

Exploring the Role of Social Assets in Refinery Implementation: Using Case Study Research to
Ground-Truth CAAM

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Authorization to Submit Thesis

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Abstract

In the U.S. West, the potential to develop biofuels from woody biomass is gaining significant momentum. Despite potential environmental and economic benefits, an obstacle to successful project implementation may be attributed to poor public perception and lack of community support. This project implementation barrier emphasizes the importance of biorefinery site selection. These decisions tend to be based on various economic and biogeophysical resource criteria and often overlook valuable social assets necessary for successful implementation of these highly technical projects.

This study ground-truths the first refinery decision support tool that incorporates both biogeophysical and social assets measures. Four community case studies of successful and unsuccessful fuel and high-tech refineries explore the influence of social assets on project outcomes. Through interviews with key stakeholders, the role of social, cultural, and human capital in successful adoption and implementation is analyzed and provides insights into the impact of social assets.

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Dedication

Thank you to all my family and friends for your unwavering love and support. I am so grateful to be part of your community.

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Chapter 1: Introduction

Background

Anthropogenic emissions of greenhouse gases (GHGs) are reaching historical levels, leading to an increasing interest in the use of cellulosic biomass to replace fossil fuels to produce heat, electricity, and transportation fuels (IPCC, 2014). GHG emissions from the energy sector have a significant influence on climate change with 85 % of current primary energy driving economies powered by fossil fuels (Sims et al., 2011; Moomaw et al., 2011). Since all societies require energy services to meet basic human needs and to serve productive processes, research is turning toward developing renewable energy technologies and alternative fuels to meet these goals (Moomaw et al., 2011).

In the Pacific Northwest, potential to develop biofuels from woody biomass is gaining significant momentum (Martinkus et al., 2014). The Northwest Advanced Renewables Alliance (NARA) focused on developing socially and economically viable biofuel solutions for the Pacific Northwest States of Montana, Idaho, Oregon and Washington. NARA sought to accomplish its goals by demonstrating the feasibility of utilizing existing forest products infrastructure and unutilized wood resources to revive rural economies and create a new wood-based aviation biofuel industry. Feedstock sources include wood-based construction debris and forest residuals of unmerchantable timber, such as tops and branches that compose slash piles following forest harvest or silvicultural treatments for thinning or fire treatment (NARA, 2014).

Over the last decade, pine and spruce bark beetle infestations have led to widespread tree death in coniferous forests across the Rocky Mountains. Climate change is likely to intensify this trend resulting in vast expanses of beetle-killed wood, and providing a large potential biomass resource for bioenergy and biofuel production (BANR, 2015). Bioenergy Alliance Network of the Rockies (BANR) brings together scientists, educators, and extension agents from universities and government agencies across the inland northwest to work with the industry and develop a comprehensive program addressing the major challenges limiting feedstock development, production, logistics and utilization of insect-killed trees to produce biofuels and biochar (BANR, 2015).

Using woody biomass from forest residues to make biofuel could provide ecological and social benefits concerning climate change, wildfire mitigation, forest management, and reducing dependence on fossil fuels. Forests are critical to the global carbon cycle and flux between being a carbon source and a carbon sink (Masera et al., 2003). The natural fire regimes of our forests have been significantly altered, leading to increased fuel loads and wildland fire risk and hazard (USDA Forest Service, 2005). In 2005, the United States Forest Service (USFS) reported that there are at least 28 million acres of

forest that need treatment from fuel loading in the 15 Western States (USDA Forest Service, 2005). Using non-merchantable timber, such as slash piles from fuel reduction projects, has been suggested as an opportunity for rural communities to change their role in the wood products industry and capture more value from timber management activities (Crandall et al., 2017). However, there are significant limitations in the way before woody biomass becomes a critical tool for rural development.

Despite the potential economic and environmental benefits of biofuels production and use, some of the largest obstacles to successful biofuel production are non-technical barriers (Rosch & Kaltschitt, 1999; White, 2010; Plate et al., 2010). For example, in cases where projects failed despite positive feasibility studies, Rosch and Kaltschitt (1999) identified the reasons to be problems with funding, financing, and insuring; unfavorable administrative conditions; organizational difficulties; lack of knowledge and adequate information; and insufficient perception and lack of public acceptance. Public policy and energy education efforts are targeting the first three barriers, but the influence of local community support on success or failure of biorefinery site selection has only recently been explored.

Importance of Biorefinery Site Selection

Biorefinery site selection is critical to achieving the goal of producing economically viable and environmentally sustainable biofuels. Locating a facility requires large investments of financial resources and represents long-term strategic commitments. These decisions are primarily driven by factors such as access to labor and markets, raw materials, and cost-reducing local incentives (Noon et al., 2002). These physical and economic criteria will always be central to site selection decision. However, the non-technical challenges stated above demonstrate a need to assess the factors influencing social acceptance of biorefinery projects. Tigges and Noble (2012) found that local community support can lower implementation costs, and opposition can increase costs. While social assets have been known to influence project success, due to their qualitative nature, they are rarely incorporated into the decision-making process.

A Step-wise Approach to Site Selection

Recognizing the importance and inherent difficulty in quantifying social measures, Martinkus et al. (2014) were the first to create a decision support tool (DST) that aims to capture community capacity for collective action as an indicator for community acceptance of a biorefinery project. This effort was the first facility siting tool that combined biogeophysical and social measures to identify communities in a region with the highest potential for successful biorefinery implementation (Martinkus et al., 2014). This tool has been improved by incorporating enhanced measures of both social assets and biogeophysical metrics (Martinkus et al., 2017). While the tool has shifted from using city- and

county-level datasets to site-specific requirements, the research team continues to promote a step-wise approach that considers biogeophysical criteria to determine physical feasibility and social measures to assess community capacity for acceptance and support.

The first stage requires market ‘primary drivers’ or minimum physical requirements to support a biofuel refinery. Studies indicate factors to be access and availability of biomass feedstock, co-product marketing opportunities, access to markets, minimal transportation costs, low fuel prices, and transportation infrastructure (Lambert et al., 2008; Awudu & Zhang, 2012). The first iteration of this tool assessed transportation infrastructure, woody biomass accessibility and availability, a minimum population of 1,000 people to ensure a viable workforce (Martinkus et al., 2014). This initial assessment was performed at the community level with the assumption that a valid biorefinery location could be found, rather than considering existing industrial sites for repurpose (Martinkus et al., 2017). Existing pulp mills hold great potential as repurposed wood-based biorefineries due to their scale, infrastructure compatibility, and feedstock logistics, and may provide significant reductions in biorefinery capital expenditures (Fornell, et al., 2013). Martinkus et al. (2017) use a ranked list of mills based on biorefinery repurpose potential and operational cost-based metrics including total delivered feedstock cost, electricity rate, average weekly wage, and infrastructure retrofit potential (Martinkus et al., 2017).

Second step location decisions are based on characteristics of specific sites such as local incentives, community resistance or enthusiasm, and features of the labor supply (Tigges & Nobles, 2012). Numerous studies have found community characteristics, such as social capital, civic engagement, and participation, to be significant for project sustainability (Parisi et al., 2004; Miller & Buys, 2008; Portney & Berry, 2010). Martinkus et al. (2014) used county-level social assets to calculate a single score that measures favorability of social, human, and cultural capital. The second stage of this DST that captures social measures is the Community Asset and Attribute Model (CAAM) developed by Rijkhoff et al. (2015). The measurements included in CAAM are based on Emery and Flora’s (2006) Community Capital Framework (CCF). This framework provides a systematic approach to measuring the resources within a community and how they interact to promote collective action. Both iterations of Martinkus et. al (2014) DST incorporate this framework to select what datasets are included in the model. The latest version has been expanded to include more measures to capture social capital, creative leadership and public health status. The measurements included in both versions of the step-wise DST are presented in Table 1. Further explanations of the CCF and CAAM are found below.

Table 1. Comparison of 2014 City/County-Level Model and Proposed Site-Specific Model (Martinkus et. al, 2017)

COMMUNITY ASSETS	CITY/COUNTY MODEL (2014)	SITE-SPECIFIC MODEL (2017)
Biogeophysical Assets (Natural & Physical Capital)	Cities selection criteria: Population greater than 1,000; located within 1.6 km of major road and rail; near large quantities of biomass; near petroleum terminals	Pulp mill assessment criteria: delivered feedstock (biomass) cost; average electricity rate; % reduction in Greenfield construction cost through infrastructure assessments; average weekly wage
Social Capital <ul style="list-style-type: none"> Rupasingha et al., 2006 2009 data used 	# Rent-Seeking Groups: Political, labor, professional and business organizations	# Rent-Seeking Groups: political, labor, professional and business organizations # Non-Rent Seeking Groups: civic organizations, bowling centers, golf clubs, fitness centers, sports organizations and religious organizations # Non-Profit Organizations % Voter Turnout
Cultural Capital <ul style="list-style-type: none"> WESTAF 	\$ average annual revenues of arts-related goods and services based on all revenues between 2002 and 2010	# Arts related organizations # Arts related business # Occupational employment in the arts \$ Revenues of arts related goods and services
Human Capital* County Health Ranks	% Self-reports of poor health condition (physically and mentally)	Health: % Low birth-weight % Premature deaths % Obese (BMI >30) % Self-reports of poor health condition (physically and mentally) Poverty % Poverty (and % children in poverty) % Uninsured % Unemployed % No access to health due to costs Education: % Between age 25 and 44 with some post-secondary education Language: % Non-proficiency in English

All counts (#) and amounts (\$) are calculated as a rate of the population per 10,000.

Community Capitals Framework

Developed by Emery and Flora (2006), the Community Capitals Framework (CCF) (Figure 1) offers a way to analyze community and economic development efforts from a systems perspective. Every community has resources within it, and when those resources or assets are invested in creating new resources, they become capital. Community capitals are resources within a community that can be invested, saved, or used up (Jacobs, 2007). Flora and Flora (2013) have found that dividing invested resources into seven capitals is helpful in fostering holistic analysis and action. The capitals individually and together contribute to or detract from sustainable communities (Flora & Flora, 2013). The seven types of community capital are social, cultural, human, political, natural, financial, and physical and are summarized in Table 2.

Table 2. Definitions of Community Capitals

CAPITALS	DESCRIPTIONS
Social	Reflects the connections among people and organizations within the community to make things happen (Emery & Flora, 2006; Flora & Flora, 2013) Often classified as either bonding social capital-ties that link individuals or groups with similar backgrounds, or bridging social capital-connecting diverse groups within the community to each other and groups outside the community (Putnam et al., 2003; Emery & Flora, 2006; Flora & Flora, 2013).
Cultural	Consists of symbols and language, and determines a community's distinctive character (Jacobs, 2007). Cultural Capital reflects the way people see the world and how they act within it, as well as their traditions and language (Emery & Flora, 2006; Flora & Flora, 2013).
Human	The ability of people to use their knowledge, skills and experience skills to develop and enhance their resources. It is also the capacity to access and connect with outside resources to contribute to community organizations and self-improvement (Emery & Flora, 2006; Flora & Flora, 2013).
Political	The ability of a group to influence the distribution of resources within a community, and this includes helping set the agenda of what resources are available. Highly intertwined with social and cultural capital, political capital tends to reflect the dominant culture. Flora and Flora (2013) also note that political capital reflects the types of social capital existing in a community.
Natural	All the natural resources available to a community and includes air, water, soil, land use, biodiversity, weather and natural beauty (Emery & Flora, 2006; Jacobs, 2007; Flora & Flora, 2013).
Financial	The financial resources available for the community to invest in capacity-building (Lorenz, 1999; Emery & Flora, 2006). Changes in poverty, firm efficiency, diversity of businesses and increased assets of local people can assess community financial capital (Flora & Flora, 2013).
Physical	Community infrastructure and includes technologies, roads, bridges, factories, day care centers, and wind farms (Emery & Flora, 2006; Flora & Flora, 2013).

The seven types of capital regularly interact and demonstrate a flow of stock between capitals. Gutierrez-Montes (2005) asserts that the interaction of assets across capitals can initiate a spiraling effect, either upward or downward. "Spiraling-up" is the process demonstrated in (Figure 2) in which assets gained can begin an ongoing process of assets building on assets, or "success building on success" (Emery & Flora, 2006). However, spiral-down periods can occur when the community has declined in one capital, leading to declines in all capitals.

In Emery and Flora's (2006) model using community capitals, as one capital increases, it is easier for increases in other community capitals to occur. Emery and Flora (2006) have found that the typical rural development strategy of infusions of financial or physical capital do not contribute to a cumulative impact. "Spiraling-up reverses declines in assets through a similar cumulative causation process in which asset growth becomes a self-reinforcing cycle of increased opportunity and community well-being" (Emery & Flora, 2006). Emery and Flora contend that high social, human and cultural capitals significantly drive the continuous flow of capital assets toward an upward spiral. This spiraling-up effect is leading researchers to explore how these three capitals play a role in biofuel refinery project implementation.

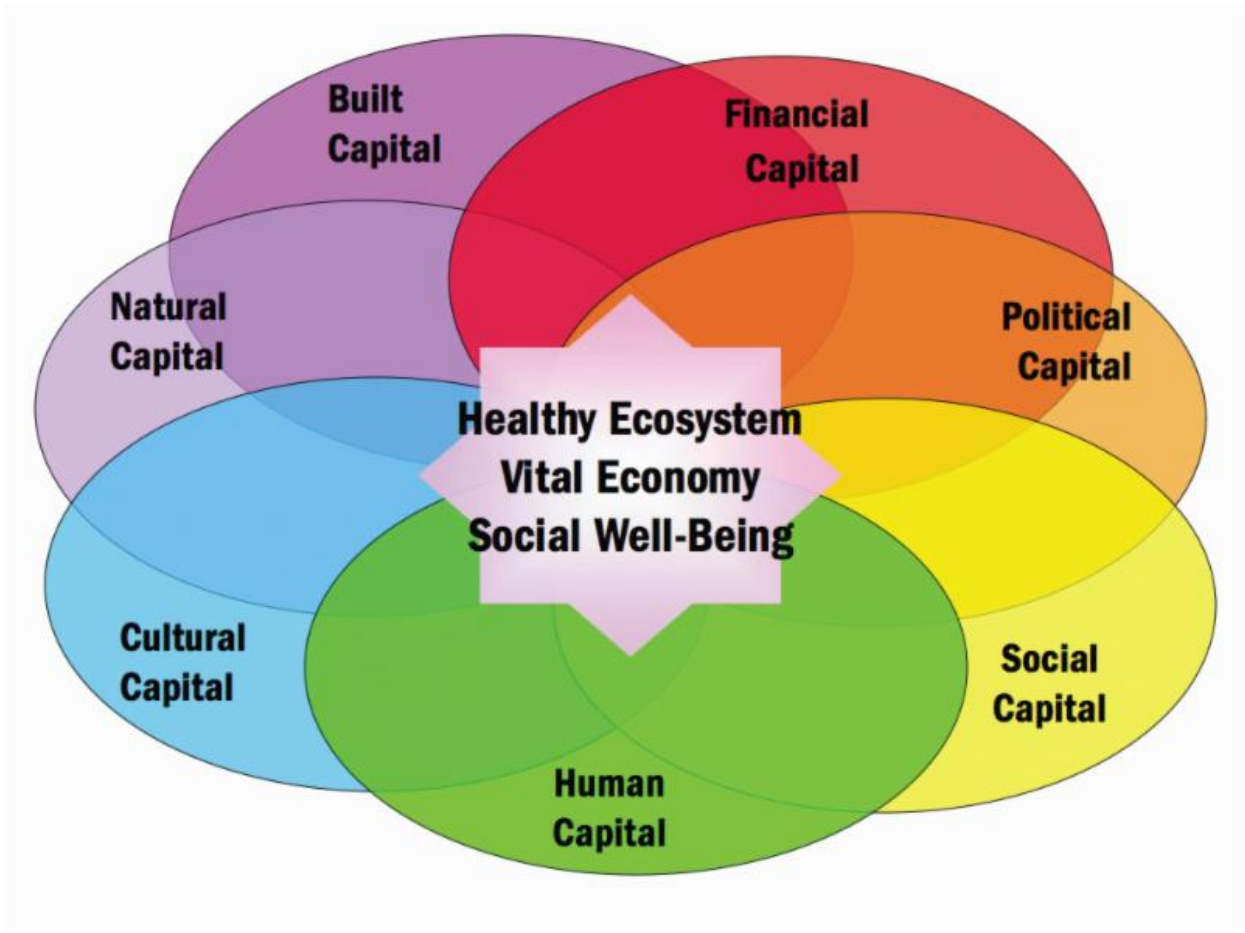


Figure 1. Community Capital Framework (Flora and Flora, 2013)

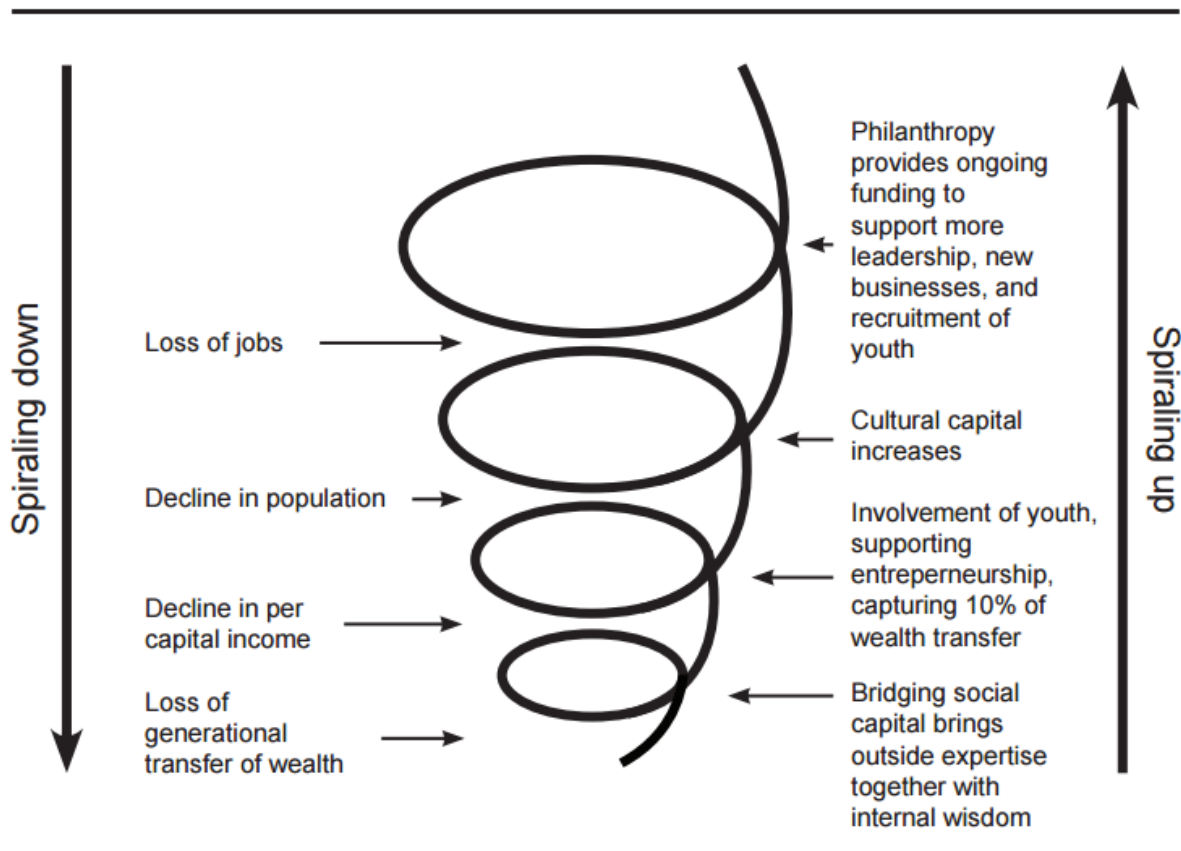


Figure 2. The spiraling of community assets (Gutierrez-Montes, 2005)

Community Asset and Attribute Model (CAAM)

Applying the CCF to refinery site selection could provide insight into predicting successful project implementation. Biorefinery site selection decisions tend to focus on economic and biogeophysical resources, which fall into the CCF as natural, physical, and financial capital. However, these resources constitute only part of the assets necessary for successful implementation of these highly technical projects. Excluding social, cultural, human, and political capital when making these decisions potentially risks failure of the overall project (Rijkhoff et al., 2017). Predicting resistance or support for the biofuels industry may be the key to success. Communities have successfully organized against other alternative fuel projects despite the perceived economic benefit (Reid, 2010). Rijkhoff et al. (2017) contend that this framework can provide important insight into the resources necessary for successful site selection, including natural, physical and financial capitals.

Rijkhoff et al. (2017) developed the Community Asset and Attribute Model (CAAM) to assess the social, cultural, and human capital in a community. Based on existing datasets, CAAM serves as a

quantitative tool that enables CCF's social measures to be integrated into project site selection and implementation decisions (Rijkhoff et al., 2017). Scores for social measures are integrated with biogeophysical assets to assess community readiness for biofuels site selection in Martinkus' et. al (2017) DST. The next section discusses two important facets of this study. The first part describes how the three capitals of the CCF—social, cultural, and human capital—are defined in the literature. The second outlines the datasets and measures that CAAM uses to assess these capitals so they can be incorporated into the site selection process.

Measuring Community Capitals

Social Capital

Social capital is the network of voluntary and reciprocal cooperation among individuals and organizations (Rohe, 2004). Most literature agrees that social capital positively influences economic growth, promotes trust and increases collective action through social networks and cooperation between individuals and groups (Coleman, 1988; Putnam R. D., 1995; Montgomery, 2000; Rupasingha et al., 2006). Social capital has been confirmed by studies in the Pacific Northwest to contribute to community cooperation and successful project outcomes (Grott, 1999; Lovrich et al., 2005; Erp et al., 2009). Social capital and social assets have also been found to contribute to successful environmental sustainability measures in U.S. cities and natural resource management (Portney & Berry, 2010; Miller & Buys, 2008; Parisi et al., 2004).

There are now a variety of measures used to provide information about the levels of social capital in a community. Much of the disagreement about measuring social capital lies in scale. Several scholars argue that social capital should be measured at the individual level (Bourdieu, 1986; Coleman, 1988; Montgomery, 2000; Rupasingha et al., 2006). Putnam (1993) argues that social capital should be measured at the community level because there are two distinct types of social capital: bonding and bridging (Putnam et al., 2003). Bonding social capital describes those ties connecting individuals with shared values and beliefs (Emery & Flora, 2006; Patulny & Svendsen, 2007). The potential negatives of bonding social capital are that it tends to promote trust within the group and distrust outsiders (Patulny & Svendsen, 2007). Bridging social capital refers to the ties connecting organizations and communities across greater social and physical distance (Emery & Flora, 2006; Patulny & Svendsen, 2007). Patulny and Svendsen (2007) write that bridging social capital creates generalized trust, which allows different people to meet, interact, and share or “non-excludable” goods such as low criminality, non-corrupt and efficient governmental institutions. The distinction between the two types of social capital may be significant when measuring the strength of the community to come together to solve

problems. This distinction is why Putnam and Rupasingha et al. (2006) argue that social capital is better measured at the subnational or local levels, rather than individual levels because the goal is to measure what kinds of social capital facilitates collective action.

Social capital is commonly measured in proxies for which reliable and accurate data are available, such as the density of civic, religious, and sports organizations in a county. This proxy deals mostly with bridging capital and is based on surveys like the National Opinion Research Center's General Social Survey (GSS). This survey measures trust, civic engagement, and association memberships of individuals (Rupasingha et al., 2006). Putnam (1993) and Rupasingha et al. (2006) encourage measuring associational activities as indicators of social capital by counting the groups in civil society and memberships in sports clubs, bowling leagues, literary societies, etc. Knack and Keefer (1997) disagree with Putnam's assertion that associational activity correlates with economic performance.

Another relevant concept of social capital to this research is called entrepreneurial social infrastructure (ESI). This concept was developed by Flora et al. (1997) to measure how social capital plays a role in economic development. ESI is the social capacity and the collective will of local communities to provide for their social, economic and environmental well-being (Flora et al., 1997). A community with ESI mobilizes resources both within and outside the community and "maximizes the resource potential of a community's social diversity." ESI is divided into three main concepts, the legitimation of alternatives, inclusive and diverse social networks, and resource mobilization. The ability of a community to legitimate alternatives, means that they can accept controversy and share a vision of the future. Politics are depersonalized and there is emphasis on trusting the process (Flora et. al, 1997; Flora & Flora, 2013). Inclusive and diverse networks describe communities that foster outside links and actively seek outside resources from other communities and state and federal sources (Flora & Flora, 2013). The ability of a community to mobilize public and private resources is an essential element of community action (Flora & Flora, 2013).

The last concept of social capital pertinent to this study was developed by Inkeles (2000) describing modes of communication and association between individuals and between collective entities. Highly related to bridging social capital, Inkeles argues that ease of contact within, between, and across stakeholders and groups can reveal the level of stakeholder cooperation which is an important factor in economic growth.

Cultural Capital

Emery and Flora (2006) describe cultural capital as the traditions and languages of the community that determine how one sees the world, what one takes for granted, what one values, and what one thinks is

possible to change (Flora & Flora, 2013). Within cultural capital is a concept of legacy, or that which parents seek to pass on to their children or that which communities seek to pass on to the next generation. This includes material possessions, education, values, and behavioral patterns (Flora & Flora, 2013). Legacy is an understanding of society and their role in it, speech, dress, and ways of being that families, communities, groups, and nations pass on to the next generation (Flora & Flora, 2013). This study looks at legacy in the context of social, environmental, and industrial legacy. Cultural capital has been evaluated by looking at community traditions, festivals, and local history (Fey et al., 2006).

Some assert that cultural capital is vital to community success because it influences creativity and innovation. CAAM developers reason that emergence of innovative approaches to development will be beneficial to communities as they overcome challenges associated with defining their role in the overall biofuel supply chain (Martinkus et al., 2014; Rijkhoff et al., 2017). Florida (2002) argues that creative communities are the centers of diversity, innovation and economic growth. Florida developed a multifaceted measure of community creativity, known as the Creative Vitality Index (CVI). The CVI consists of four equally weighted attributes:

- a. The creative class—groups of people with jobs that require creativity, such as scientists, engineers, writers, poets, graphic designers, architects, and performers (Florida, 2002).
- b. Innovation—measured by analyzing the number of patents per capita.
- c. High-tech industry
- d. Diversity—measured by the Gay Index, which Florida argues is a reasonable proxy for an area's openness to different kinds of people and ideas.

Human Capital

Human capital is the ability of people based on their characteristics—such as formal and informal knowledge; technical and intrapersonal skills; experience, leadership, and talent—to develop and enhance their resources (Gutierrez-Montes, 2005; Emery & Flora, 2006). This capital also includes those attributes of individuals that contribute to their ability to earn a living, strengthen community, and otherwise contribute to community organizations, their families, and self-improvement (Flora & Flora, 2013). Measuring human capital provides insight into the health of the potential workforces and ability of the community to be resourceful and access outside resources and bodies of knowledge (Emery & Flora, 2006). The local labor force in turn affects the community's success in attracting or supporting new business enterprises (Flora & Flora, 2013).

Human and social capital are closely linked and are argued to be necessary for developing sustainable solutions to natural resource management issues (Pretty & Ward, 2001). This type of capital describes the community's capacity to access outside resources to contribute to local community and economic development (Emery & Flora, 2006; Flora & Flora, 2013). This combination of capital could play an important role in supporting biorefinery projects through the implementation process.

CAAM Measures

To examine human, cultural, and social capital, Rijkhoff et. al (2017) used existing data sets that include measures at the county level. Using publicly available statistics such as the County Health Rankings from 2013 (human capital), the Creative Vitality Index (CVI) from WESTAF 2010 (creative or cultural capital), and the dataset collected by Rupasingha et al. which incorporates data from the years 1997, 2005, and 2009 (social capital), the study calculated scores for each social asset per county for the years available (Rijkhoff et al., 2017). Table 3 provides an overview of the proxy datasets used to quantify social, human, and cultural assets.

Table 3. Measures of Social, Cultural and Human Capital used in CAAM (Rijkhoff et al., 2017)

COMMUNITY CAPITAL	COMMUNITY ASSET ASSESSMENT MODEL
Social Capital	# Rent-Seeking Groups: political, labor, professional and business organizations # Non-Rent Seeking Groups: civic organizations, bowling centers, golf clubs, fitness centers, sports organizations and religious organizations # Non-Profit Organizations % Voter Turnout
<ul style="list-style-type: none"> Rupasingha et al, 2006 	
Cultural Capital	# Arts related organizations # Arts related business # Occupational employment in the arts \$ Revenues of arts related goods and services
<ul style="list-style-type: none"> WESTAF 	
Human Capital*	Health: % Low birth-weight % Premature deaths % Obese (BMI >30) % Self-reports of poor health condition (physically and mentally) Poverty % Poverty (and % children in poverty) % Uninsured % Unemployed % No access to health due to costs Education: % Between age 25 and 44 with some post-secondary education Language: % Non-proficiency in English
<ul style="list-style-type: none"> County Health Ranks 	

Note: Table shows what variables were used to measure the community assets. All counts (#) and amounts (\$) are calculated as a rate of the population per 10,000.

* The scores for human capital were reversed so that higher scores indicate more human capital. This was done for ease of interpretation and continuity among the three capitals of interest.

Research Objectives

Site selection is an important decision that can critically impact the success of the aviation biofuel industry. These decisions tend to be based on various economic and biogeophysical resource criteria and often overlook valuable social assets necessary for successful implementation of these highly technical projects (Martinkus, et al., 2014; Martinkus, et al., 2017). This step-wise approach to biorefinery site selection has the potential to provide a more holistic approach to biorefinery siting and is the first DST to attempt to incorporate social assets into the site selection process. CAAM relies on social measures proxies to assess social, human, and cultural capital. To ensure that these proxies are measuring and thus accurately predicting community readiness, it is essential to validate and refine the model.

A project applying a multiple case study methodology relying on key informant or stakeholder interviews and documentary evidence was developed to ground-truth CAAM. This study explores how social assets (social, cultural, and human capital) play a role in four communities in the U.S. West—Lakeview, Oregon; Missoula, Montana; Boardman, Oregon; and Tacoma, Washington—where biofuel, refinery, or high-tech projects have achieved success, partial success, partial failure, or failure to implement the project. This research takes a qualitative analysis method and uses case study methodology to test CAAM’s robustness and to offer recommendations based on insights gained from the research. Findings will compare the qualitative analysis with the indicators of Rijkhoff et al. (2017) county scores to address to address the research questions below:

- I. How are the community characteristics tracked by CAAM—social, human, and cultural capital—playing a role, positively or negatively, in complex project implementation?
- II. Do the findings of the case study research support or conflict with the predictions of the CAAM county scores?

Chapter 2: Methods

Case Selection

Using a purposeful and selective approach, four communities were identified as case study locations (Bickman & Rog, 2009; Yin, 2009). Practical and substantive considerations were applied because this multiple case study is specific to the locations that meet the criteria listed below (Patton, 1990). These requirements are critical for the theories on which the case study is based.

- (1) An energy, fuel, or high-tech biomaterial industry has chosen to locate a facility in this community. Ideally, all cases would be biofuel facilities using wood-based biofuel facilities, but it was necessary to expand the facility type to other forms of energy, fuel, and biofuel facilities due to limited implementation.
- (2) The community is located in the Pacific and/or Inland northwestern U.S., which are the study regions for the USDA-NIFA supported bioenergy projects, NARA and BANR (NARA, 2014; BANR, 2015).

The case study communities and facility type that were selected are listed below (Table 4.). The criteria for determining success or failure is described in the next chapter.

Table 4. Case Overview

Case #	City	County	State	Incoming Facility	Feedstock Source	Product	Status	Rating
1	Lakeview	Lake	OR	Red Rock Biofuels	Forest Biomass	Aviation jet fuel	Not yet built	Partial success
2	Missoula	Missoula	MT	Blue Marble Biomaterials	Agriculture and Forest Biomass	Biochemical	Operating	Success
3	Boardman	Morrow	OR	ZeaChem, Inc.	Agriculture and Forest Biomass	Ethyl Acetate/ Ethanol	Operating	Partial failure
4	Tacoma	Pierce	WA	Northwest Innovation Works	Liquid Natural Gas	Methanol	Never built	Failure

Data Collection

The research used both primary and secondary data sources. Primary data collection strategies included interviews with project stakeholders and key informants. Twenty-one phone interviews took place January—March 2017. The phone interviews ranged from 15 to 75 minutes. Interviewees were given generic labels (i.e. Local Government Employee_1). Study participants represented key actors and stakeholders involved in the process of implementing the energy, fuel, or high-tech refinery.

Stakeholders consisted of six females and fifteen males. Participants included local and state government employees; local and regional nonprofits; local and state elected officials; representatives from the incoming facility; university stakeholders; local industry representatives; and private citizens (Table 5). The interviewees' selection process was guided by purposeful sampling. Purposeful sampling was chosen to ensure the selection of stakeholders who could illuminate the questions under study (Patton, 1990). Initial participants were based on recommendations of the local extension agent, city planner, or by documentary or archival evidence (i.e. meeting minutes or local newspaper article). Additional interview participants in each community were recommended by interviewees, a form of snowball sampling (Bickman & Rog, 2009). Steered by the Interview Guide (see Appendix A), the interviews were semi-structured to allow participants to share their experiences and perceptions. All interviews executed and completed during this research were approved by University of Idaho's Institutional Review Board (Appendix B) (University of Idaho, 2016).

Table 5. Case Study and Stakeholder Group Representation of Interview Participants.

CHARACTERISTIC	TOTAL
Community	
Lakeview, Oregon	6
Missoula, Montana	4
Boardman, Oregon	5
Tacoma, Washington	6
Total	21
Stakeholder Type	
Government Employee	5
Local and Regional Nonprofit	4
Local and State Elected Officials	3
Incoming Facility	2
Local Industry	2
University	3
Private Citizen	2

Secondary sources of data include local newspaper articles; public meeting minutes; videos of public outreach and information meetings; feedstock assessment and analysis plans; government policy documents; and local organization internet sources for information on local history and background for each case community.

Data Analysis

Qualitative analysis methods used in this case study research followed a systematic process of analysis, coded first by hand and then using a qualitative data analysis software program. The interviews were recorded, transcribed, and stored in a Microsoft Word document to facilitate analysis. Apart from one individual, all interviews were audio recorded, and in those instances detailed notes were taken. Coding procedures were guided by Miles and Huberman (1994) qualitative methods involving assigning labels or tags to words, phrases, sentences, or paragraphs that relate to a concept or emerging theme within the study. Prior to analysis a “start list” of codes was established based on the study’s research questions and conceptual framework consisting of social, human, cultural, political, natural, financial, and physical capital definitions. All seven CCF capitals were used in the coding process, but this study focuses on the themes and concepts of the capitals predicted by CAAM, social, human, and cultural capital (See Table 6). The transcripts were read carefully several times, reviewed line by line, and using inductive coding techniques, added emerging themes or attributes to the code list. The transcripts were then uploaded into ATLAS.ti, a qualitative data analysis software program for the second cycle of coding. All 21 transcripts were coded and recoded thematically to ensure consistency throughout all four cases (Saldaña, 2013). Analytical notes and memos for each transcript were developed with the goal of understanding the participant’s perception and contextual meanings (Glaser, 1978; Miles & Huberman, 1994).

Strategies for accuracy and to enhance validity were employed. Two independent researchers coded a sample of the findings to ensure intercoder reliability. An interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Landis & Koch, 1977). There was substantial agreement between raters, $K=0.68$ ($p<0.001$), 95% CI (0.52609, 0.82792).

The findings from this qualitative assessment will be reported as individual cases and compared to the CAAM scoring data developed by Rijkhoff, et. al (2017). The numbers in the CAAM capital measurement tables represent the county scores as differences between the cutoff and the raw county score. For clarification, case studies focus on cities in counties where facilities have been proposed. Qualitative data focuses on the community rather than the county that the CAAM scores are based on. Shaded cells indicate scores that are better than the cutoff scores and thus, levels that are predicted to be favorable for successful project implementation. Cut-off scores are based on averages for the respective years and variables for the US West region, which has over 446 counties and are divided by themselves so that all scores were comparable (Rijkhoff et. al, 2017). Due to missing data in the health scale for some of the counties, Rijkhoff, et al (2017) added the raw obesity scores (percentage of the population with a BMI of 30 or higher) for comparison.

Table 6. Coding Themes Used for Social, Human, and Cultural Capital.

THEMES	KEY CONCEPTS	Examples
SOCIAL CAPITAL	Trust Bridging Bonding Entrepreneurial Social Infrastructure (ESI): <ul style="list-style-type: none"> • Legitimation of Alternatives • Inclusive and Diverse Networks • Mobilization of Resources Modes of Communication	Trust: “I think what we’ve got is a lot of trust that we’ve built over the years with the collaborative here, and to have those honest discussions without threats... is doable.” –Lakeview, OR
HUMAN CAPITAL	Labor and Workforce Skills: <ul style="list-style-type: none"> • Technical • Intrapersonal Knowledge: <ul style="list-style-type: none"> • Formal • Informal Experience Capacity	Labor and Workforce: “We also have a pretty skilled workforce when it comes to handling cargos and manufacture and industrial development.” –Tacoma, WA
CULTURAL CAPITAL	Values History Legacy: <ul style="list-style-type: none"> • Industrial • Environmental • Social Sense of Place	Values: “I would say, anything that supports sustainability or green initiatives would be very much a why that Missoulians would view themselves.” –Missoula, MT

Chapter 3: Results

Overview

This chapter presents four individual case studies of communities in the U.S. West addressing the two research questions of this study:

- I. How are the community characteristics tracked by CAAM—social, human, and cultural capital—playing a role, positively or negatively, in complex project implementation?
- II. Do the findings of the case study research support or conflict with the predictions of the CAAM county scores?

This section first defines what determines project success or failure. Each case study is reported individually, identifying the incoming facility, location, project rating, and operating status. A brief overview for each case provides auxiliary information and local context to assist the reader in understanding the capital analyses. Transcriptions of the participant interviews were coded thematically with the social, human, and cultural capital themes presented in Table 6. Each of these themes were identified throughout the four case studies but not necessarily found in every individual case. Capital analyses represent the themes and concepts identified in an individual case's data. These themes are examined for their role in leading to project success or failure, and then compared to the predictions of the CAAM scores, where shaded cells indicate scores that are better than the cutoff scores and predict favorable asset levels for project implementation. These case studies aim to assess the degree to which CAAM accurately measures or predicts project outcome.

Defining Success and Failure

Each case was examined for its level of success or failure based on a protocol adapted from a retrospective analysis of past refinery projects (Rijkhoff et al., 2017).

Success: The refinery has been operating smoothly throughout its existence. This project has encountered very little to no resistance from the local community, and it has not faced any significant legal roadblocks. It has also been economically viable throughout its operation.

Partial Success: The refinery is currently operating and producing fuel or biomaterials. This case will include refineries that are successfully moving through the public permitting process with local support and refineries that have encountered some significant legal or economic roadblocks throughout its operation. These may include major environmental lawsuits or violations or struggles to remain economically viable. Despite these challenges, the refinery operates normally today and can remain economically viable on products.

Partial Failure: The refinery is currently operating but has been forced to diversify its operations to maintain economic viability, compromising the original purpose of the refinery; lawsuits or environmental violations have greatly impeded the refineries ability to operate continuously; or financial problems have forced the refinery to operate only periodically, greatly limiting production.

Failure: The refinery was never built, having encountered strong local resistance to its construction or severe economic constraints that dried-up funding for construction or the refinery had to shut down operations completely due to local resistance, environmental litigation, or economic ruin.

Case Study 1:

Incoming Facility: Red Rock Biofuels
 Location: Lakeview, Lake County, OR
 Rating: Partial Success
 Status: Not Yet Built

Case Overview

The town of Lakeview, population 2,500, is in south central Oregon (U.S. Census Bureau, 2010). The landscape varies from high desert to the mixed conifer woodlands of the Fremont-Winema National Forest. Including forest, range, and sage brush meadow, nearly 78 percent of Lake County is federally-owned land (Kruse, 2012). The history and economy of Lakeview are deeply tied to both the rangelands and forests. At the peak of the timber boom, Lake County had five operating sawmills pulling most of their supply from the Fremont-Winema National Forest. During the late 1980s and early 1990s, protests over environmental degradation and the listing of the Northern spotted owl as an endangered species disrupted the timber industry; four of the five saw mills in Lake County closed (Kruse, 2012). In addition to economic losses, forests around Lakeview had significant health issues (e.g. bark beetle infestation, overstocked fuel loads, etc.) requiring restoration and wildfire risk reduction (Kruse, 2012). To address these concerns, community leaders and land management agencies formed the Lakeview Stewardship Group (LSG) in 1998 (White et al., 2015).

The LSG worked with local environmental nonprofits and economic development organizations to seek markets for post-harvest forest residuals (e.g. slash piles) from fuel reduction projects. LSG and local partners conducted a biomass supply assessment and a renewably energy opportunity analysis and implementation strategy (Mater, 2006; Hider, 2010; Gardner, 2011). These efforts spurred Iberdrola Renewables, out of Spain, to attempt to build a 26.8 MW biomass cogeneration facility in Lakeview (Iberdrola Renewables, 2011). After starting construction, the project was halted because the company was unable to attain a Power Purchasing Agreement with the local utility (Austin, 2011).

The Iberdrola biomass project opened the doors for Red Rock Biofuels (Red Rock). Red Rock has selected Lakeview as the location for their first commercial scale, wood-based jet, diesel and naphtha fuels facility (Red Rock Biofuels, 2015). While this facility has not yet been built, the company has attained several approvals and permits meeting requirements for an enterprise zone, air quality, and pipeline capacity, and receiving an urban growth boundary amendment.

Capital Analysis

Social Capital:

Key concepts of social capital, including trust, bridging, bonding, entrepreneurial social infrastructure, and communication, were present in every stakeholder interview conducted in Lakeview and are illustrated by quotes in Table 7. Lake County has established trust and working relationships between various stakeholders in the LSG who have worked together on contentious forest management issues for over a decade. Within this forest collaborative, there are environmental advocates that do not want to see an industry created around small diameter wood utilization because of fear of overharvesting and environmental degradation. The executive director of a participating nonprofit believes that these groups are not opposing the project because of the trust that has been established over the years; Trust in each other, and trust in the collaborative's forest monitoring and decision making process.

I think what we've got is a lot of trust that we've built over the years with the collaborative here and to have those honest discussions without threats and those kinds of stuff, is doable. And that's the neat process about having the collaborative operate for so many years is that trust level. We don't always agree on everything but we can discuss them without getting angry...

If it was not for the monitoring, and we report and we do field trips with them every year and go to these places where the work is occurring both pre- and after and they get to go out there and we explain the data. Without that, I'm convinced [they] would be against it. Then that fear of over harvest is real because who is watching it?
(Local Nonprofit)

The LSG practices high levels of social capital. This group's ability to discuss and combine different perspectives on forest management to reach shared goals, demonstrates Flora's (et. al, 1997) concept of legitimization of alternatives, an important component of ESI.

Table 7. Selected quotes on social capital from interviews with stakeholders in Lakeview, OR.

THEMES		SELECTED QUOTES
Trust		<i>I think what we've got is a lot of trust over the years that we've built with the collaborative here and to have those honest discussions without threats and those kinds of stuff, is doable. And that's the neat process about being in, having the [forest] collaborative operate for so many years is that trust level. We don't always agree on everything, but we can discuss them without being, getting angry. (Nonprofit)</i>
Bridging		<i>And I said, I need to just go over there because I know a lot of those tribal leaders and just explain to them. If we want to grab the map out right now and change the line, we can do it. Because we're going to work with you, not against you. It's not going to be something that's negative for the tribe." (County Commissioner)</i>
Entrepreneurial Social Infrastructure (ESI)	Legitimation of Alternatives	<i>[Environmental nonprofits] and others are taking a neutral stance right now on it. On this specific project. Not on biofuels in general. Maybe other places they come out and oppose it because of the long-term collaborative and our local participation. That collaborative agreed to stay neutral on it for now. (Local Nonprofit)</i>
	Inclusive and Diverse Networks	<i>We put together... a biomass committee, on the federal lands biomass and [he], has been very involved in that. It has been about a year now that we've been doing this but I've reached out to Senator Wyden's office, and we've started out with a couple of conference calls that I was on with him describing the need to go back and try to get the renewable energy RINs credits applied to federal lands again through a pilot process, instead of a broad sweeping across the nation. (County Commissioner)</i>
	Resource Mobilization	<i>We joined with [our] Senator to try and introduce a piece of legislation that would remedy that. I work very closely with staff from Red Rock and [the] Senator's office and ... a number of other stakeholders for about six months to try to get a piece of legislation that had a path forward. Ultimately, we were unsuccessful but you know, we worked together quite closely for a pretty long period of time. (State Government Employee)</i>
Modes of Communication		<i>The county commissioners our representatives and myself, and their forester and the governor's office hold every other week calls. (Local Nonprofit)</i>

The project is not only moving forward without opposition from environmental advocacy groups, but it is actively supported by local leadership who have engaged their networks to increase the viability of this project. Regular conference calls enable communication and keep multiple-stakeholders informed of progress and potential obstacles. As one local nonprofit representative explained, “The county commissioners, our representatives and myself, and their forester and the governor’s office hold every other week calls.” And tangible results are emerging. Local elected officials have worked with county, state, and federal employees and nonprofit groups to put forth a bill aiming to expand the federal renewable fuel standards to include woody-biomass from federal lands.

I've reached out to the Senator's office and we've started out with a couple of conference calls that I was on with him describing the need to go back and try to get the renewable energy RINs credits applied to federal lands again through a pilot process, instead of a broad sweeping across the nation. (Local Elected Official)

This effort to change federal law was ultimately unsuccessful, but the group continues to try new strategies to increase the long-term economic feasibility of this biofuel refinery. This case study shows concepts of social capital— trust, relationships, networks, and communication—contributing to the development and enhancement of ESI and community agency that recruited a wood-based biomass

industry to Lake County. They are continuing to use their social capital to support the biofuels company through the implementation process.

Table 8. CAAM Indicator: Social capital in Lake County, OR (Shaded box indicates favorable levels of social capital)

CAAM MEASUREMENTS OF SOCIAL CAPITAL	Soc Cap 1997	Soc Cap 2005	Soc Cap 2009	Soc Cap 2009 ISD
# rent-seeking groups- political, labor, professional, and business organizations.	3.00	2.64	2.81	2.12
# non-rent-seeking groups-civic organizations, bowling centers, golf clubs, fitness centers, sports organizations, religious organizations				
# non-profit organizations				
% voter turn out				

To measure social capital, CAAM uses several proxies identified in the social capital literature including the number of rent-seeking, non-rent-seeking groups, nonprofit organizations and percent voter turnout (see Table 8). CAAM predicted that Lake County, where Lakeview is located, had favorable levels of social capital.

Human Capital:

In Lakeview, human capital concepts that appeared most often in the stakeholder interviews described the skills, knowledge, and experience of the local stakeholders involved in the project (see Table 9). Many interviewees mentioned the contribution of one local stakeholder seen as supporting the progression of the project:

He's quite knowledgeable about renewable energy in general but has specific knowledge surrounding biomass and has a grasp on the federal policy surrounding it. (Incoming Facility)

[With him], specifically, it's just the expertise and the understanding of all the issues around the forest and the jobs, the economics, the economic benefit of the job creation. (Local Elected Official)

Absent in the Lakeview interviews was discussion of the local labor and workforce. Only once a local elected official mentioned that implementing projects of this size could present challenges for rural communities with small administrative staffs.

Table 9. Selected quotes on human capital from interviews with stakeholders in Lakeview, OR.

THEMES	SELECTED QUOTES
Skills (Technical & Intrapersonal), Knowledge (Formal & Informal), and Experience	County Commissioner speaking of another commissioner: <i>He's very versed in the forest health side of it. He has 32 years' experience as working for the forest service on the fire side; he is our biggest voice... and he has the connections at the D.C. level. He's good. (County Commissioner)</i>
Capacity	<i>Some of the challenges [are] whenever they have 200-250 million dollar projects that's looking to come into a frontier rural community. It is huge, most agencies, locally, and even state agencies haven't dealt with this as much as what is coming at you. So, it's not only the impact to the investor developer; it's impact to the state agencies that have to do a lot of extra work to answer these questions. It's a lot of extra work for, you take a small place like Lakeview, our departments, our planning department, our building departments, and all, are one or two people within them. So, it takes extra time, extra hours. (County Commissioner)</i>

Project-related skills, local and technical knowledge, and experience contributed to Lakeview's ability to support Red Rock through the implementation process. This type of human capital was specific to individual stakeholders and could be difficult to measure. CAAM predicted favorable levels of health, obesity, and language, but it is unclear from this study's data if these measures accurately describe the state of the local workforce (Table 10).

Table 10. CAAM Indicator: Human capital in Lake County, OR (Shaded box indicates favorable levels of human capital)

CAAM MEASURES OF HUMAN CAPITAL		
Health	Health 2013	Health ISD
% low-birth-weight	-1.98	-1.01
% premature deaths		
% self-reports of poor health condition (physically and mentally)		
Obese	Obesity 2013	Obesity ISD
% obese (BMI >30)	-1.6	-0.4
Poverty	Poverty 2013	Poverty ISD
% poverty (and % children in poverty)	0.87	0.45
% uninsured		
% unemployed		
% no access to health care due to costs		
Education	Education 2013	Education ISD
% between age 25 and 44 with some post-secondary education	-1.0	-0.1
Language	Language 2013	Language ISD
% non-proficiency in English	-4.0	-0.8

Cultural Capital:

Key concepts of cultural capital in Lakeview described local history, legacy, and community values. The environmental history of the endangered species listing of the Northern spotted owl led some to have reservations of an incoming wood-based biofuel refinery.

Certainly, there are groups that are not supportive, there are environmental organizations that don't want to see an industry created around small diameter wood utilization because they fear the political and economic forces that may follow and that I think stems from their particular worldview and their past experiences.
(Regional Nonprofit)

However, for the most part, the community sees this project as fitting with their goals of creating a “new natural resource economy” based on both natural resource and renewable energy development. They also have a social legacy that is more supportive of biomass projects than neighbors in the region.

So, if you were to put this in Klamath Falls, 100 miles to the east, where there is a history of protest and antagonism around the siting of biomass plants. From a feed stock perspective, if you can get everything you need in Lakeview, and it's no more or less expensive to rail it into California, why would you locate closer to an urban center where you were going to get potentially more antagonistic relationships with people for the siting of the plant?” (State Government Employee)

History, legacy, and values have shaped Lakeview’s mostly-supportive outlook on siting a biofuel refinery in their community (see Table 11).

Table 11. Selected quotes on cultural capital from interviews with stakeholders in Lakeview, OR.

THEMES		SELECTED QUOTES
Legacy	Industrial Legacy	On why the facility chose to site in Lakeview, OR: <i>Abundant woody biomass supply, preexisting timber and forestry community, and an existing forest product industry.</i> (Incoming Facility)
	Environmental Legacy	<i>Certainly, there are groups that are not supportive; there are environmental organizations that don't want to see an industry created around small diameter wood utilization because they fear the political and economic forces that may follow and that I think stems from their particular worldview and their past experiences.</i> (Regional Nonprofit)
	Social Legacy	<i>So, if you were to put this in Klamath Falls, 100 miles to the east, where there is a history of protest and antagonism around the siting of biomass plants.</i> (State Government Employee)
Values		<i>I think a third thing, is just what we know about rural communities and the way that they react to biomass projects much more favorably than a lot of their urban counterparts.</i> (State Government Employee)

While CAAM measures did not indicate that Lake County would have favorable levels of cultural capital (Table 12), the community’s legacy and values support the Red Rock project. Evidence of creativity and innovation in the support of this project is demonstrated during the stakeholders’ bi-weekly phone calls trying to change the legislation to make the project viable. Their creativity demonstrated in support of this refinery project stems from having a local history of collaboration around natural resource management decisions that is backed by social capital. The values of this community align with this project, and the stakeholders are applying their knowledge, experience, and networks (human and social capital) to troubleshoot problems that arise and maximize project feasibility and expand forest restoration. Concepts of cultural capital—values, legacy, and traditions—shape how the Lakeview perceived this project and influenced how they employed their human, social, and political capital to support or oppose the project.

Table 12. CAAM Indicator: Cultural capital in Lake County, OR (Shaded box indicates favorable levels of cultural capital)

Creative Vitality Index (CVI)	CVI 2006	CVI 2007	CVI 2008	CVI 2009	CVI 2010
	-0.215	-0.25	-0.179	-0.2	-0.3171

Case Study 2:

Incoming Facility Blue Marble Biomaterials

Location: Missoula, Missoula County, MT

Rating: Success

Status: Operating

Case Overview

Missoula is in western Montana on the edge of the Clark Fork River near the confluences of the Bitterroot and Blackfoot Rivers. The city has a population of 69,190, and the county has a population of 109,225 people (U.S. Census Bureau, 2015). Historically, the primary sources of employment in the area were the USFS and the state's first public university, the University of Montana. The Missoula Valley had an active timber industry until the mid-1990s, and the local pulp mill closed in 2009 (Make It Missoula, 2010). Today, the leading employer is still the University of Montana which enrolls approximately 12,400 students (University of Montana, 2016). The next major employers in the area are a mix of public and private sectors, including Community Medical Center, the Providence St. Patrick Hospital, Missoula County Public Schools, and the USFS (Missoula Economic Partnership, 2011).

In addition to being a source of employment for the area, the University of Montana plays an intentional role in local economic development by training a local workforce and providing support services for entrepreneurs and start-ups (LocalNonprofit2, 2017). The area also hosts a range of organizations offering technical and financial assistance, such as the Missoula Economic Partnership, Angel Network, Montana Procurement Technical Assistance Center (PTAC), and Montana World Trade Center. Blue Marble Biomaterials (Blue Marble) worked with some of these organizations when they relocated their facility from Seattle, Washington to Missoula in 2010. They worked with various organizations to locate a site and apply for local and state grants. Blue Marble manufactures specialty chemicals from cellulosic biomass for the global flavor, fragrance and cosmetic industries (Blue Marble BioMaterials, 2014).

According to stakeholder interviews, the refinery has been operating smoothly without community resistance. Missoula-based entrepreneurial and economic development organizations help start-ups like Blue Marble to access local and state grants, connect with stakeholders, and locate sites for facilities. This formal, economic development infrastructure supported the relocation of the biorefinery from Seattle to Missoula. The biochemical company has been operating in Missoula since 2012 and is continuing to expand its technology and partnerships.

Capital Analysis

Social Capital:

Interviews in Missoula presented several concepts of social capital, including bridging social capital and communication between stakeholders (Table 13). The most interesting concept of social capital demonstrated in Missoula was the presence of several organizations and networks in the community with the sole purpose of assisting start-ups and entrepreneurial ventures through the implementation process.

We spent a lot of time working with [Blue Marble] on various incentive packages the state of Montana offers companies that are relocating [here], we helped them secure where they are located now, they got some job creation grants, they got some workforce training grants... (Local Nonprofit)

This is a strong example of how bridging social capital and networks between stakeholders can be engaged to mobilize resources for economic development.

Table 13. Selected quotes on social capital from interviews with stakeholders in Missoula, MT.

THEMES		SELECTED QUOTES
Bridging		<i>We were able to broker a conversation with all the interested parties to get that moving forward and realize that that's not regulated by our county health department so they can move forward. But we're a little different, we, most of our work with a company like Blue Marble is reactive, versus proactive. They come to us with a problem or issue and we try to help provide a solution. (Local Nonprofit)</i>
Entrepreneurial Social Infrastructure	Inclusive and Diverse Networks	<i>It's actually much broader, the different programs will serve different constituencies. The Launchpad in particular is very student oriented, though we also work with Alumni and faculty and staff. Most of those other programs are not specifically geared to serve UM affiliated individuals or the student population. It's more that they are generally open for business for anyone who needs help or looking to grow in Missoula or Montana and we can provide help. (Local Nonprofit)</i>
	Resource Mobilization	<i>We spent a lot of time working with them on various incentive packages with the state of Montana offers companies that are relocating [here], we helped them secure where they are located now, they got some job creation grants, they got some workforce training grants. (Local Nonprofit)</i>
Modes of Communication		<i>I do but I think there's many, and I think they would say the same thing. One of the factors that they chose Montana was just the ease of access to whoever they needed. Whether it be the mayor or the governor or congressional delegation. Or even a local elected official or environmental groups. Because I've heard them say that many times they were in Seattle before hand, trying to get recognized, or some awareness was always a difficulty. What they've always thought, just the ease of access into Montana was the decision maker of why they located there. (Local Nonprofit)</i>

CAAM's measures predicted that Missoula had levels of social capital that would support the incoming projects is supported with the qualitative findings (Table 14).

Table 14. CAAM Indicator: Social capital in Missoula, MT (Shaded box indicates favorable levels of social capital)

CAAM MEASUREMENTS OF SOCIAL CAPITAL	Soc Cap 1997	Soc Cap 2005	Soc Cap 2009	Soc Cap 2009 ISD
# rent-seeking groups- political, labor, professional, and business organizations.	1.17	2.07	1.84	1.07
# non-rent-seeking groups-civic organizations, bowling centers, golf clubs, fitness centers, sports organizations, religious organizations				
# non-profit organizations				
% voter turn out				

Human Capital:

Missoula stakeholders addressed concepts of human capital that are important for a small, high-tech biomaterial refinery, such as availability of a skilled and educated workforce (Table 15). All four interview participants emphasized the role of the University of Montana in connecting the refinery with a skilled workforce:

Having access to the University of Montana played a pretty key role for them. Whether it be recruiting students or doing research with a faculty and that's been a big part of their reason for locating there. So, I guess we shouldn't ever lose out the ties to the University of Montana, was a big deal as to why they were there. (Local Nonprofit)

Table 15. Selected quotes on human capital from interviews with stakeholders in Missoula, MT.

THEMES	SELECTED QUOTES
Labor and Workforce	<i>Having access to the University of Montana played a pretty key role for them. Whether it be recruiting students or doing research with a faculty and that's been a big part of their reason for locating there. So, I guess we shouldn't ever lose out the ties to the University of Montana, was a big deal as to why they were there. (Local Nonprofit)</i>
Skills (Technical & Intrapersonal), Knowledge (Formal & Informal), and Experience	<i>Well, I mentioned the University. We have a fairly educated community, you know, you have the ability to get the right employees, because, not just here, but in a lot of places, there's difficulty in getting skilled employees and because it's a University town, I think for what they need. I know I've met some scientists that work out there, I think it's positive in that regard. (Local Government Employee)</i>

Both the interview findings and the CAAM measurements suggest favorable levels of human capital in Missoula (see Table 16).

Table 16. CAAM Indicator: Human capital in Missoula, MT (Shaded box indicates favorable levels of human capital)

CAAM MEASURES OF HUMAN CAPITAL		
Health	Health 2013	Health ISD
% low birth-weight	2.38	-1.02
% premature deaths		
% self-reports of poor health condition (physically and mentally)		
Obese	Obesity 2013	Obesity ISD
% obese (BMI >30)	-5.3	-1.2
Poverty	Poverty 2013	Poverty ISD
% poverty (and % children in poverty)	-0.95	-0.5
% uninsured		
% unemployed		
% no access to health care due to costs		
Education	Education 2013	Education ISD
% between age 25 and 44 with some post-secondary education	16	1.4
Language	Language 2013	Language ISD
% non-proficiency in English	-2.9	-0.7

Cultural Capital:

Concepts of cultural capital found in the Missoula interviews focused on community values and sense of place, examples in Table 17. Blue Marble uses cellulosic material from woody biomass and agricultural waste to create biochemical that replace their petroleum counterparts found in foods, fragrances, etc. Seen as a “green” and “clean” industry, this project was easily accepted by the community.

I would say, anything that support sustainability or green initiatives would be very much a way that Missoulians would view themselves. So, any company that supported that, they would identify with pretty well. (Local Nonprofit)

Table 17. Selected quotes on cultural capital from interviews with stakeholders in Missoula, MT.

THEMES	SELECTED QUOTES
Social & Environmental Legacy	When asked if there was opposition: <i>Not really, the community that we're in is sort of our liberal part of Montana, so, if it was a project that had environmental concerns it would likely bring out some groups. (Local Government Employee)</i>
Values	<i>I mean, anything in Missoula that you could somewhat put under some, 'green' industry, and I think people think of them as a 'green' type of industry is looked on favorably. (Local Government Employee)</i>
Sense of Place	<i>Cause its, I don't know if you agree with this, but most people would say because it's the best place to live. We're not necessarily a cheap land buy, so that's not necessarily the reason. (Local Government Employee)</i>

Each of the stakeholders interviewed in Missoula suggested that Blue Marble chose to locate their facility in Missoula because they had a connection to the community and a strong desire to live there.

Both the cultural capital themes found in the interview process and the measures of CAAM (Table 18), indicate that this would be supportive culture for Blue Marble to site in Missoula.

Table 18. CAAM Indicator: Cultural capital in Missoula, MT (Shaded box indicates favorable levels of cultural capital)

Creative Vitality Index (CVI)	CVI 2006	CVI 2007	CVI 2008	CVI 2009	CVI 2010
	0.915	0.894	0.921	0.956	0.946

Case Study 3:

Incoming Facility: ZeaChem, Inc.
Location: Boardman, Morrow County, OR
Rating: Partial Failure
Status: Operating at reduced capacity

Case Overview

Boardman is in northeastern Oregon along the Columbia River Gorge and Interstate 84. Boardman's population of 3,320 relies primarily on agriculture, food processing, and timber resource economies (Boardman Chamber of Commerce, 2013; U.S. Census Bureau, 2015). The Port of Morrow, located near Boardman on the Columbia River, plays an important role in the local economy. With three industrial parks, the Port provides excellent physical infrastructure with appropriate zoning, and access to multi-modal transportation, and utilities. The Port is known for hosting food, seed, lumber and agriculture processing companies (Port Of Morrow, 2014a). Examples include Lamb Weston's French fry plant, Oregon Potato Company's potato flake plant, CLD Pacific Grain, and an ethanol refinery, Pacific Ethanol (Port of Morrow, 2014b). ZeaChem, Inc. (ZeaChem), a cellulosic ethanol and biochemical refinery, secured sites for both its demonstration and future commercial scale operations in one of the Port of Morrow's industrial parks. In 2012, ZeaChem and GreenWood Resources struck a biomass supply agreement to provide the plant feedstock from their hardwood, hybrid poplar tree farm (Local_Industry, 2017).

Before locating in Boardman, ZeaChem had headquarters in Denver, Colorado, and a laboratory in San Francisco (Incoming_Facility, 2017). In 2012, ZeaChem completed construction of its demonstration biorefinery in the Port of Morrow (ZeaChem, 2012). The company participates in the USDA's National Institute of Food and Agriculture (NIFA) through the Agriculture and Food Research Initiative (AFRI) Regional Coordinated Agricultural Project (CAP), called Advanced Hardwoods Biofuels Northwest (AHBN), which includes GreenWood Resources and several university stakeholders (Lane, 2015). Citing financial challenges, ZeaChem has not reached commercial scale and is operating at a limited capacity in its demonstration facility. Other setbacks include the loss of its primary feedstock source as the local hybrid poplar tree farms will be converted back to row crops. ZeaChem's technology can utilize other forms of feedstock including wood, grasses, and agricultural residues and is continuing operations at the demonstration level (Lane, 2015).

Capital Analysis

Social Capital:

The main concepts of social capital present in the Boardman interviews were bonding, bridging, inclusive and diverse networks, and communication, (see Table 19). Evidence of bonding social capital was present when a stakeholder described the community as insulated from outside influences:

Morrow County is a small enough area that individuals and groups kind of become everybody. I will say we never saw any outside groups or influences. In some communities, an operation [like] this could potentially invoke a local environmental group or regional environmental group to come in and either be opposed or supportive for differing reasons. We just don't seem to have that influence here in this community or in this area, like they do in other places. (Local Government Employee)

ZeaChem was said to be proactive with their communication and outreach efforts. Early in the implementation process, they hired a local entrepreneur to be the communication liaison between the company, the local community stakeholders, outside networks and organizations like NARA and AHBN, demonstrating both bonding and bridging social capital.

Having city council, having the mayor, having brought in county commissioners, we gave them tours, we brought in the county judge, I made sure, I can't say I, we made sure we reached out to the right people and to as many people as we possibly could, to get their support. ZeaChem was very proactive in that respect and that was the reason they hired me.

I toured every governor in the 5 years. We had three at that time, do that times ten. I toured all the governors, I toured all the senators, I gave slide presentations on the process. I did it for colleges. I did community outreach to chamber of commerce, locally, in the surrounding area. I was in charge of all tours and presentations of our process. (Local Entrepreneur)

Interview participants thought this early outreach and community engagement contributed to the initial success of implementing the demonstration plant of the ZeaChem refinery.

Table 19. Selected quotes on social capital from interviews with stakeholders in Boardman, OR.

THEMES		SELECTED QUOTES
Bonding		<i>Morrow County is a small enough area that individuals and groups kind of become everybody. I will say we never saw any outside groups or influences. In some communities, of an operation similar to this could potentially invoke a local environmental group or regional environmental group would come in and either be opposed or supportive for differing reasons. We just don't seem to have that influence here in this community or in this area. Like they do in other places. (Local Government Employee)</i>
Bridging		<i>Having city council, having the mayor, having brought in county commissioners, we gave them tours, we brought in the county judge, I made sure, I can't say I, we made sure we reached out to the right people and to as many people as we possibly could, to get their support. ZeaChem was very proactive in that respect and that was the reason they hired me, I guess. (Local Leadership)</i>
Entrepreneurial Social Infrastructure (ESI)	Inclusive and Diverse Networks	<i>It was very informative to the public, and we reached out to the Universities. The University of Washington, Washington State University, Idaho, then another one in California. We reached out with all of these organizations. We just wanted to utilize all of the knowledge that was brought and they also brought some technical people that helped as well. (Local Leadership)</i>
Modes of Communication		<i>He was a wonderful spokesman, he, it seemed like every day I was in touch with him. He was conducting tours for different citizen groups or interest groups or what have you. He was very active in explaining what the refinery was doing, why it was in Boardman, how it was operating, what the promise of it was going to be. (Local Industry)</i>

However, this early community engagement and support could not counter the technical and financial challenges that have kept ZeaChem operating at limited and reduced capacity. While the qualitative data demonstrates concepts of social capital engaged in support of the project, CAAM's measures of proxy datasets do not suggest favorable levels of social capital (see Table 20).

Table 20. CAAM Indicator: Social capital in Boardman, OR (Shaded box indicates favorable levels of social capital)

CAAM MEASUREMENTS OF SOCIAL CAPITAL	Soc Cap 1997	Soc Cap 2005	Soc Cap 2009	Soc Cap 2009 ISD
# rent-seeking groups- political, labor, professional, and business organizations.				
# non-rent-seeking groups-civic organizations, bowling centers, golf clubs, fitness centers, sports organizations, religious organizations	0.05	-0.28	-0.02	.02
# non-profit organizations				
% voter turn out				

Human Capital:

Key concepts of human capital present in the participant interviews in Boardman, were labor and workforce, skills, knowledge, and capacity (Table 21). Interview participants cited challenges of getting employees with technical expertise to come from Denver and San Francisco to continue research and development on the demonstration site.

Boardman is, in a modern sense a little bit remote and so because, this is subtle, I'll be careful here, because we were a demonstration plant and we were still developing technology in trying to put it in phase with the actual construction with the plant. One of the problems was that it was very hard to get highly trained people or even temporary staff, temporary meaning needing to go to the plant there and back again. (Incoming Facility)

Stakeholders contended that when the project reached commercial scale, Boardman and the surrounding area would be able to meet its labor and workforce needs. However, ZeaChem remains operating at the demonstration level. A participant representing the biofuel company went as far to say that in addition to technical challenges, the coordination of their employees could have contributed to the facility to depart from their financial and technological timelines.

Table 21. Selected quotes on human capital from interviews with stakeholders in Boardman, OR.

THEMES	SELECTED QUOTES
Labor and Workforce	<i>I would say the Port of Morrow authority was equally important in terms of a place, remember my point was it wasn't just a pilot plan, the Boardman facility as exists today and was developed was only the first step to commercializing, so it needed industrial type infrastructure, people were available to work in facilities. (Incoming Facility)</i>
Skills (Technical & Intrapersonal), Knowledge (Formal & Informal), and Experience	<i>It was difficult though to run an R&D project there. Because you just had to get a whole lot of people who lived in Denver and SF to a place that was a little bit hard to get to. (Incoming Facility)</i>
Capacity	<i>But you would never do the research there because it's just too hard to get to and get people to live there. That's not a criticism of the community again, that's not about Boardman, that's about just the nature of Rand D and things like that. (Incoming Facility)</i>

CAAM's proxy measures of human capital, health, obesity, and poverty, indicate favorable levels of human capital, except in education and language (Table 22).

Table 22. CAAM Indicator: Human capital in Boardman, OR (Shaded box indicates favorable levels of human capital)

CAAM MEASURES OF HUMAN CAPITAL		
Health	Health 2013	Health ISD
% low birth-weight	-0.92	-0.47
% premature deaths		
% self-reports of poor health condition (physically and mentally)		
Obese	Obesity 2013	Obesity ISD
% obese (BMI >30)	-1	-0.2
Poverty	Poverty 2013	Poverty ISD
% poverty (and % children in poverty)	0.67	0.35
% uninsured		
% unemployed		
% no access to health care due to costs		
Education	Education 2013	Education ISD
% between age 25 and 44 with some post-secondary education	23.6	-2.2
Language	Language 2013	Language ISD
% non-proficiency in English	4.4	-0.8

Cultural Capital:

Key themes of cultural capital present in Boardman described the supportive influence of the local community's legacy and values, see Table 23. Interviewees said the community and local stakeholders are generally supportive of most economic development projects and especially those projects that relate to food, agricultural, and timber industries.

They were supportive of the project but, it's kind of hard to call them out as supportive of this project, they're supportive of most projects that get proposed at the Port. I can't say, there wasn't anything uniquely different about this project.
(Local Government Employee)

Community representatives saw the project as a natural fit in the community's agriculturally-based economy and found it easy to support the project. They also thought that it aligned with their values of a community to have a "green industry" like ZeaChem. A company that uses agriculture and wood waste to make fuel that produced cleaner emissions.

I think that whole area of renewable biomass, renewable biofuels really builds into the Boardman community. (Local Industry)

Boardman's industrial legacy and community values resulted in this project be easily accepted and supported by the community stakeholders.

Table 23. Selected quotes on cultural capital from interviews with stakeholders in Boardman, OR.

THEMES		SELECTED QUOTES
Legacy	Industrial Legacy	<i>The Port of Morrow is trying to find ways to diversify the operations that are happening there. So, 40 years ago as the Port was beginning and in its infancy stage and kind of getting its feet wet and starting to site businesses there. We're an agricultural based economy, and so those industrial opportunities were value added opportunities. (Local Government Employee)</i>
Values		<i>A lot of it has to do with keeping the loop together if you will because... The trees would be grown, they produce oxygen, clean air, they come in, we produce ethanol put off zero emissions, and it had to be into your cars which reduces pollution. It was, it had the right connotation if you will, it was touchy-feely good. (Incoming Facility Employee)</i>

However, as shown in Table 24, CAAM's measures do not indicate favorable levels of cultural capital.

Table 24. CAAM Indicator: Cultural capital in Boardman, OR (Shaded box indicates favorable levels of cultural capital)

Creative Vitality Index (CVI)	CVI 2006	CVI 2007	CVI 2008	CVI 2009	CVI 2010
	-0.557	-0.551	-0.548	-0.59	-0.552

Case Study 4:

Incoming Facility: Northwest Innovation Works

Location: Tacoma, Pierce County, WA

Rating: Failure

Status: Never Built

Case Overview

Tacoma is a port city in Pierce County, Washington. With a population of 203,481, Tacoma is the largest city included in this case study research (U.S. Census Bureau, 2015). Tacoma is located on Commencement Bay in the Puget Sound, approximately thirty miles southwest of Seattle, Washington. The natural deep water harbor is home to the Port of Tacoma, one of the largest container ports in the world. The Port has been an active industrial hub since the late 1800s and is the location of several Superfund sites, including the Kaiser aluminum smelter site in the Tacoma-Tide Flats area. This Superfund site was the proposed location of the Northwest Innovation Works (NWIW), a natural gas-to-methanol production plant. The facility would export methanol to produce olefins for use in plastics and other goods (City of Tacoma, 2016).

The methanol plant had early political support from Washington State Governor Jay Inslee and other public officials (Nunnally, 2016). On May 1, 2014, the Port of Tacoma commissioners voted to sign the lease agreements for the Port property (Port of Tacoma, 2014). After the announcement of the lease agreement, there was an outpouring of public opposition and concerns about safety, pollution, and the methanol plant's demands on water, electricity and natural gas (Martin & Nunnally, 2016). NWIW failed to address the community's concerns. Several community groups formed to organize against the project. Seeing this swell of opposition, established stakeholders who work on local water resource issues sought to gather and provide information to the public. Two of these organizations, Citizens for a Healthy Bay and the University of Washington-Tacoma's Center for Urban Waters held four informational sessions to discuss the project's potential impacts on the local environment and regional water and power supplies. The goal of these sessions was to develop a common understanding of the factors involved in siting a methanol production plant in the Port of Tacoma (Center for Urban Waters, 2016).

These informational meetings did not ease public concerns. The community expressed opposition through letter writing campaigns and during the public comment period prior to the State Environmental Policy Act (SEPA) environmental review process (Stepankowsky, 2016). Three public comment meetings were scheduled in February, 2016. Hundreds of Tacoma residents attended the first two public meetings. Not everyone in attendance opposed the project; people in the economic

development sector and the building and trades unions came to express support the continuation of the review process, citing the potential benefit of new job opportunities. Public concerns pushed the Tacoma-Pierce County Board of Health to ask the city of Tacoma to require a human health assessment, along with the SEPA review (Martin, 2016). After the opposition at the second public comment meeting, NWIW announced a temporary suspension in the permitting process for the methanol plant (Stepankowsky, 2016). By the end of April, 2016, NWIW had terminated their lease on the Port of Tacoma property. The opposition groups are still active and are now focusing their disapproval on a proposal to build a liquefied natural gas facility at the Port of Tacoma. The NWIW project was frustrating to many of the stakeholders involved, the primary reason being that the project was terminated without consulting the information that would have been provided by the environmental review process.

Capital Analysis

Social Capital:

The analysis of social capital in Tacoma was complex because it demonstrated both negative and positive indicators of social capital concepts. Some examples are illustrated in Table 25.

Communication failure and breakdowns between stakeholder groups eroded public support for this refinery in two ways. The first, mentioned by all six interview participants, was NWIW's failure to adequately address the community's environmental and safety concerns. This meant the Port of Tacoma was left to answer to the public, but could not properly address these concerns until after the environmental review.

The second communication breakdown occurred between the Port and its constituents. Although the Port notified the public of meetings through traditional modes of outreach (e.g. press releases, newspaper articles, radio advertisements, and county websites), this information did not reach community members who learned about the incoming methanol refinery through social media.

I had a fascinating conversation with a woman at one of our meetings afterward, where she said, 'Why am I just hearing about this now from my friends on Facebook?' I said, 'well, there was a front-page story in the newspaper,' and she said, 'well, I don't subscribe to the newspaper.' ...I think that's something that I as a communications professional am still grappling with. (Local Government Employee)

Feeling inadequately informed and distrustful of the Port, people in the community began organizing in opposition of the methanol refinery.

Negative indicators of ESI were present in this case in two ways. In places with high levels of ESI, there is an ability to accept controversy without personalizing politics and there is trust in the process. In Tacoma, the opposite was shown for both. For example, the groups opposing the Chinese-backed methanol project were labeled as xenophobic:

One of the things that was really disappointing to many of us was, this pretty quickly turned into a xenophobic exercise because the backers of this project were Chinese. (University Stakeholder)

But a sub plot to this whole thing was the feeling that the opposition and some of my words were construed as being xenophobic against the Chinese. (State Elected Official)

The swell of opposition led NWIW to terminate the lease before it could go through an environmental review process. This brought out some members of the community to oppose the opposition:

It wasn't necessarily in favor of the project as it was, 'hey, we have an environmental review process for a reason. You should let the review process go forward. So, that we can determine whether this is a beneficial project or not.' I think they were particularly disturbed that we shoved aside due process. (Local Government Employee)

Positive indicators of bonding and bridging social capital were present in this case, but not used to support the methanol refinery. Several interview participants commented that this level of public participation was surprising and unusual for Tacoma. Connecting organizations, a nonprofit and university stakeholder, tried to facilitate accurate information to the community.

[A University Stakeholder] stepped in to try and answer some of the more technical aspects of the questions. How is methanol made, what is the burning point, what are its uses? [The local nonprofit] played more of a role of facilitator and questioner. They weren't trying to answer any of the questions, they were just trying to make sure the questions got answered. (Local Government Employee)

Opposition groups formed and connected with established organizations to mobilize resources and develop campaigns against the project.

That was kind of the role that we took as an organization, it kind of evolved as the process took shape and we set out to empower the community, whether it was individuals or other organizations to take effective action on the methanol plant. (Local Nonprofit)

Table 25. Selected quotes on social capital from interviews with stakeholders in Tacoma, WA

THEMES		SELECTED QUOTES
Distrust		<i>I believe of all the Ports in the NW, the Port of Tacoma is still willing to put active polluting facilities in, like Seattle would never ever allow such a thing. So, I think number one, our Port commission is weak and people, the industry understands that. (Community Member)</i>
Bridging		<i>We hooked up with the Sierra Club, our local chapter and we did this letter writing campaign to the City making sure that they would not schedule the scoping meeting between Christmas and the New Year because it was on track to be set that. The we also did a letter writing campaign asking for a longer public comment period. (Community Member)</i>
Entrepreneurial Social Infrastructure (ESI)	(negative indicator of) Legitimation of Alternatives	<i>But a sub plot to this whole thing was the feeling that the opposition and... were construed as being xenophobic against the Chinese. (State Elected Official)</i>
	Resource Mobilization	<i>That was kind of the role that we took as an organization, it kind of evolved as the process took shape and we set out to empower the community, whether it was individuals or other organizations to take effective action on the methanol plant. (Local Nonprofit)</i>
Modes of Communication (poor)		<i>I think that's part of what fed into the challenges that we had in communicating the benefits, or the potential benefits of this project. By the time we got to that public hearing, there were all of these people that were coming out of the wood work saying 'why am I just now learning about this?' (Local Government Employee)</i>

Neither the interview findings or CAAM measures, found in Table 26, suggest favorable social capital for project implementation.

Table 26. CAAM Indicator: Social capital in Tacoma, WA (Shaded box indicates favorable levels of social capital)

<i>CAAM Measurements of Social Capital</i>	Soc Cap 1997	Soc Cap 2005	Soc Cap 2009	Soc Cap 2009 ISD
# rent-seeking groups- political, labor, professional, and business organizations.				
# non-rent-seeking groups-civic organizations, bowling centers, golf clubs, fitness centers, sports organizations, religious organizations	-0.86	-0.7	-0.75	-0.56
# non-profit organizations				
% voter turn out				

Human Capital:

The concepts of human capital found during the interviews in Tacoma focused primarily on the type and availability of the local workforce (Table 27). When asked why they thought NWIW selected Tacoma to site the methanol refinery, after first mentioning the natural and physical infrastructure, the interviewees described the workforce as ideal for this industry:

We also have a pretty skilled workforce when it comes to handling cargos and manufacturing and industrial development. So, that I think contributed to them selecting Tacoma as well. (Local Government Employee)

Geographic infrastructure, natural deep water port, we also have the capacity in terms of the workforce to build and operate the plant. This is a very blue collar city and there's a lot of qualified folks to work here. (Local Nonprofit)

Table 27. Selected quotes on human capital from interviews with stakeholders in Tacoma, WA.

THEMES	SELECTED QUOTES
Labor and Workforce	<i>We also have a pretty skilled workforce when it comes to handling cargos and manufacturing and industrial development. So, that I think contributed to them selecting Tacoma as well. (Local Government Employee)</i>

CAAM measures, found in Table 28, demonstrate favorable levels of education and language indicators of human capital, but no other favorable human capital measures (e.g., health, obesity or poverty).

Table 28. CAAM Indicator: Human capital in Tacoma, WA (Shaded box indicates favorable levels of human capital)

CAAM MEASURES OF HUMAN CAPITAL

Health	Health 2013	Health ISD
% low birth-weight	0.64	0.33
% premature deaths		
% self-reports of poor health condition (physically and mentally)		
Obese	Obesity 2013	Obesity ISD
% obese (BMI >30)	3.8	0.9
Poverty	Poverty 2013	Poverty ISD
% poverty (and % children in poverty)	-1.37	-0.72
% uninsured		
% unemployed		
% no access to health care due to costs		
Education	Education 2013	Education ISD
% between age 25 and 44 with some post-secondary education	3.4	0.3
Language	Language 2013	Language ISD
% non-proficiency in English	-1.9	-0.4

Cultural Capital:

Key concepts of cultural capital were found to influence the swell of opposition to the incoming methanol refinery in Tacoma, quotes illustrated in Table 29. Perceived negative industrial, environmental, and social legacies led some community members to voice concerns about environmental degradation, excessive water and energy consumption:

Tacoma has kind of had a sordid environmental past and with the Asarco smelter and being named a superfund site, I think that the kind of the grassroots mobilization here was a bit reminiscent of 30 years ago when Commencement Bay was listed as a superfund site.

I think it kind of you know, came full circle here with the methanol plant because the big issue a lot of people first rallied around was the water issue and the water use issue. How much water they were going to use. (Local Nonprofit)

In addition to industrial and environmental legacy, a social theme that was persistent throughout the participant interviews was the general sentiment that Tacoma gets Seattle's unwanted projects:

So, while we get, while Tacoma apparently has become the petrochemical kitchen of the NW, Seattle gets the high-tech incubator jobs. (Local Community Member)

Many of these concerns were not addressed by NWIW, and because the project had not gone through the SEPA review process, the Port could not address them either.

Table 29. Selected quotes on cultural capital from interviews with stakeholders in Tacoma, WA.

THEMES		SELECTED QUOTES
Legacy	Industrial Legacy	<i>Tacoma kind of has this political reputation as fast tracking Port projects. Yea. It's a very permissive kind of perception. (Local Nonprofit)</i>
	Environmental Legacy	<i>I think the amount of civic engagement that happened on this project is, it was a pivotal moment for Tacoma, you know, Tacoma has kind of had a sordid environmental past and with the Asarco smelter and being named a Superfund site, I think that the kind of the grassroots mobilization here was a bit reminiscent of 30 years ago when Commencement Bay was listed as a Superfund site. Named on the national priority list for cleanup. One of the most polluted bodies of water in the country. (Local Nonprofit)</i>
	Social Legacy	<i>There is this feeling that Tacoma always gets the short end of the stick, as compared to Seattle. That all the dirty projects that Seattle rejects come down to Tacoma. There's this kind of feeling of being the lesser kind of child, if you will. I think that that kind of played a role here, too, in that there was a lot of kind of narrative around, you don't see this kind of project being proposed for Seattle, there's a reason why it was proposed for Tacoma. They had a reputation as the, you know, industrial, dirty hub. That kind of feeling... contributed to a lot of the fervor of the fight. (Local Nonprofit)</i>
Values		<i>Yes, so even after NWIW decided not to do the project here in Tacoma, there was a group that had energized around that who are still watching the Port very closely and they have rallied around the notion of, they want no fossil fuel infrastructure whatsoever. It doesn't matter if it is a cleaner source than what we have now. They just don't want any fossil fuel infrastructure. (Local Government Employee)</i>

In this case, the cultural capital concepts of values and legacy do not support this methanol refinery.

The CAAM measures do not indicate favorable levels of cultural capital, shown in Table 30.

Table 30. CAAM Indicator: Cultural capital in Tacoma, WA (Shaded box indicates favorable levels of cultural capital)

Creative Vitality Index (CVI)	CVI 2006	CVI 2007	CVI 2008	CVI 2009	CVI 2010
	-0.037	-0.055	-0.76	-0.06	-0.36

Chapter 4: Conclusions

Discussion

Researchers developing CAAM and the step-wise DST have called for qualitative research to refine and validate the social asset measures used in the model (Martinkus et al., 2017; Rijkhoff et. al, 2017). This study aimed to ground truth CAAM by exploring two research questions:

- I. How are the community characteristics tracked by CAAM—social, cultural, and human capital—playing a role, positively or negatively, in complex project implementation?
- II. Do the findings of the case study research support or conflict with the predictions of the CAAM county scores?

The results of this study show that social, cultural, and human capital can play a major role in complex project implementation. In these four case studies, CAAM predictions were mostly supported by the interview evidence.

- In the case of success, Missoula, CAAM predicted favorable levels of social, human, and cultural capital.
- In partial success, Lakeview, CAAM predicted favorable levels of social capital and mixed levels of human capital and cultural capital.
- In the case of partial failure, Boardman, CAAM had predicted mixed levels of social and human capital and did not find positive cultural capital.
- In the case of failure, Tacoma, CAAM did not predict favorable levels of social, human, or cultural capital.

Social Capital

CAAM's predictions of favorable levels of social capital in these four cases were supported by qualitative evidence. In 2017, Martinkus et. al enhanced the social capital measures to include nonprofit and civic organizations, in addition to the initial measures of political, labor, business and professional organizations. This enhancement might have improved the accuracy of the social capital indicator because some of the most important players in project implementation were well-connected nonprofit organizations whose work focused on environmental, economic, and community development. These groups facilitated communication between stakeholders and with the public. They were also the first to help the incoming facility address or troubleshoot problems. These findings are reinforced by previous work that states economic development strategies based on civic, rather than governmental strategies, are more likely to be successful (Flora et al., 1997).

Another emerging theme was the role of communication between, among, and across stakeholder groups. Previous work supports this as an important concept of social capital that demonstrates the degree of cooperation between stakeholders (Inkeles, 2000). Within this research, there is evidence that modes of communication played an important role in two ways. The first was how well and how often multiple levels of stakeholders communicated between each other and second, was how well they presented this information to the public. In the case of success, stakeholders mentioned a major factor in Blue Marble's decision to relocate from Seattle to Missoula because of the ease of access to and communication with key local stakeholders such as economic development groups and elected officials. In contrast, NWIW's failure to communicate with the public about their environmental and safety concerns contributed to the opposition the methanol refinery faced.

Human Capital

Two distinct forms of human capital were present in these case studies. The first describes the strength and status of the local workforce. CAAM's measures of health, obesity, education, and language aim to assess this, but it is unclear if the case study findings can validate these predictions. Both Tacoma and Missoula stated that the type and skills of the available local workforce would be supportive to the incoming refinery. In Boardman, ZeaChem faced challenges coordinating employees for its demonstration facility. Stakeholders in Lakeview only mentioned the workforce in terms of its small administrative capacity. Future research or follow up interviews could include specific questions about the health and type of the local workforce and how it corresponds to the needs of the incoming refinery.

The second form of human capital, which is closely aligned with political capital (not measured by CAAM) focused on the critical role of leaders with high levels of formal and informal knowledge, technical and intrapersonal skills, and relevant experience. These individuals played an important role in project outcome. In cases that were partially or fully successful, key individuals were important in facilitating and supporting the project. This finding supports previous research on ethanol plant siting that suggests enlisting local entrepreneurs to facilitate the development process can strengthen the relationship between the plant and its host community (Tigges & Noble, 2012). The role of local leaders is important; they can influence not only the refinery's location decision but also the community's attitude toward the refinery (Tigges & Noble, 2012).

Cultural Capital

Evidence of key concepts of cultural capital, such as legacy and values, shaped community and stakeholder perception of the incoming refinery and influenced how they used their resources to

support or oppose the project. In Lakeview and Boardman, the biofuel refineries were easily supported because the projects aligned with a shared and valued legacy of timber and agricultural industries. In Tacoma, a legacy of environmental degradation with NWIW's failure to address the community's fears fueled project opposition. The findings suggest that it is important for the incoming refinery to understand the local history of an area before proposing a facility and supports earlier work that states community level support and dynamics depends on the nature of the industry and the local context of the development (Tigges & Noble, 2012).

Previous work (Klamer, 2002; Florida, 2002; Fey, et al., 2006) agrees that cultural capital plays an important role in community and economic development and can describe a community's capacity for creativity, innovation, and willingness to take risks. However, there is discrepancy on how to measure cultural capital's influence on these projects. Klamer (2002) and Fey (et al., 2006) argue that it is important to look at how a community invests in itself through community projects and plans, such as festivals, traditions, and museums. Florida's (2002) measures focus on trying to capture creativity and innovation with the CVI index (number of arts-related organizations and businesses, occupational employment in the arts, and revenues of arts-related goods and services) and is the sole cultural capital measure of CAAM. Examples of creativity, innovation, and risk-taking were present in this case study, but not captured by the CVI index.

This research presents another option for measuring the impact of cultural capital on refinery site selection and implementation. These case studies highlight the influence of cultural capital concepts—values, legacy, and history—in shaping how a community employs its social capital to support or oppose the project. Flora et. al (1997) define the social organization and cultural characteristics that communities use to promote change or collective action as Entrepreneurial Social Infrastructure (ESI). Attention to the components of ESI—legitimation of alternatives, inclusive and diverse networks, and the ability to mobilize resources—might enhance CAAM's predictive measures. These three sub-themes of ESI emerged during the coding process, and positive indicators of ESI were present in both cases of success. Missoula had many economic development groups looking to invest and support “green” industries like Blue Marble. Lakeview's history of collaborative forest management with diverse stakeholder groups demonstrated agency as they recruited an industry to use woody biomass from their local forest land. In the case of failure, Tacoma showed negative indicators of ESI, the personalization of politics and distrust in the process. Previous research has attempted to identify proxies for measuring ESI: availability of unbiased news sources, multiple contributions by financial institutions to community projects, and more external linkages (Flora et al., 1997). Future iterations of CAAM might consider adding datasets that measure some of these items.

Limitations

Limitations in this case study research center around the ability to connect with knowledgeable stakeholders and their willingness to participate. Due time constraints, the sample size was limited to four cases and four to six interviews in each community.

Another note on the findings of this research is that the refineries included in the cases were in different stages of development. For example, Lakeview is determined a ‘partial success’ because while the facility has not yet been built, there is significant community support for it. Interviews in Boardman suggest that the demonstration phase of the ZeaChem refinery was backed by both bonding and bridging social capital, local leaders who facilitated communication, supportive industrial legacy and shared value for an agriculture-based biofuel refinery. This project was determined a ‘partial failure,’ not because a lack of social assets, but because of the financial and technical reasons that forced the refinery to operate at the demonstration level and not progress to the commercial scale.

The sizes of communities included in the case study were variable, ranging from a remote ‘frontier’ community of 2,500 (Lakeview) to a large urban center of 203,481 people (Tacoma). The CCF offers a clear, systematic framework for assessing community resources in rural communities. However, it might need supplemental frameworks to better evaluate urban sites with a larger and complex set of stakeholders and more formal political and social infrastructure.

Conclusions

This study emphasizes the importance of including an assessment of social assets in addition to biogeophysical assets in the site selection process. Tacoma presents a case with ideal biogeophysical infrastructure, affordable and abundant feedstock, and access to markets. Despite these assets, community opposition led to early termination of the project. Alternatively, the Lakeview case presents a remote ‘frontier’ community with acceptable natural and physical infrastructure, however, it is the community’s willingness to support the project and use their own networks and resources to help Red Rock that might ultimately result in successful project implementation.

CAAM measures predicting social capital assets were supported by the findings of the research. These predictions were likely improved by the incorporation of nonprofit organizations. Each of these cases underline the value of direct communication between project developers and local stakeholders to ease the implementation process, facilitate accurate information and address community concerns. The importance of learning local context, history, and legacy of a potential site is also emphasized in this research. Cultural capital shapes how communities perceive and mobilize their social capital around a

project. A challenge for CAAM will be identifying additional proxies to supplement the CVI Index that capture how these abstract concepts can be grounded to measure innovation and creativity.

Future research might focus on the identification of datasets or potential proxies that measure concepts of ESI, and include interview questions specifically about the health of the local workforce. These four cases show CAAM to be a useful predictor of social capital and a valuable, preliminary tool for biofuel companies to use in narrowing in on specific communities. After priority communities are identified with CAAM, the next steps will be to meet with key stakeholders to ensure the right location.

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APPENDIX A: INTERVIEW GUIDE

Interview Guide

Preliminary Questions:

1. How long have you lived in this community?
2. What is your job title?
 - a. How long have you held this position? (In what capacity? Government official how long in office?)
3. What is the operational state of the biorefinery project?

PART I:

1. How familiar are you with the biorefinery project?
2. Would you characterize it as a success or failure?
 - a. Why?
 - b. In your opinion, what contributed to the success or failure of the project?

PART II:

1. How did you participate with the development of the biorefinery project?
 - a. Did you attend public meetings?
 - b. In what capacity? (Professional, citizen)
2. How was the community engaged in the decision making around the biorefinery?
 - a. If so, how?
 - b. If not, why not?
3. Do you feel that there was an individual or any particular group that had an influence on the outcome (success or failure) of this project?
4. Were there particular groups or individuals that stand out in playing a positive role?
 - a. If yes, who?
 - b. Could you provide examples as to how this influence was exercised?
 - c. Do you think the outcomes for the project would have been different without that community engagement?
5. Were there particular groups or individuals that stand out in playing a negative role?
 - a. If yes, who?
 - b. Can you provide examples as to how community influence was exercised?
 - c. Do you think the outcomes for the project would have been different without that community engagement?
6. Are there any other aspects of the community that contributed to the success/failure of the project?
7. Why do you feel that project proponents selected your community?

PART III:

Demographics:

- Age
- Education
- Gender
- Employment

APPENDIX B: IRB OUTCOME LETTER

University of Idaho

Office of Research Assurances

Institutional Review Board

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To: Cc: Randy H. Brooks

Kelli Roemer

From: Jennifer Walker, IRB Coordinator

Approval Date: December 19, 2016

Title: Assessing the effectiveness of the Community Asset and Attribute Model regarding biofuel refinery site selection

Project: 16-144

Certified: Certified as exempt under category 2 at 45 CFR 46.101(b)(2).

On behalf of the Institutional Review Board at the University of Idaho, I am pleased to inform you that the protocol for the research project Assessing the effectiveness of the Community Asset and Attribute Model regarding biofuel refinery site selection has been certified as exempt under the category and reference number listed above.

This certification is valid only for the study protocol as it was submitted. Studies certified as Exempt are not subject to continuing review and this certification does not expire. However, if changes are made to the study protocol, you must submit the changes through [VERAS](#) for review before implementing the changes. Amendments may include but are not limited to, changes in study population, study personnel, study instruments, consent documents, recruitment materials, sites of research, etc. If you have any additional questions, please contact me through the VERAS messaging system by clicking the 'Reply' button.

As Principal Investigator, you are responsible for ensuring compliance with all applicable FERPA regulations, University of Idaho policies, state and federal regulations. Every effort should be made to

ensure that the project is conducted in a manner consistent with the three fundamental principles identified in the Belmont Report: respect for persons; beneficence; and justice. The Principal Investigator is responsible for ensuring that all study personnel have completed the online human subjects training requirement.

You are required to timely notify the IRB if any unanticipated or adverse events occur during the study, if you experience and increased risk to the participants, or if you have participants withdraw or register complaints about the study.