strong content analysis supporting and highlighting weaknesses of the given project	Any lack of methodological quality review can lead to uncertainty regarding how to weigh ambiguous-standing literature when identifying strengths and shortcomings of the evidence collected.