Stakeholder Attitudes Toward Forest-Residual Based Biofuels in Washington State

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ABSTRACT

Stakeholder Attitudes Toward Forest-Residual Based Biofuels in Washington State

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Residual-based biofuels potentially provide a renewable and technically feasible route of mitigating negative effects of climate change. Washington State is uniquely placed to develop biofuels given its abundance of woody biomass as feedstock. Forest residuals provide an excellent use of otherwise overly abundant forest fire hazards, and have the potential for economic profitability. However, ecological and economic arguments present only one side of the story. Others significantly oppose use of forest residuals as feedstock for bioenergy production. Use of forest residuals for biofuel production is therefore a socially contested phenomena within Washington State. It is important to understand the underpinnings of this contention in order to pinpoint and mitigate it to increase cooperation between decision-makers and stakeholders and overall social acceptability. My objective for this study was to understand stakeholder attitudes to illuminate points of contention and attitude change and suggest ways in which decision and policy makers can utilize these to promote more favorable attitudes towards residual based biofuels. Favorable attitudes are critical in reducing opposition and conflict between decision- and policy-makers and stakeholders to increase social acceptability. Results can be used to inform decision- and policy-making of stakeholder perceived benefits, constraints,

and suggested solutions. I conducted key-stakeholder and focus group interviews that focused on the attitudes and perceptions informing expressed attitudes about using forest residuals as feedstock for biofuels production. Interviews were recorded, transcribed, and analyzed using deductive and inductive qualitative methods and NVivo software. Interviewees from Native American, political, government, and industry stakeholder groups held positive attitudes towards forest residuals as feedstock for biofuels, while nongovernment organizations and community members had mixed perspectives. Perceived benefits and constraints primarily focused on economic and ecological sustainability, with extensive deliberation and repeated occurrences in all interviews. Interviewees suggested three main solutions: research and preparation, persuasive communication and outreach, and management and policy. I make suggestions to decision- and policy-makers on how to use this research to create persuasive communication messages to increase social acceptability of a residual-based biofuels industry in Washington State.

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1. THESIS INTRODUCTION

Washington State generates the cleanest electricity in the United States, primarily through hydro-electric and nuclear generation, yet still relies solely on national and international oil importation for liquid fuel (Mason et al. 2009). In 2006 alone, the state of Washington spent $9 billion on importing fuel, most of which was used for transportation. Transportation fuel accounts for half of all Washington greenhouse gas (GHG) emissions (Mason et al. 2009). Developing a renewable resource for transportation fuel is crucial in decreasing GHG emissions and mitigating effects of climate change. Plant material and animal waste (i.e. biomass) supplies five times more energy in the United States than both wind and solar power combined, and its potential is not yet fully tapped (EIA 2008). Residuals from forest management activities are currently the primary feedstock for biomass-derived renewable electricity in the United States (UCS 2006). Forest residuals have been identified as the largest source of Washington State produced biomass as well, accounting for two-thirds of all potential available biomass (Galinato et al. 2009).

Trees help minimize effects of climate change, in three primary ways: sequestering carbon through photosynthesis, storing carbon while standing or when transformed into building product, and as a renewable resource for bioenergy. However, trees can also contribute to climate change by suddenly releasing sequestered carbon via disastrous wildfires. Preventative forest management activities such as thinning are important for reducing the occurrences of these catastrophic fires; residuals from these thinning practices can be used as raw material for bioenergy production, specifically ethanol (Mason et al. 2009). Examining this biomass and other forest resources as feedstock for biofuel can help provide a renewable resource for transportation biofuels and reduce greenhouse gas emissions.

Biofuels technology is already largely developed and feasible (Mason et al. 2009). The triple bottom line states three pillars for feasible and successful endeavors: economic, ecological and

social (Elkington 1998). Economic and ecological perspectives of renewable energy have been addressed in the literature (e.g. ECOTEC 1999; Krotscheck et al. 2000; Mason et al. 2009); however the social dimensions are often overlooked. In the case of biofuels, there is evidence of both acceptance (Ulmer et al. 2004; Wegener & Kelly 2008; Dwivedi & Alavalapati 2009) and skepticism (Blaine et al. 2002; Selfa et al. 2010). Debates over contentious issues lead to and are the source of low social acceptability (Buchholz et al. 2011). This is a likely constraint when assessing forest resource management and use for biofuels. Attitudes are predictive of acceptability; targeting and bolstering them in favor of biofuels is critical for increasing social acceptability (Pires 2011). The subsequent journal article discusses the results of our research regarding increasing social acceptability of a residual-based biofuels industry in Washington State. I discuss this research further in the objectives section.

2. Literature Review

2.1. Attitude Theory and Application

Attitudes can be predictive of perceptions (Fazio & Williams 1986), behavior, and social acceptability (Ajzen & Fishbein 1980). To increase social acceptability, attitudes and perceptions must be changed in favor of a targeted behavior (Petty & Cacioppo 1986). To do this, we need to know the motivational basis of attitudes and appeal to them appropriately (Shavitt & Nelson 2002). There are three facets of attitude: content, structure and function. Attitude content has three synergistic yet distinct components associated with an attitude object: cognitive (beliefs, thoughts, and attributes), affective (feelings or emotions) and behavioral (past behaviors). Attitude structure looks at how positive and negative evaluations are organized within and among the components of attitude. Attitude function describes the variety of reasons individuals hold attitudes (Maio & Haddock 2009).

The most fundamental literature on attitude function (Smith et al. 1956; Katz 1960), describes underlying factors and functions of attitudes, both suggesting that attitudes are used to fulfill psychological goals. It is important to appeal to these diverse attitude functions appropriately, as each will respond differently (Katz 1960; Shavitt & Nelson 2002) (Table 1). Persuasive messaging is one way to appeal to different attitude functions, and is most effective when it directly addresses the motivation(s) supporting the targeted attitude, i.e. take advantage of the functional matching effect (Lavine & Snyder 1996). The subsequent article following this thesis introduction uses these attitude functions as a basis for creating persuasive messages.

Attitude Function	Psychological Goal of Function	Persuasive message
Object-appraisal(S)/ knowledge(K)/ utilitarian(K)	Organizing information; Balancing positive and negative attributes about attitude objects	Tangible costs and benefits of attitude object
Social adjustment(S)	Concerned with how others view attitude object and increasing social relationships.	Link recommended attitude to facilitation of social relationships
Ego-defensive(K)/ externalization(S)	Protect our self-esteem. Process rather than a factor: Message --> Message assessment (discounting and source derogation or acceptance) --> Attitude bolstering or conformation	Minimally counterattitudinal and ego-involving; intending to provoke positive thoughts rather than resistant, negative thoughts. I.e. a nonthreatening message that doesn't challenge beliefs
Value-expressive(K)	Express our self-concept or central values	Link the recommended attitude with the facilitation of value-related goals

Table 1: ATTITUDE FUNCTIONS AND GOALS
Smith et al. (1956) and Katz (1960)'s descriptions and goals of attitudes functions, and how to best apply persuasive messaging. (S)=term given by Smith et al. (1956); (K)=term given by Katz (1960)

It is important to appeal to these diverse attitude functions appropriately, as each will respond It Another important component of persuasive messaging is the effect of dual process models. The Elaboration Likelihood Model (ELM) and the Heuristic/Systematic Model (HSM) are exemplary of dual process models that "embody this general process of message reception, attitude change,

(and perhaps) behavior change" (Crano & Prislin 2006). Dual process models employ the concepts of central and peripheral processing (Cacioppo et al. 1986). Central processing is when the listener thinks about the message directly; peripheral processing assesses messages based on other cues besides the idea or strength of the argument (Petty & Cacioppo 1986). Transitioning concepts from peripheral to central processing is one form of persuasion and attitude change that can increase social acceptability.

In central processing, individuals are able and properly motivated to analyze persuasive messages. In this scenario, well-reasoned, data-based, and logical messages are strong enough to form stable attitudes. In peripheral processing, individuals are unable or unmotivated to process a message. In this case, peripheral cues and heuristics are stronger than message content to form attitudes, though these attitudes are weaker and less stable. Attitude strength is correlated to behavior; strong attitudes are more difficult to change, while weak attitudes are more malleable and sometimes even constructed on the spot (Maio & Haddock 2009). Persuasive messaging is just one route to attitude change. It is important to examining previous research in social acceptability to gauge and target the most prevalent attitude function of the target audience.

2.2 Previous Research

Technical, environmental and economic bases for opposition of renewable energy in general is prevalent throughout the literature (e.g. refinery siting, fuel efficiency, transportation, costs, wildlife effects, land displacement, water use, economy of scale, energy security) (Mason et al. 2009). The public shares all of these concerns and more, e.g. opposition due to refinery location (Van der Horst et al. 2002), wariness regarding carbon neutrality (Savvanidou 2010), and hesitation about policies and subsidies (Bailey et al. 2011).

In this section, I discuss previous research on the effects of attitudes and perceptions on social acceptability – benefits, concerns and suggested solutions. Attitudes and perceptions have been

shown to have a strong effect on social acceptability of biofuels, bioenergy, and renewable energy in general (Petty & Krosnick 1995; Petty et al. 1997; Wegener & Kelly 2008). Most research focuses on the acceptability of broader bioenergy options rather than biofuels specifically. There have been many quantitative surveys looking at different aspects of acceptability and different forms of renewable and bioenergy in developed countries beyond the United States. Surveys from many of these countries show preference of respondents for renewable energy over fossil fuels, in Australia (Dalton et al. 2008), Crete (Zografakis et al. 2010), and European countries (Magar et al. 2011).

To my knowledge, few researchers examine perceptions and attitudes toward biofuels specifically, and even fewer look at it within the context of the United States. Most studies that meet these criteria are quantitative surveys that show moderate or favorable attitudes held by US citizens toward biofuels (Ulmer et al. 2004; Wiser 2007; Wegener & Kelly 2008; Dwivedi & Alavalapati 2009; Stidham & Simon-Brown 2011). Wegener and Kelly revealed a favorable attitude for the polled biofuel feedstock (corn, switchgrass and wood/wood chips) in their 2008 quantitative survey of Midwest residents, as well as "the majority of US citizens (78%) agree that 'using biofuels is a good idea' ".

Further supportive research has found that the majority (91%) of US diesel-powered truck fleet operators had a positive attitude concerning biodiesel and almost half are using biodiesel, while 70% have a keen interest in learning more about biodiesel (ASG 2004). Quantitative studies such as those listed above are highly valued among researchers (Geer 1991). Qualitative research methods are often overlooked and undervalued, but their importance must be emphasized. These methods allow participants to more fully express the motivations, values and beliefs that form attitudes and perceptions, and subsequently shape behavior (Esses & Maio 2002). Understanding

the bases for attitudes and perceptions allows researchers to pinpoint attitude and behavior formative perceptions, values and beliefs and catalyze behavior change (Esses & Maio 2002). Stidham and Simon-Brown (2011) is one of very few qualitative studies that bolstered these findings with qualitative interviews of the Oregon State public.

There is also research supporting an opposing viewpoint (Upham & Shackley 2007). Plate et. al (2010) found extremes of both support and opposition, yet both subgroups were smaller than the "neutral" subgroup. Many studies have shown that alternative options are often preferred over biomass-as-feedstock (Upreti 2004), biofuels (Savvanidou 2010), and renewable energy in general (respondents in Savvanidou (2010)'s survey preferred to reduce energy use). The elements of acceptability subsequently discussed are: knowledge, fear of uncertainty, NIMBY, and trust.

2.2.1 Knowledge

Results from several studies show mixed levels of knowledge about biofuels. There have been studies showing that different European populations are uninformed, such as Savvanidou's (2010) who revealed that nine out of ten UK citizens are not well informed about biofuels, and only 55% know what biofuels are. It is also noted that only 23.8% of Greek survey respondents knew the difference between biodiesel and bioethanol (Savvanidou 2010). This is a reoccurring theme, as Wegener and Kelly (2008) found in their survey of US citizens; they are not very well informed about ethanol production. Lahmann (2005) found that 60% of US citizens are "very" or "somewhat" knowledgeable about biodiesel. West (2007) shows that knowledge and attitude are directly correlated in a survey of Canadian citizens.

A common finding is the literature is that although respondents generally held a positive attitude toward ethanol and biodiesel, there was an obvious polarity in knowledge levels, an all-or-

nothing trend, assessing 56% of respondents have “high” to “very high” knowledge regarding ethanol and biodiesel, while remaining respondents have “low” knowledge (West 2007). For example, Plate et al. (2010) suggest that the source of an all-or-nothing trend they found in their Florida survey may be a general lack of knowledge. This may be a simple information accessibility issue. While researchers and experts have access to expansive specialist literature, the public only has local and lay circumstantial knowledge (Chowdhury & Haque 2008). This barrier can be mitigated with awareness of this knowledge gap and persuasive communication regarding it (Van der Horst et al. 2002).

Plate et al. (2010) found a low level of knowledge awareness in Floridian respondents; they admitted their lack of knowledge, initially reacted to the prospect of a wood-to-energy facility in their area with interest and curiosity rather than fear. A high level of interest and low level of fear suggests a general willingness of these respondents to learn more about the potential of wood-to-energy projects. This willingness to learn is promising, but research has shown that education alone is not enough to necessarily increase knowledge absorbed or change attitudes (Katz 1960). It is suggested that if local people lacked knowledge, they would be less accepting of and less involved in biomass energy development (Van der Horst et al. 2002; Upreti 2004). This can potentially be attributed to a fear of unknown risk or uncertainty.

2.2.2 Fear of Uncertainty

The biomass industry is still in its infancy and because of this, there is a lot of uncertainty surrounding its development. Members of the public react differently to this uncertainty in knowledge. For some, it can provoke curiosity (Plate et al. 2010), but for others, it can cause unease and fear (Van der Horst et al. 2002; Upreti 2004). There are many negative effects that can stem from this fear – NIMBYism (not-in-my-backyard), mistrust, unwillingness to buy/use, opposition, etc.

Upreti (2004) found that people evaluate risk based on subjective criteria that affects their daily lives (e.g. less perceived local benefits, unknown consequences of potential failure). It has also been found that people perceive familiar things as less risky, irrespective of actual risk (Upreti 2004). Studies have found that opposition and conflict is likely to occur between developers and the public when: (i) the development is involuntarily imposed in their locality, (ii) the technology is not familiar, (iii) the public has no decision making power, or (iv) the development is for corporate profit rather than local benefit (Rakos 1998; Löfstedt 2002). An effective means of mitigating opposition is strategic refinery citing and including the public in the decision making process (Upreti 2004).

2.2.3 NIMBY

Allowing the public opportunity to participate is not enough; however, decision makers need to consider their opinions when making decisions. The term "NIMBY" or Not-In-My-Backyard, reflects the negative attitude of local residents toward industrial siting within close vicinity of their homes or communities despite positive attitudes among the general public (Savvanidou 2010). Van der Horst et al. (2002) describe the importance of listening to those most affected – local community members – and not just dismissing them as ignorant. Van der Horst et al. (2002) gives merit to this idea, stating that there is an issue of social injustice. Local residents are most likely to experience the most negative aspects and "residual risks," which tend to be those viewed as unlikely by experts. Potential negative experiences and risks, such as noise, smell, unsightly refineries, reduced property prices, road destruction, are likely to cause a reduced level of acceptability (Van der Horst et al. 2002).

2.2.4 Trust

Social psychological reasons for opposition can include mistrust and exclusion. Van der Horst et al. (2002) examined this by looking at development failures of the Centre for Environmental

Strategy in the UK caused by local community opposition. Van der Horst et al. (2002) provided a table of rejected and operational wood or straw-fueled power plants; only two of the five plants are currently operational and that was after a lengthy planning process full of public unease, mistrust, and opposition regarding potential environmental impacts (Van der Horst et al. 2002).

There is also relevant work regarding who the public trusts in siting controversies, and it is often not the "experts". The public trusts environmental groups and local extension agents more than policymakers and private industry (Plate et al. 2010). This study reveals that the public perceives those from private industry and the chamber of commerce as the *least* trustworthy because of their vested interest in economic benefits (Plate et al. 2010). Similarly, when local community members feel excluded from decision making, acceptability of a project is reduced (Khan 2001; Upreti 2004). These are just a few factors of social acceptability that can be addressed and reduced to increase the overall public acceptance establishing a biofuels industry in Washington State.

3. Objectives

The goal of this study was to examine stakeholder attitudes to identify points of potential attitude change and produce suggested solutions to aid decision-makers in increasing favorable attitudes and social acceptability of a residual-based biofuels industry in Washington State. To achieve this goal I addressed the following objectives:

(i) Examine stakeholder attitudes and perceptions toward using forest residuals as feedstock for biofuels and establishing a biofuels industry in Washington State.

(ii) Determine stakeholders' perceived benefits, constraints and suggested solutions toward using forest residuals as feedstock for biofuels and establishing a biofuels industry in Washington State.

(iii) Provide recommendations for attitude change to decision-makers to increase favorable attitudes and social acceptability of a residual-based biofuels industry in Washington State.

To address these objectives I conducted one-on-one and focus group interviews with identified stakeholder groups and key informants. These stakeholder groups include: government organizations, non-government organizations, Native American tribes, local communities [urban and rural], political figures, and industry representatives. The remainder of this thesis is presented in the form of a publishable manuscript. In this manuscript, I provide an introduction followed by an explanation of methods. I then present the results of this study and suggest ways to bolster perceived benefits, mitigate constraints, and incorporate suggested solutions into decision-making to increase social acceptability and allay obstacles in the process of establishing a residual-based biofuels industry in Washington State.

STAKEHOLDER ATTITUDES TOWARD FOREST-RESIDUAL BASED BIOFUELS IN WASHINGTON STATE

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3. ABSTRACT

Residual-based biofuels potentially provide a renewable and technically feasible route of mitigating negative effects of climate change. Washington State is uniquely placed to develop biofuels given its abundance of woody biomass as feedstock. Forest residuals provide an excellent use of otherwise overly abundant forest fire hazards, and have the potential for economic profitability. However, ecological and economic arguments present only one side of the story. Others significantly oppose use of forest residuals as feedstock for bioenergy production. Use of forest residuals for biofuel production is therefore a socially contested phenomena within Washington State. It is important to understand the underpinnings of this contention in order to pinpoint and mitigate it to increase cooperation between decision-makers and stakeholders and overall social acceptability. My objective for this study was to understand stakeholder attitudes to illuminate points of contention and attitude change and suggest ways in which decision and policy makers can utilize these to promote more favorable attitudes towards residual based biofuels. Favorable attitudes are critical in reducing opposition and conflict between decision- and policy-makers and stakeholders to increase social acceptability. Results

can be used to inform decision- and policy-making of stakeholder perceived benefits, constraints, and suggested solutions. I conducted key-stakeholder and focus group interviews that focused on the attitudes and perceptions informing expressed attitudes about using forest residuals as feedstock for biofuels production. Interviews were recorded, transcribed, and analyzed using deductive and inductive qualitative methods and NVivo software. Interviewees from Native American, political, government, and industry stakeholder groups held positive attitudes towards forest residuals as feedstock for biofuels, while nongovernment organizations and community members had mixed perspectives. Perceived benefits and constraints primarily focused on economic and ecological sustainability, with extensive deliberation and repeated occurrences in all interviews. Interviewees suggested three main solutions: research and preparation, persuasive communication and outreach, and management and policy. I make suggestions to decision- and policy-makers on how to use this research to create persuasive communication messages to increase social acceptability of a residual-based biofuels industry in Washington State.

4. INTRODUCTION

Establishing a biofuels industry provides a renewable and technically feasible method of contributing to the mitigation of the effects of climate change. The residuals from active management of forests, found abundantly throughout Washington State, is a woody biomass resource (Mason et al. 2009) that can be used to catalyze this biofuels industry if we alleviate concerns and bolster acceptance. The objective of this study was to explore perceptions and attitudes held by Washington State stakeholders toward a residual based biofuels industry in Washington State to subsequently inform pro-biofuel attitudes through management and decision-making. It is important to understand stakeholder attitudes because, despite being most affected by decisions, their knowledge and voices are often overlooked. We aim to understand

attitudes and include this knowledge at the forefront of renewable energy research to increase awareness and social acceptability.

Brunson (1996) defines *acceptability* as "a condition that results from a judgmental process by which individuals (1) compare the perceived reality with its known alternatives; and (2) decide whether the "real" condition is superior, or sufficiently similar, to the most favorable alternative condition." These judgments are influenced by more than just social factors, and Brunson specifies that *social acceptability* is an "aggregate form of public consent whereby judgments are shared and articulated by an identifiable and politically relevant segment of the citizenry" (Brunson 1996). High levels of social acceptability are exemplified by reduced opposition and are achieved by bolstering drivers of support and assuaging concerns. Social acceptability of forest residuals as feedstock for biofuels is critical for successful development of a biofuels industry in Washington State. In this article, we explore the perspectives of seven identified stakeholder groups in order to assess the nature and level of stakeholder acceptability, i.e. what values, beliefs, attitudes and perceptions inform such levels of acceptability.

Climate change has been a popular topic in research and social media for years now, particularly regarding fossil fuel use. The United States' reliance on fossil fuels is becoming increasingly less socially acceptable as can be seen from many international studies showing preference of renewable energy over fossil fuels by respondents (Dalton et al. 2008; Zografakis et al. 2010; Magar et al. 2011). One route of alleviating this dependence is through biofuels, which the United States government promotes through policies such as the Energy Independence and Security Act's Renewable Fuels Standard (EPA 2009). This policy requires that 21 billion US gallons of fuel must be derived from cellulosic ethanol – derived from trees – and other advanced

biofuels, as well as increases the total amount of biofuels added to gasoline to 36 billion US gallons by 2022 (Sissine 2007).

Washington State is appropriate for the development of a biofuels industry because of its available and widespread woody biomass resource, estimated to provide more than 11 million bone dry tons per year (Mason et al. 2009). Woody biomass can be defined as "wood fiber that does not have higher value product potential for non-energy applications," and is found in forests (Mason et al. 2009). Woody biomass has multiple sources, including residuals from logging, pre-commercial thinning, primary and secondary wood product manufacturing, lumber and sawmill manufacture, pulp and paper manufacture, and forest fuel reduction activities. Removing these residuals reduces forest fire vulnerability and the corresponding release of sequestered carbon (EIA 1998; Mason et al. 2009; Pausas & Kelley 2009). In this article, we present the results of interviews with key stakeholder groups. The interviews explored stakeholders' attitudes towards using forest residuals as feedstock for biofuels. Specifically we present stakeholders' perceived benefits and constraints to the use of residuals.

There is considerable research on the feasibility of biofuels in the technical sense, but other perspectives have been relatively underexplored. The triple bottom line states three pillars for feasible and successful endeavors: economic, ecological and social (Elkington 1998). Economic and ecological perspectives have been addressed in the literature, however the social aspect is often overlooked, making it that much more critical. In the case of biofuels, there is a gradient of acceptability, from enthusiastic (Ulmer et al. 2004; Wegener & Kelly 2008; Dwivedi & Alavalapati 2009) to highly skeptical or outright opposed (Blaine et al. 2002; Selfa et al. 2010), and an abundance of neutrality (Plate et al. 2010). Forest management is an openly contentious topic within the public sphere (Savvanidou 2010). These debates lead to low acceptability, a

major constraint when assessing forest resource management and use for bioenergy (Buchholz et al. 2011). Public support is critical for the future and ultimate acceptance of biofuels (Dwivedi & Alavalapati 2009). Favorable attitudes reduce conflict and improve cooperation and communication between decision-makers and stakeholder groups, and overall minimizing opposition and costs toward establishing a biofuels industry in Washington State (Pires 2011).

Public participation benefits both decision-makers and the public. Decision-makers benefit from improved quality of the decision-making process by utilizing relevant information only the public could provide, and the public benefits from having their voices heard. Public participation increased social acceptability and support by engaging the public and requesting ownership of the process, e.g. transforming a perception of "their problem" to "our problem" (Duram & Brown 1999).

Public support for biofuel development can be gained by raising social acceptability. This can be achieved by examining stakeholder attitudes towards using forest residuals for biofuel, expressed as perceived benefits and concerns. *Perception* is the process by which we interpret and organize sensation to produce a meaningful experience of the world (Pickens 2005). A person's receptiveness to environmental stimuli is highly selective and may be limited by a person's existing beliefs, perceived benefits, personality and attitudes (Pickens 2005). *Attitudes* are feelings and dispositions toward certain objects, either favorable or unfavorable (Fishbein & Ajzen 1975). They are expressed through what we say and do, and are formed on the basis of beliefs – one's understanding of oneself and the surrounding environment (Fishbein & Ajzen 1975). Both attitudes and beliefs are subject to change based on new information, e.g. persuasion, life experiences, and other learning processes (Bengston & Fan 1999).

Examining stakeholder attitudes towards using forest residuals for biofuel is important because they are known to have strong effects on social acceptability of biofuels (Petty & Krosnick 1995; Petty et al. 1997; Wegener & Kelly 2008). Several studies have shown moderate or favorable attitudes held by study interviewees toward biofuels (Ulmer et al. 2004; Wegener & Kelly 2008; Dwivedi & Alavalapati 2009; Pires 2011; Stidham & Simon-Brown 2011). In Wegener and Kelly's 2007-2008 telephone survey of the favorability and overall evaluations of biofuels, the authors concluded that the results for the polled biofuel feedstock (corn, switchgrass and wood/wood chips) revealed a favorable attitude toward all feedstocks. The authors also showed that these attitudes were not particularly strong, though attitude strength is correlated to media attention, and are thus strengthened as media attention on biofuels increases (Kiousis 2005). Attitude strength is the degree of attitude resistance to change in the face of attack (Haugtvedt & Wegener 1994), and is relevant because a strong attitude can be predictive of behavior (Miller & Peterson 2004).

The studies cited above are mostly quantitative and may inadequately inform management and policy. Quantitative research, surveys in particular, are highly valued among researchers for their ease and accessibility (Geer 1991). Qualitative methods, on the other hand, result in more in-depth and nuanced understanding of the topic under examination by allowing respondents to express motivations, values and beliefs in their own words (Esses & Maio 2002). Exploring factors that form and explain attitudes is key to locating where to intervene and catalyze change. Quantitative studies often overlook knowledgeable stakeholders' voices (Esses & Maio 2002). For instance, Native American tribal members traditionally value their resources very highly (Harris & Harper 1997), yet are rarely consulted when searching for solutions to natural resource quandaries.

Social acceptability of biofuels can be managed and accommodated by examining, analyzing, and subsequently informing pro-biofuel perceptions of and attitudes toward the planning and operation of forest-residual based biofuels production. We employed both individual key informant and focus group interviews to gain qualitative understandings of individuals' perspectives and the co-constructed meanings of groups' perceptions and attitudes toward using forest residuals as feedstock. The results of this study can be used to inform policy to increase social acceptance of biofuels in Washington State.

5. METHODS

5.1 Sampling Procedure

Before collecting data, we identified major stakeholder groups to interview. We separated these interviews into two phases for ease of data collection and analysis. For the first phase, we conducted six individual interviews with expert stakeholders. We used the resulting themes to inform the interview script for the second phase: seven individual and seven focus group interviews with the remaining stakeholder groups (government organizations, non-government organizations, Native American tribes, local communities [urban and rural], political figures, and industry representatives).

The noncommercial groups were targeted because of their influential yet often marginalized role in decision making. The industry group was chosen for their pivotal role in this process. We compiled an initial list of potential participants via purposive sampling. From this initial list, we used web search, snowball, convenience, opportunistic and maximum variation sampling methods (Patton 1990). We contacted them via e-mail or telephone to explain the study and request participation. The study designs and interview questions for the two phases were reviewed and approved by the University of Washington's Institutional Review Board of the

Human Subjects Division (IRB approval numbers 41324; 42866) before contacting and recruiting interviewees.

5.1.1 Data Collection

Before initiating interviews, we gained interviewee consent to participate in individual or focus group interviews by explaining the consent process and providing them with two copies of a consent form (Krueger & King 1998). We tape-recorded interviews and retained interviewees' privacy by storing consent forms, audio files and tape recorders in a locked office. Interviews were held at a site most convenient to both the interviewer and interviewees. We conducted individual interviews to acquire a depth of information and inform the interview script for second phase interviews. These interviews allowed for very detailed and specific information and articulation of interviewees' opinions (Agar & MacDonald 1995; Kaplowitz & Hoehn 2001); more than a focus group could permit.

For the second phase, we primarily conducted focus group interviews to allow for co-constructions of meanings and perspectives about a residual-based biofuels industry in Washington State. Focus groups reveal insights into target populations, (e.g. terminology, range of opinions, behaviors, motivations, and the influence of these variables on different perspectives in different groups) (Krueger & Casey 2000). We moderated interviews using non-directive moderation techniques of open-ended and semi-structured questions (Kvale 1996; Krueger 1998). These techniques allowed interviewees to more freely express individual and co-constructed attitudes and perceptions without boundaries (Glaser & Straus 1967; Krueger & Casey 2000). Questions were intentionally open-ended to allow a restriction-free response based on three broad question categories: (i) perceived benefits (ii) constraints and (iii) suggested solutions to constraints for establishing a biofuels industry in Washington State. We conducted

interviews until we reached the point of data saturation – where new or relevant information becomes sparse (Given 2008).

We interviewed seven homogenous stakeholder groups (Table 2). For the first phase, we interviewed six experts in forest residuals for biofuels between October 13 and November 15, 2011. Each represented varied and specified knowledge of the contributing to their unique perspectives in the fields of economics, politics, forest ecology, plant biochemistry, and bioresource science and engineering related to using forest residuals as feedstock for biofuels. We selected these interviewees based on expertise and accessibility, making these sampling methods convenient and cost-effective (Marshall 1996). Individual interviews lasted about one hour on average.

For the second phase, we interviewed stakeholders between January 13 and October 12, 2012. Seven individual and seven focus group interviews had a total of 55 interviewees from each of the six remaining stakeholder groups. Industry, government, nongovernment, political figure, and expert stakeholders were identified as most or very knowledgeable about biofuels within their stakeholder groups. Participants from community, and Native American tribal stakeholder groups were identified based on accessibility.

Each focus group interview included 4-9 interviewees and lasted about two hours on average. We conducted seven focus groups with five of the six stakeholder groups, and seven individual interviews. We focused the majority of individual interviews on non-government organizations and industry stakeholder groups, foregoing focus group interviews because we could not reach a sufficient number for focus group interviews.

Stakeholder Groups	Stake
Expert	Technology & research
Community (rural and urban)	Influence decisions
Nongovernment Organization	Influence decisions
Native American Tribal Member	Influence decisions
Government	Inform and make decisions
Political Figure	Inform and make decisions
Industry	Provide feedstock and conversion processes

Table 2: STAKEHOLDER GROUPS AND STAKE

5.2 Data Analysis

We transcribed interview recordings and incorporated memos and notes taken during interviews to become more familiar with and form ideas about the narrative. We transcribed interview recordings by listening to audio files of interviews at half speed in Express Scribe and typing dialogue into Microsoft Word. We repeated this process until satisfied with the quality of the transcription. We read transcripts multiple times to ensure accuracy and begin to pinpoint overarching themes of each and all interviews.

We uploaded transcripts into the NVivo analysis program (QSR International, Versions 8, 9, 10) to deductively code perceived motivations, constraints, and suggested solutions of constraints for using biofuels through five STEPE categories (Social-Technical-Economic-Political-Ecological). We then used a grounded theory approach to identify salient attitudes, values and beliefs. We constructed narratives by grouping emergent categories into themes that reflect perceived benefits, constraints and suggested solutions of establishing a residual-based biofuels industry in Washington State. We used both inductive and deductive methods of analysis to ensure comprehensive analysis (Saldaña 2010). Inductive analysis is derived from grounded theory coding and analysis, positing that a theoretical framework should emerge from the data (Glaser & Strauss 1967; Corbin & Strauss 2008). Deductive analysis tests if existing data aligns with a pre-existing framework (Zhang & Wildemuth 2009).

We used first cycle coding to configure data into a select list of themes. We used second cycle coding to reorganize and reconfigure first cycle themes and corresponding data into major themes (Saldaña 2010). We used multiple cycles of a combined approach of inductive axial coding and deductive provisional coding. The inductive method of axial coding is used to develop and link concepts into hierarchical conceptual families. Subcodes were examples or causes of, or contexts for STEPE categories (Strauss & Corbin 1990).The deductive analysis method of provisional coding begins with *a priori* categories of codes prior to data collection (Miles & Huberman 1994).

We simultaneously lumped and split information data into *a priori* categories of perceived benefits, constraints, and suggested solutions based on study objectives. We adapted the STEPE model as a framework for subcategories within each of the broader categories. The STEPE model is a variant of the more widespread PESTLE (Political-Economic-Social-Technical-Legal-Ecological) analysis, used in marketing and business analysis audits. This analysis tool is useful in the business world for examining external factors beyond the control or influence of a business or organization with the intent of using this information to guide decision-making (Morrison 2007). Analysis is built on the assumption that assessing the current environment and forecasting changes will allow the business or organization the better to respond to changes and thus increase their own competitiveness (CIPD 2010).

6. RESULTS

Interviewees expressed perceived benefits, constraints, and suggested solutions, which we split into five categories for analysis: social, technical, economic, political, and ecological. We lumped together and renamed some categories for ease of presentation (Table 3). Quotes are

differentiated from multiple focus group and key informant interviews. We chose this presentation as the most intuitive and interesting method of presenting results.

TABLE 3: RESULTS CATEGORIES

Perceived Benefits
Economic & Ecological
Social
Technical
Concerns
Economic & Political
Ecological
Social
Suggested Solutions
Research & Preparation
Persuasive Communication & Outreach
Management & Policy

Concerns largely focused on areas that most affected interviewees but they had little knowledge regarding. For example, expert interviewees were knowledgeable and less concerned about technical feasibility, but were uncertain about social aspects:

> *"I think the [technical] processes can be developed in a way [that is] good. So I think the one element [that is] really an unknown is the social side of it."*

Interviewees agreed that benefits and concerns are interdependent and difficult to tease apart. Many noted the need for a careful balance of the parts to sustain and propel sustainability of the whole. One Native American tribal member interviewee illustrated the complexity of intertwined benefits through description of an immaculate forest in a different area of the reservation, touching on benefits within four of the five STEPE categories: forest aesthetics (social),

community (social), tourism (economic), future generation benefits (ecological), and cleaner fuel (technical):

> *"They [have] this pristine forest where they did this clean up and got rid of all that debris and [it is] beautiful; [it is] like a park. I think our whole reservation could be like that, and then people are [going to want to] come and look at it. We could be a model for our generation, for our kids. Our grandkids could come see it. [I would] like to leave them that instead of an eye sore. It needs to be cleaned up and why not use it to make better fuels [that is going to] cut back on our pollutions?"*

6.1 Perceived Benefits

6.1.1 Economic and Ecological Benefits

Interdependence of themes was common throughout interviews. Economic and ecological effects, and to a lesser extent other categories, were often tangentially or latently intertwined. For example, Native American tribal interviewees generally focused on the positive economic impacts of a biofuels industry as a basis for supporting community and ecological processes. For instance, one interviewee repeatedly discussed a desire for a cleaner forest for the cultural value of huckleberry picking and aesthetic value it provided:

> *"[I would] love to be able to drive over that hill and back sometime before I die of real old age and see a cleaned forest land. Pull the car over and stop and walk up and see how everything is. There used to be some huckleberry bushes, but it needs to be really clean and [I would] love to see that happen."*

Largely, however, economic and ecological benefits were the most tightly intertwined themes. One interviewee suggested that success in establishing a biofuels industry can lead to an increased value and appreciation of the forest as both an ecological entity and economic resource:

> *"If we increase the variety of ways that [we are] using our natural resources then it will be one more thing that will cause us to stop*

> *developing over our forest lands and our agricultural lands and things like that because [we will] see higher value in those things than simply just grading them down and chopping everything down and building houses on them."*

Another interviewee discussed domestic biofuel production as both an economic and ecological benefit. He suggested bolstering the sustainability of both by utilizing the United States' stringent environmental practices, as opposed to importing it from other countries which may currently sell energy and fuel obtained with unethical ecological practices:

> *"You spend a lot of money to import [biofuels] from somewhere else in the world. It may not be as environmentally good – importing biofuels from Southeast Asia or from South America. The environmental impact from them doing it may be greater than the environmental impact of [the US] doing it. Certainly the economic impact would be worse, if we have to import all that."*

A purely economic theme present throughout interviews was economics as the primary motivation and driver for a residual-based biofuels industry. Expert interviewees gave a positive and occasionally enthusiastic response regarding their belief in an economic future for residual-based biofuels and bioenergy in Washington State. Regional employment and economic gain were repeatedly discussed as a primary benefit in every interview, particularly regarding rural communities.

> *"Let's say Washington ends up using a couple billion gallons a year of biofuels to meet greenhouse gas goals, and they [do not] make it, they import it. So at $3-$4 a gallon that's $3-$4 billion that is going out of the state. If we make it here, [that is] $3-$4 billion dollars that goes into jobs here in the state."*

> *"Even if [it is] not a return on energy of fossil fuels, [it is] local and [it is] providing jobs and tax money for our local economy."*

> *"[We would] like to see it create jobs for our people and if [it is] cleaning up the forest and turned into energy, [that is] a gold star all the way around, [that is] like three stars in my eyes."*

A purely ecological theme present throughout interviews was utilizing residual removal as a beneficial way to both "cleans up" the forests and increase forest health. One interviewee pointed out how the forest would benefit from a biofuels industry utilizing currently unused raw material:

> *"[There is] no question that it would help the forest, cleaning up slash. In the old days, my father-in-law was a logger and [they would] pack up all that brush and deliver the trees in the slash piles and they burned it. Every year they burned it and they [cannot] do that anymore. So the forest is a mess. It would definitely help the forest if they developed a biofuel industry from forest products."*

Interviewees expressed approval in improving forest health and restoration by removing economically low value residuals for use as feedstock for biofuels. One interviewee acknowledged the enriching effects of leaving residuals in the ecosystem on forest health, but ultimately concluded that this was outweighed by potential greenhouse gas emission reduction:

> *"But of course, even as [residuals are] enriching the soils [they are] also putting off carbon dioxide. The fire hazard from residuals is an immense thing, particularly, things like [the] national forest that are fire hazards just waiting to burn, and being able to use that for energy. 'It is] a major opportunity that appeals to people both in industry and also in the environmental community."*

6.1.2 Social Benefits

Positive economic and ecological effects of a biofuels industry in Washington State could contribute to increased public acceptability of and desire for further development of the industry. Often these values translate into personal or community-wide benefits. On a larger scale, one expert interviewee noted that biofuels may contribute to a pre-existing environmentally friendly, or "green", norm of the Pacific Northwest. This notion was particularly common with rural community interviewees, who were more familiar with this type of industry. Building on the economic benefit of job creation, one interviewee stated a community benefit of attracting more

families and populating the local school. Another described the coinciding community building and collaboration they received from establishing such a conversion facility:

> *"I think about all the hoopla and all the organization it took to get this thing here and all the people that had to come together to form that. It was our local public development authority that found funding. It was the county investors that were a part of it. It was the city and utilities, everybody had to work together to make that happen. Department of Commerce, the USDA was involved, everybody, all of the players. [We have] all invested in getting this here."*

Native American interviewees similarly expressed community benefits as a primary motivator, specifying a cultural basis for their support of this industry. Interviewees were particularly adamant about using their land and resources for this industry. One interviewee described a need to revitalize the land for cultural and educational purposes, and saw cleaning up the forests as one method of doing so:

> *"It would be a big thing with biofuel if we could clean up a lot of the stuff because the land is supposed to be like the heart of our people. Without our land-base, we [would not] exist as a reservation or a tribe any longer. So we really [have to] put the cultural preservation back in there so our youth can grow up learning with those traditional medicines and foods and hunting. Our whole culture was being lost and I think [that is] being revitalized when you revitalize the land. At least for our youth, they know that we can live, [we will] be able to survive because we have this land."*

When asked how establishing a biofuels industry would affect them personally, interviewees were generally confused and unable to come up with anything substantial. The one exception was given by a political interviewee who saw removing forest residuals as personally beneficial for forest recreation:

> *"Personally I like to go to eastern Washington [and] hike in the woods. [I am] concerned about the forest health problems and maybe this will help shift the economics a little bit so that we can*

> *actually go in there and take out some of the smaller stuff if the biofuel markets help to do that. Then I think that will be good for me personally, because I like to recreate in those areas."*

6.1.3 Technical Benefits

Interviewees discussed the benefits biofuels can have on the technical development of the renewable energy industry. Some interviewees envisioned biofuels as representative of the potential of future energy options:

> *"[Biofuels] present opportunity for alternative or cleaner fuels for things that [are not] easily electrified. You can electrify a car, you can electrify a motorcycle, [but it is] hard to electrify a plane. But you can create aviation biofuels and that could dramatically decrease carbon emissions from aviation fuel. So that I think is very promising."*

Some interviewees were particularly adamant about this project not being a sole solution to the nation's energy crisis, but rather it can contribute to mitigating "America's unquenchable thirst for energy" by contributing to a self-reliant future with a more diverse array of sources of renewable fuel:

> *"[It is] a good way to diversify the market so [we are] not completely dependent on something like fossil fuels. But that you can get energy from different sources and maybe [it will] help stabilize prices or if there was a problem in the Middle East then we still have options elsewhere. So I think [it is] a part of a broader solution."*

Energy independence was deliberated about in all focus groups, though in a very general way. It was not discussed in depth, and mostly only in regards to national self-reliance and energy security:

> *"We get our fossil fuels from the bad guys, and being able to produce more of our transportation energy domestically will certainly be beneficial for a number of security themed reasons."*

When thinking of the future, focus group interviewees talked about improved forest management. One expert interviewee stated that improving practices could increase knowledge and inform future forest practices:

> *"If you have a biomass, people start to think, 'okay we can actually harvest. We [do not] have to leave it in the forest,' because that might make sense from [an] economical point of view. So it might actually change the forest practices."*

6.2 Constraints

6.2.1 Economic and Political Concerns

Economic and political concerns included economic viability, minimal job creation, maintaining local production, financial costs, competition with related industries, regulation and policy and reduced reliance on foreign energy and fossil fuels. While expert interviewees were wholly in favor of using forest residuals as feedstock, other stakeholder groups were not as enthusiastic. As one political interviewee stated, "with biofuels in general, my main concern is the economic viability of them." An expert interviewee echoed this concern, warning that building a refinery is not enough; the economic viability will have to be maintained:

> "O*nce you build a mill or facility, [you are going to] want to have a supply. The question is how far is your supply base? [What is] economically viable for that mill? What [we have] seen with all of the traditional timber values, they build mills and guess what? When [it is] not economically viable anymore, they close it down. So [do not] assume that [it is] going to stay there and suck everything from western Washington to make it run. [It will] only pull what they can get at at a reasonable price to make it work. Otherwise they will shut it down and they [will] dismantle it."*

Cost was a highly deliberated theme in interviews, namely those associated with the final product. Most interviewees were not willing to pay more for the final product than they were already paying for conventional fuel, despite other non-monetary benefits they had mentioned

throughout the interview (e.g. forest health and preservation of cultural areas or values). One nongovernment organization interviewee again emphasized the salience of economics:

> *"People are really coin-operated. It has to do with subsidies, it has to do with royalties, it has to do with environmental costs, it has to do with health costs, and all those things that really [are not] weighed into it. All they see is the price at the pump which [is not] a realistic price at all. [It is] like saying, for instance, the cost of going to school is just tuition, well [that is] ridiculous; everyone knows [it is] not just that, but that may be how they compare schools, the tuition costs."*

Interviewees emphasized the politics of economic competition with related industries such as pulp and paper, timber, and corn. They were concerned that these industries may view a biofuels industry as encroaching on their territory, especially if there is competition for feedstock:

> *"If these biorefineries start coming, the pulp mills may not be happy people. It has [been a problem] in the South. [They are] already upset about this whole idea because [they are] afraid that the biofuels guys will be subsidized and that their prices [are] going to go up."*

The topic of the corn ethanol industry was raised in every interview. One interviewee talked about the corn ethanol industry as political folly, useful only for appeasing producers, despite its inefficiency. Another interviewee elaborated on this opinion, saying that if the corn industry feels threatened, powerful investors in the industry may be unwavering in their stance:

> *"The ethanol component has been a political construct by congress to appease the corn industry. [That is] all [it has] been. We can supplement gasoline and you can reward the corn-producing part of the United States and Canada and pretend to be less dependent on foreign oil. [That is] what [it is] all about; [it is] totally political. [It is] nothing to do with efficiency or the availability of petroleum or anything like that. [It is] actually not a very efficient way to run an automobile."*

There were concerns about regulation and policy throughout interviews with urban and rural community members, particularly regarding taxing, legislation and usage standards. Interviewees highlighted the need for careful consideration regarding policy on biomass price:

> *"If you put a tax on biomass, this would have a big impact. Anything that affects the biomass price is going to have a big impact. So if [there is] a tax on it or a subsidy, either one, this could be a huge motivator or disincentive."*

The most commonly discussed political concern was whether or not biofuels was a way to ease our nation's dependence on foreign oil. Some interviewees were skeptical of the ability of biofuels to facilitate foreign energy independence or as a replacement to our current foreign fossil fuel reliance. Multiple interviewees, particularly expert interviewees, listed it as both a benefit and a concern due to its nature as a contributor to the diversification of fuels sources, rather than a sole solution:

> *"One [benefit of a biofuels industry] is energy independence. Although I kind of hesitate to say that because I [do not] think, even if we used every bit of bio-based material in the state, that we could truly become independent. I [do not] think [there is] enough material to completely divorce ourselves from things that are external to the state."*

6.2.2 Ecological Concerns

Interviewees discussed ecological concerns of ecosystem effects, specifically: forest health, balance between forest health and feedstock supply and pollution. Interviewees extensively deliberated this first point of forest health, particularly nongovernment organization interviewees who self-identified as opposed to a establishing a biofuels industry. One interviewee bluntly stated his belief that any amount of forest management was "a war on our forests." A common concern among interviewees was that of striking a balance between optimizing forest health and sufficient supply of raw material, as well as recognizing diverse needs for different ecosystems:

> *"Since we are kind of at the front end of this, I could imagine state forest practices rules addressing how much material you would have to leave on a site. Right now you have to leave so many standing trees, so many snags, such distance from a creek, things like that. I do [not] think there [are] any standards for how much biomass you have to leave on a particular site. I would think that if the folks that are thinking this is a good idea could come up with some scientifically valid sense of, 'okay if you left this amount, or this amount, you have a sustainable, ecological basis here.' How much of that material can you take off?"*

> *"How much can we take before we can actually affect our wildlife and soil characteristics and the whole environment? You have a perfect example of [what is] happening right now in China. The government is deciding to change the path of [the] river. They [are] shutting down the towns, and [they are] floating the other towns. They [are] playing nature and then they have one of the most severe droughts in [a] hundred years. The whole environment suffers. The consequences if we [do not] know all the problems associated with the removing all the forest thinnings might be huge. We have to be aware; we have to know how much. [That is] what will be [the] critical issue. Place by place, [it is going to] be very unique. Every single part of the land, [we will] have individual issues."*

One scenario an interviewee portrayed was an increased demand for the product offsetting this delicate balance. Without proper preparation, feedstock harvesting could spread to private or national forest, or a less efficient tree species, or any number of alternatives that can destabilize an infant biofuels industry:

> *"Given the demand for the product, it could evolve. So you may have to eventually move into conifer, which is the national forest, primarily. Maybe state forest, maybe private. So [that is] a big issue, the supply and the intended or unintended consequences of supplying the industry in a sustainable source of raw materials I think is [going to] be a big deal."*

As discussed earlier, there is a strong link between economic and ecological effects and therefore a need to strike balance between the two. There were also pollution concerns regarding the biorefinery. One interviewee from the political figure stakeholder group revealed a concern for this pollution and economic viability:

> *"I don't know much about [the forest product biofuels] industry, I just know that in Tacoma [there are] power plants that burn that kind of fuel and it puts a lot of pollution into the urban area. You [have] to watch out for the pollution behind that type of production and turning that type of fuel into ethanol. I [do not] know what the pollution is but I would just say it's a balance between environmental concerns and economic concerns, i.e. jobs."*

Future generation ecological concerns surrounded long-term wildlife effects more often than on-the-ground effects of establishing a residual-based biofuels industry. There were concerns about longer term effects such as carbon neutrality and long-term forest health:

> *"And then the other concern, you know, the debate goes on about the carbon cycle and whether we have it right in the whole Pacific Northwest. [We are] growing a lot of trees and [it is] a complex cycle out there, we got a lot of disease in the trees. We know [there are going to] be a lot of trees dying, [they are] going to be giving up a lot of CO_2 as they get chewed up by the little critters. [We are going to] be adding to that if we start taking, whether [it is] thinnings or forest residuals and using it for biofuels. Is that still consistent with a net neutral, or even a reduction of our carbon footprint for the region? The science is developing on that and I know [there is] still pretty intense debate even within the forestry community on that subject."*

6.2.3 Social Concerns

Social concerns were a commonly discussed barrier to social acceptability, particularly confusion and level and state of knowledge about biofuels, specifically associations with controversial issues (e.g. forest management, corn as feedstock), and general understanding of biofuels. Interviewees were very concerned about their own levels of knowledge, in that they did not know as much as they thought they should. One political interviewee pointed out that while information exists, it was not very accessible.

In all interviews, a basic definition of biofuels was the first topic discussed. The time spent discussing was dependent on the level of knowledge within the stakeholder group. For example, expert and industry stakeholders only needed a brief definition to set the context, while Native American tribal and community members discussed different kinds of biofuels and associated controversies for a much longer duration. Interviewees were often confused about terminology regarding the nuanced concepts of sustainability and biofuels. One government interview pinpointed inconsistency as the source of this confusion:

> *"There are so many different, conflicting definitions for things. Like the definition of biomass: in the popular lexicon it means wood, [there is] the scientific definition, the policy definition, the federal. There are 14 different definitions, so just agreeing what [we are] talking about is a long conversation."*

Levels and states of knowledge can generate cycles of debates and social unacceptability. One of these debates was the ecological sustainability of removing residuals from the forest. Many interviewees were concerned about how much to remove. Removing too much robs the forest of nutrients, and removing too few increases propellant for catastrophic forest fires. An expert interviewee discussed the hypocrisy displayed when there is a desire for ecological preservation and an economically viable product:

> *"A lot of the environmental community wants a green, sustainable society, 'but [do not] go in there and screw up my forests, because I want that too'."*

Interviewees expressed many concerns about the biorefinery and a "not-in-my-backyard" (NIMBY) attitude, namely negativity surrounding unaesthetic odor, and pollution:

> *"There are very few things really that the public gets engaged actively, but people do get engaged in their community when they see things that are kind of directly affecting them or their families."*

> *"If it raises eyebrows in the community [they are] not gonna do it. [I have] raised 35,000 hogs; nobody wants to live next to a hog farm. And if this things makes a lot of pollution and a lot of smell, [they are] not gonna want it. If it smells like Tacoma, the answer is no."*

This theme of indifference may be widespread, as one urban community member exemplified:

> *"If they replace gasoline with biofuels, I will still go to the service station, fill the car up with a fuel, and drive off. I suppose technically the fuel is a biofuel rather than gasoline, but do I really care?"*

Concerns mostly stemmed from mistrust and uncertainty. Many interviewees questioned the efficiency of ethanol and its drop-in abilities to the current fuel infrastructure. In most focus group interviews, with urban community members in particular, this led to an examination of whether or not biofuels are worthwhile for the time, effort, and money required. One urban community member describes the complexity of the industry, ultimately viewing it as an effort not worthwhile:

> *"[There is] a key difference between biofuel and fossil fuel. In the case of biofuel, it is something [that is] kind of grown or harnessed. The cost associated with producing that fuel is clearly more than what meets the eye. [If we] take a simple case like using cloth diapers versus using the traditional diapers. People say, "hey I go with cloth diapers, so therefore [I am] environmentally friendlier." But then if you look at it, [there is] now a diaper cleaning company and then there are trucks, there are the employees, [there is] a whole industry going on over there and they have their trucks moving on the roads and so on and so forth and adding to the carbon footprint or whatever. [It is] so complex at that point that I [do not] even think [it is] worth it. "*

6.3 Suggested Solutions

Interviewees suggested three major solutions to perceived constraints: research and preparation, persuasive communication and outreach, and taxing and policy. A government-employed interviewee had a similar strategy to change behavior:

> *"[There is] the old adage that [there are] three ways to change behavior, you can incentivize, you can coerce, or you can educate. And the reality is you [have to] do all three. Education is the long term solution, but if you have near term prices, then you need to incentivize. Coercion would be an incentive and then regulation would be the stick."*

Interviewees suggested that the first step of research and preparation is an economically, ecologically, and socially sustainable plan for effects of establishing a biofuels industry by decision makers and researchers. They can achieve the second suggestion by communicating this plan to the public through outreach programs. The third suggestion is management and policy to modify industrial behavior and contribute to increasing social acceptability. Results are presented in stratified themes of main suggested solutions: research and preparation, persuasive communication and outreach, and taxing and policy.

6.3.1 Research & Preparation

Research and preparation was a commonly suggested preventative solution to problems; most interviewees were reassured with the idea of holistic, sustainable and strategic research and preparation for any negative effects of this industry. One expert interviewee states research and preparation as a solution to a potential water problem:

> *"Sometimes people [do not] understand how much water it takes to actually make the certain types of biofuels. But as long as we know and we start developing the practices and processes to save [and] recycle more water, at least [we will] be prepared for it."*

Keeping a comprehensive inventory of resources, investigating and incorporating knowledge regarding the limits of certain geographies, and strategizing the biorefinery location and economy of size in order to mitigate concerns such as transportation, economic value, and social concerns due to unfamiliarity are three ecological and technical examples of how research and preparation can maintain the original goals of sustainability and thus public trust and social acceptability.

6.3.2 Persuasive Communication & Outreach

Research and preparation was a common suggestion, but it can only be effective if the public trusts the source. Many interviewees suggested making information accessible through communication and outreach programs, particularly by using media outlets to advertise a message. They suggested focusing on the message content, framing and delivery. Some specified techniques such as using "the power of story" or profiles to show an example of success or public acceptance. An industry stakeholder discusses the initial anxiety about biodiesel and ethanol mandates in Oregon and California that have since been alleviated:

> *"I think consumer stigma about [biodiesel] is falling off fast, based on the B5 standard in Oregon. I think that scared a lot of people were nervous about that, but after seeing that cars [do not] break down all over the place, people kind of became more accepting of that. You go to most gas stations up here, and if they have a diesel pump, chances are [there is] going to be a sticker on that pump that says 'may contain up to 5% biodiesel' on it. Most consumers [are not] super worried about it, and the more they see it the more comfortable they become with it, just like it was with E10, or in California MTBE."*

Interviewees also found it important that the message was consistent and framed in such a manner that appealed to diverse audiences. One expert interviewee suggested that a broad appeal be made, but also specifically tailored to specific communities:

> *"NIMBYism. [It is going to] be out there. Whether [it is] biofuels infrastructure or the mental health treatment center or the homeless shelter or whatever. [You are going to] have to deal with that community by community. Education and a broad marketing plan is probably good in general, you need to have that, but [you will] also be able to have to show each community that there are air pollution controls that [are not going to] make your kids sick and [we are going to] operate this at hours that [are not] going to keep people awake at night. And all the kinds of things that with other types of big projects you have to win the community over."*

One focus group interviewee who self-identified as opposed to biofuels explained his tactic of tailoring advocacy techniques to specific communities in order to recruit and spread public

opposition to bioenergy refineries and facilities. He stated that Western Washington State residents are less focused on ecological concerns and have a more emotional response to public health concerns:

> *"It may be a harder sell for urbanites who are completely divorced from forests. If it [was not] for the human health aspect and the incinerator pollution, I'm not sure [we would] have any base at all [for] trying to sell forest health to Seattle public."*

One interviewee who worked for a nongovernment organization in support of establishing a biofuels industry discussed a tactic of influencing influencers known as "grass-tops messaging" or targeting decision-makers and leaders in communities to spread a message:

> *"Reaching out to business leaders in communities and talking to them about what clean energy means, then having them sign onto letters of support, or op-eds. Messaging out that [they are] a small business owner or business leader and that they support this. Finding stakeholders, specifically entrepreneurs, investors, and businesses that would benefit from a local, regional biofuel industry and getting them together to speak up about it."*

6.3.3 Management & Policy

Management and policy will have an enormous effect on establishing a biofuels industry because, as one interviewee explicates, "…the economics is [going to] drive this thing…" Most interviewees were supportive of government management and policy, aside from interviewed rural and urban community members who were very concerned about subsidies and government support. Their primary suggestion given by rural community members was a reduction in government intervention and mandates for farmers, particularly regarding environmental regulations:

> *"A lot of [farmers] that utilize ground are making a business livelihood of it and so [you are] not out there to destroy and pillage the resources at hand otherwise you go out of business. Many [farmers] are in this business for generations and generations and you probably [do not] need all the restrictions*

> *and mandates because you guys are doing a good job, [that is] why [you are] still in the business. There are those people who [do not] understand how to stay in the business and they do overuse a resource. And it hurts everybody that you know locally, whether [it is] water quality or air quality or species diversity or whatever. Then all of a sudden the government will start imposing restrictions on those folks, whereas other people who are being a good job of being stewards of the lands are being negatively affected by it."*
>
> *"Would it create more government mandates? Once we allow something like this, would the government say, 'we [have to] do this every time we trim a tree.' Would it create another bureaucracy? I [do not] have any trust or faith where this would go from here."*

One interviewee noted that a shortcoming of Imperium Renewables, a biodiesel company in Washington State, as a lack of contracts with local suppliers to maintain a sustainable feedstock supply:

> *"Imperium Renewables take[s] the biomass from Canada or from Indonesia to produce biodiesel because they [did not] have enough contracts with the local farmers to sustain that. Something to learn from that, if we create something we [want to] make sure our farmers [are going to] be the ones who deliver the biomass."*

This forced the company to import from other countries, no longer retaining local production, while simultaneously increasing costs. This could have been mitigated through appropriate policy such as requiring maintenance of local production, constraining Imperium Renewables to find better enticement for supplier involvement, or government incentives, or any number of possibilities.

7. DISCUSSION

The triple bottom line weights economic, ecological, and social components as equal and necessary for any successful endeavor. This research addresses the social component, drawing a

theoretical framework from fundamental functional attitude theories (Smith et al. 1956; Katz 1960) as a basis for justification. By understanding the motivational basis of attitudes and appealing to different attitude functions, we can alter attitudes and perceptions in favor of our targeted behavior of increased acceptance of residual-based biofuels.

We can use Smith et al. (1956) and Katz (1960)'s framework for attitude functions and Lavine & Snyder's (1996) proposed functional matching effect as a basis for crafting persuasive communication messages. For reference, the functional matching effect describes targeting attitudes through directly addressing the motivation(s) that support them (Lavine & Snyder 1996). By pinpointing and examining the attitude function in play and whether it aligns with the desired attitude, decision-makers can either bolster that attitude or persuade targets their attitude no longer serves the function they think it does. Results did not warrant justification to include the ego-defensive attitude function, and it is thus omitted. A functionally pure message is more effective than a functionally mixed message, and should be used to target specific audiences with one primary attitude function prevalent. I recommend industry and state decision-makers use this type of message to target each stakeholder group (Table 4).

Attitude Function	Sample Expression	Sample Communication Message
Object-appraisal/ knowledge/ utilitarian	“I agree with everyone else as far as the subsidies. It might be more expensive to have these biofuels, but on the other hand we should have some sort of back up to our current situation. I think it’s a good idea to have some alternatives, but not heavily subsidized.”	"Using forest residuals: cleans up our forests, reduces fuel prices, provides jobs for rural communities, and improves forest recreation, all without government subsidies!"
Social adjustment	“There’s something about marketing and behavior change [for biofuels]. In Portland, I would walk 40 minutes to go places. I came back from the grocery store sweating and I felt good about myself. By walking I was getting reinforcement from my friends and peer group and people around me like that’s the norm, that’s what you do.”	"Join your neighbors in support forest residuals for biofuels!"
Value-expressive	“Leave the trees alone. The stuff underneath, too. It’s what keeps the trees going.”	“Fire-prone, dry forests need active management to reduce catastrophic forest fires. Leaving these forests untouched thus leaves them susceptible to fire. In order to increase forest health, we must remove forest residuals.”

Table 4: FUNCTIONALLY PURE SAMPLE COMMUNICATION MESSAGES

A functionally mixed message, however, is more effective for a large, diverse audience holding an array of attitude functions. I recommend industry and state decision-makers combine functionally pure messages into functionally mixed messages to target the broader public of Washington. An example message could be:

> "Residuals for fuel can not only keep our forests safe, but it can provide a new economic resource to help our rural communities and reduce our carbon footprint. Your forests and farmers need you, support residuals for fuel!"

We can apply the functional matching effect to this research when targeting value-based attitudes of self-identified opposers. Their values of forest health and preservation are actually in conflict, as one comprehensive study shows, fire-prone dry forests need active management to reduce

catastrophic forest fires (Mason et al. 2009). Leaving these forests untouched thus leaves them susceptible to fire, reducing forest health. By making opposers aware of this, they could more easily be persuaded to support removing residuals from the forest.

7.1 Limitations and Future Work

We chose a qualitative methodology for the depth of data it provides by allowing respondents to express attitude forming motivations, values and beliefs in their own words (Esses & Maio 2002). Examining the factors that create and modify attitudes is important in pinpointing areas of intervention for behavior change. We used key informant and focus group interviews to access a depth and breadth of information and perspectives. These methods are, however, limited in scope by a small sample size and inability for generalization, though allow for very useful information for a specific population. This study can be used to inform additional research and either focus on a particular stakeholder group with case studies of communities, or extrapolate to a wider population with a generalizable survey to assess salient perceptions and attitudes of Washington State residents. We could then use these results as a representative and generalizable sample to inform future decision making in policy, outreach and behavior change strategies, culminating in high social acceptability of a residual-based biofuels industry in Washington State.

8. CONCLUSION

Our study contributes to the growing body of research surrounding the human dimensions of forest biomass conversion to energy. The objective of this study was to explore social acceptability of a residual based biofuels industry in Washington State. We interviewed Washington State stakeholders to understand their perceptions and attitudes. The resulting perceived benefits, constraints, and suggested solutions can be used to inform decision and

policy-making. Decision makers can increase social acceptability and induce behavior change by positively changing attitudes, i.e. bolstering levels and drivers of support, addressing concerns, and taking suggested solutions into consideration.

Expert interviewees expressed approval concerning the establishment of a residual-based biofuels industry within the state of Washington, and envision it as successful, especially if certain economic and social factors are addressed or bolstered. Interviewees from Native American tribe, political, government, and industry stakeholder groups held positive attitudes towards forest residuals as feedstock for biofuels, while nongovernment organizations and community members had mixed attitudes.

Most salient perceived benefits focused on economics and ecological, social, and technical benefits; most salient concerns focused on economic and political, ecological, and social concerns. Suggested solutions for increasing social acceptability revolved around research and preparation, persuasive communication and outreach, and management and policy. We gave examples of how this research can be used to bolster and target specific benefits and concerns.

9. THESIS DISCUSSION

Our study contributes to existing work by examining Washington State stakeholders' perspectives. Other studies have overlooked knowledgeable stakeholders' voices which could be helpful in decision-making. Results of our study are consistent with those of Stidham and Simon-Brown (2011), who found general support from Oregon State interviewees, though participants in their study primarily held an ecological focus (e.g. forest health and restoration). Washington State interviewees in our study focused primarily on economic effects. The difference in foci between our study and Stidham and Simon-Brown's illustrates the importance of doing research

on a regional and local scale. Attitudes and behaviors are most effectively altered when behavior change strategies align with and target specific stakeholder foci.

9.1 Utilizing and Bolstering Benefits to Promote Social Acceptability

Decision-makers can utilize benefits given by interviewees to increase social acceptability of establishing a biofuels industry. Interviewees noted the importance of targeting different messages to different communities. For example, the public of Western Washington would likely be more receptive of a message that bolsters the perception of biofuels as an environmentally friendly alternative to fossil fuels. The public of Eastern Washington may be more open to a message focusing on the economic and community benefits of local production and use.

9.2 Suggested Solutions

Interviewees suggested solutions to perceived constraints in three synergistic ways: research and preparation, communication and outreach, and management and policy. Research and preparation into social, technical, economic, political, and ecological factors are a sustainable way to plan for effects of establishing a biofuels industry. Effective communication and outreach allows for easy access of this research by the public, which can decrease confusion and increase public trust. This can increase social acceptability by creating a new social identity for residual-based biofuels, independent of any other controversial associations (e.g. corn ethanol, deforestation). Management and policy can also contribute to increasing social acceptability by modifying industrial behavior. We know that attitude change leads to behavior change, but research has shown the relationship can be weak and even reverse to also be true (Werner et al. 1995).

Communication and outreach strategies are most effective in conjunction with management and policy (Bjorkland & Pringle 2001). Partnerships between education institutions, government

agencies, private industry, and nongovernment environmental organizations are integral for effective implementation of both strategies (Bjorkland & Pringle 2001).

Research and preparation was a commonly suggested preventative solution to problems, but most interviewees favored the idea of constant research and planning for any negative effects of this industry. Therefore only the latter two of these suggestions are discussed in depth. The two remaining suggestions are presented in two subsequent sections of communication and outreach, and management and policy. Specific suggestions are given based on three main areas of concern: economic and political, ecological, and social.

9.2.1 Persuasive Communication & Outreach

Communication and outreach play an enormous role in alleviating the four main areas of interviewee concerns (economic, ecological, future generation, and social) and increasing social acceptability of a residual-based biofuels industry. Decision-makers can use communication and outreach techniques to effect attitude and behavior change with tools such as education and public participation. For example, urban community members were hesitant and at times unwilling to support an industry they had little knowledge about. These attitudes were generally weakly formed, however. Ethereal attitudes such as these can be mollified and strengthened with education and outreach campaigns that reassure the preparation of and focus on sustainability by decision makers.

Duram & Brown (1999) amassed a list of five factors for assessing public participation in watershed planning that correspond to some the suggestions for communication and outreach given by interviewees in this research. The five factors are: (1) management approach (bureaucratic/regulatory vs. collaborative/grass-roots); (2) initiating public participation in any or all planning stages; (3) levels of participation; (4) methods to soliciting participations; (5) potential positive impacts of participation.

Interviewees from nongovernment organization, government organization, industry, expert and political figure stakeholder groups were generally in favor a bureaucratic approach, in which activities are controlled by government mandates (Duram & Brown 1999). Interviewees from urban and rural community stakeholder groups, Native American tribal members, and nongovernment organization members who self-identified as opposed to biofuels were generally in favor with a more collaborative or grass-roots approach, one that works toward a consensus from concerned stakeholders for problem resolution (Ford et al. 1990).

Interviewees from these stakeholder groups were also more fervently in favor of public participation. This is intuitive, as interviewees from nongovernment organization, government organization, industry, expert and political figure stakeholder groups can utilize management and policy to advocate change, whereas the other stakeholder groups can only voice their perspectives through public participation. Level of participation can be direct or indirect, in terms of how immersed in the planning process the public is, as little as voicing casual opinions to a higher level of actual involvement in decision-making and regulation implementation (Duram & Brown 1999).

Methods of solicitation are important. Interviewees suggested the same methods as those given by Blahna and Yonts-Shepard (1989): written statements or information (e.g., newsletters, flyers, videos), public hearings, door-to-door contact, and educational programs. Interviewees suggested specific examples of how solicitation techniques can be applied to establishing a biofuels industry in Washington State including: educating legislators of benefits and how their communities are most affected, holding public education workshops, demonstrating to the public that affiliated industries follow regulations to work toward a positive and sustainable goal, and showing examples of public acceptance of similar projects to reassure benefits of a biofuels industry in Washington State.

This last point touches on Duram & Brown's (1999) fifth factor for assessing public participation. This can be assessed by measuring levels of consensus reached, whether the plan implementation was promoted, and the extent to which public participation helped improve ecological and social conditions in the watershed (Duram & Brown 1999). The feasibility of communication and outreach strategies comes into question when discussing prioritization and corresponding funding, logistically limiting factors of communication and outreach strategies. A government employee recited personal experience with this concern:

> *"That's the fundamental problem is that the governments that deal with these policy quandaries have no capacity to do these public outreach. We've been cut down to the bone so much that one of the first things that gets cut is public outreach and education."*

With strong attitudes, an attitude and behavior change campaign could be effective in using this state of knowledge to the benefit of decision-makers. Interviewees focused on the message of these campaigns, i.e. message content, framing and delivery. Example methods given in results: using stories/profiles, tailoring the message to specific communities/finding the right motivation, using trusted leadership to deliver the message.

For most members of the public, an intensive behavior change campaign likely will not be necessary. The neutrality or apathy of interviewees in this study support the results of Plate et al.'s (2010) study showing a primarily neutral standpoint from survey respondents. One interviewee from the political stakeholder group explained that neutrality can be helpful, and suggested a focus on minimum social acceptability needed as the easiest and most effective route:

> *"I think you're less trying to get people on board then you are just trying to get people to not oppose. Yeah, this comes up in committee all the time; people don't care about electricity other*

than if the light switch goes on. I think it's going to boil down to the gas pump or the resource, is it working? Am I paying more?"

Minimum social acceptability is one route, though a comprehensive education and outreach strategy is a more aggressive approach to attitude and behavior change. Decision-makers could use this approach by addressing each salient theme of concerns. This includes information on and solutions to:

- Economic concerns of minimal job creation, maintaining local production, financial costs, competition with related industries, and regulation and policy. For example, educating the public about how we can also utilize this currently unused product to help local communities and economy.
- Ecological concerns of forest health, balance between forest health and feedstock supply, and pollution. For example, showing the benefits of removing residuals on forest health because of reduced fire ammunition and thus preventing catastrophic fires.
- Future generation concerns include long term wildlife effects, skepticism of the ability of biofuels to facilitate foreign energy independence or ease foreign fossil fuel reliance. For example, reframing to show that biofuels provide a smaller-scale solution, they can help diversify our energy industry and can be used as a stepping stone toward a renewable fuel future.
- Social concerns of misinformation, uninformed stakeholders, association with controversial issues, NIMBYism, trade-off of "green" and convenience, trust and uncertainty regarding regulation and policy, logistical concerns, technical efficiencies and transportation, and whether or not biofuels are worth the time, effort and money required. For example, decision makers can increase trust by maintaining communication between all parties involved.

9.2.2 Management and Policy

Management and policy are a more tangible way to affect behavior change, and research has shown that altered behavior can lead to altered attitudes (Werner et al. 1995). So while some members of the public may be undecided about their view, if the behavior is established as a societal norm, they may be more likely to adopt that behavior and corresponding attitude. Creating a societal norm begins with targeting the intended behavior and spreading it. This can be done with policy.

Feasibility depends on cooperation between decision-makers, stakeholder groups, and the public. While most interviewees were in agreement about the path this industry should take, some were worried about communication between all parties. Another factor of feasibility is a coordinated and intertwined approach of suggested solutions. For example, if a nearby community disagrees with an implemented policy regarding the amount of forest residuals that can be removed from a forest, outreach and education campaigns can be used to inform community members of the forest health benefits of removing some but keeping an allotted amount of residuals in the forest. Also, research can be continually incorporated as appropriate.

A comprehensive management and policy campaign would address each of the salient themes of concerns:

- Economic concerns of minimal job creation, maintaining local production, financial costs, competition with related industries, and regulation and policy. Concerns over minimal job creation can be mitigated by allocating or creating jobs in communities where it will have the highest positive impact (e.g. rural communities, Native American communities). One way of reducing opposition through management and policy is utilizing available infrastructure. This reduces time, energy, costs and public opposition.

It also reduces the need to increase social acceptability because the surrounding communities are already comfortable with this type of industry. Most members of these communities are less likely to oppose it, because they know the pragmatic tradeoffs between having an industrial refinery in their community and community benefits.

- Ecological concerns of forest health, balance between forest health and feedstock supply, and pollution can be mitigated with management and policy. For example, policies on removing residuals from the forest to mandate a maximum amount of removal and maintaining forest health management practices.
- Future generation concerns given by interviewees included long term wildlife effects, skepticism of the ability of biofuels to facilitate foreign energy independence or ease foreign fossil fuel reliance. Policy and management to assuage this concern include maintenance of the Renewable Fuels Standard and other relevant policies to address and incorporate research on future generation effects.
- Social concerns of misinformation, uninformed stakeholders, association with controversial issues, NIMBYism, trade-off of "green" and convenience, trust and uncertainty regarding regulation and policy, logistical concerns, technical efficiencies and transportation, and whether or not biofuels are worth the time, effort and money required. Management and policy can be used to address the social concern primarily held by rural community interviewees of excessive regulation and policy. Decision-makers could increase trust by reducing adjustments of current regulations and policy.

9.3 Behavior Change Strategies For Specific Stakeholder Groups

The stakeholder groups that may need more consideration in behavior change campaigns are Native American tribal members who tend to be marginalized in decision-making processes, and those who self-identified as opposed to the biofuels industry. This is a unique aspect of this

study. Native American stakeholders have a unique perspective with a distinctive history with their land and value of their forests. These interviewees recognized their place in the bioenergy industry and were eager to contribute if it meant preserving cultural resources, providing jobs for tribal members, and reinvigorating their community. Decision-makers and willing tribes could coordinate to help establish a biofuels industry in Washington State.

Behavior change strategies for Native American tribal interviewees should focus on bolstering culture and community benefits, namely that a biofuels industry can: provide jobs for community members, clean up the forest, improve culturally and recreationally valued areas, and provide these benefits without exploiting or compromising their culturally valued resources. Additionally, decision-makers can assuage concerns over nontribal intervention and not being viewed as self-sufficient by allowing tribes a large financial stake in the industry.

We identified many interviewees *a priori* as holding negative attitudes toward biofuels; they themselves self-identified as opposed to bioenergy activities. Their skepticism was largely based on concerns of trust related to the sustainability of the project, which likely stemmed from a conflict with their value system, particularly as related to forest preservation and air quality. When an individual views a message or messenger as untrustworthy, they are less accepting of that message. Interviewees who were the most opposed to the project were often mistrustful of underlying factors of the project rather than the project itself. This shows their peripheral processing – assessing the message based on other cues besides the idea or strength of the argument – as opposed to central processing – when the listener thinks about the message directly (Petty & Cacioppo 1986). They relied on peripheral cues such as funding sources, mistrust of research institutions, and past perceived failures in the biofuel and bioenergy field. Moving the topic from the peripheral to central processing can increase acceptability by

decreasing opposition and increasing trust. Unlike community and Native American tribal interviewees, however, these attitudes were more stable, and thus less malleable.

Interestingly enough, only one of the seven interviewees with negative attitudes toward biofuels continued to identify themselves as strongly opposed to biofuels after interviews were completed. All other interviewees agreed that biofuels had potential to be economically and ecologically sustainable. We suggest using advertisements and education campaigns to bolster attitude change with this transition from peripheral to central processing in the minds of the public. In addition, personal contact with opinion, political leader support, and collaborative approaches for those with value-based conflict attitudes. Persuasive communication messages given in the article discussion are potentially effective examples.

9.4 Limitations and Future Work

We chose a qualitative methodology for the depth of data it provides by allowing respondents to express attitude forming motivations, values and beliefs in their own words (Esses & Maio 2002). Examining the factors that create and modify attitudes is important in pinpointing areas of intervention for behavior change. We used key informant and focus group interviews to access a depth and breadth of information and perspectives. These methods are, however, limited in scope by a small sample size and inability for generalization, though allow for very useful information for a specific population. This study can be used to inform additional research and either focus on a particular stakeholder group with case studies of communities, or extrapolate to a wider population with a generalizable survey to assess salient perceptions and attitudes of Washington State residents. We could then use these results as a representative and generalizable sample to inform future decision making in policy, outreach and behavior change strategies, culminating in high social acceptability of a residual-based biofuels industry in Washington State.

REFERENCES

Agar M, J MacDonald. 1995. Focus Groups and Ethnography. Human Organization. Vol. 54(1):78-86.

ASG Renaissance. 2004. Biodiesel End-User Survey: Implications for Industry Growth. Dearborn, MI.

Ajzen I, M Fishbein. 1980. Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice Hall.

Bailey C, JF Dyer, L Teeter. 2011. Assessing the Rural Development Potential of Lignocellulosic Biofuels in Alabama. Biomass and Bioenergy. Vol. 35:1408-1417.

Bengston D, D Fan. 1999. Roads on the U.S. National Forests: An Analysis of Public Attitudes, Beliefs, and Values Expressed in the News Media. Vol. 31(4):513-539.

Bjorkland R, CM Pringle. 2001. Educating our Communities and Ourselves about Conservation of Aquatic Resources through Environmental Outreach. BioScience. Vol. 51(4):279-282.

Blaine K, S Kamaldeen, D Powell. 2002. Public Perceptions of Biotechnology. Journal of Food Science. Vol. 67(9):3200-3208.

Brunson, M.W. 1996. A Definition of "Social Acceptability" in Ecosystem Management. In M Brunson, L Kruger, C Tyler, and S Schroeder (Eds.), Defining Social Acceptability in Ecosystem Management: A Workshop Proceedings. (pp. 7-16). General Technical Report PNW-369. Portland, OR: U.S. Forest Service.

Buchholz T, CD Canham, SP Hamburg. 2011. Forest Biomass and Bioenergy: Opportunities and Constraints in the Northeastern United States. Northeastern Forest Biomass Energy.

Cacioppo JT, RE Petty, CE Kao, R Rodriguez. 1986. Central and Peripheral Routes to Persuasion: An Individual Difference Perspective. Journal of Personality and Social Psychology. Vol. 51:1032-1043.

Corbin J, A Strauss. 2008. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory (3rd ed.). Thousand Oaks, CA: Sage.

CIPD. 2010, November. PESTLE Analysis. Cipd.co.uk. Retrieved December 24, 2012, from http://www.cipd.co.uk/hr-resources/factsheets/pestle-analysis.aspx

Crano W, R Prislin. 2006. Attitudes and Persuasion. Annual Review of Psychology. Vol. 57:345-374.

Dalton GJ. DA Lockington, TE Baldock. 2008. A Survey of Tourist Attitudes to Renewable Energy Supply in Australian Hotel Accommodation. Renewable Energy. Vol. 33:2174-2185.

DeBono KG. 1987. Investigating the Social-Adjustive and Value-Expressive Functions of Attitudes: Implications for Persuasion Processes. Journal of Personality and Social Psychology. Vol. 52:279-287.

DeBono KG, R Harnish. 1988. Source Expertise, Source Attractiveness, and the Processing of Persuasive Information: A Functional Approach. Journal of Personality and Social Psychology. Vol. 55: 541-546.

Dhar Chowdhury P, CE Haque. 2008. Knowledge of the Environmental Risk and Communication Gaps between 'Experts' and Laypersons: the Case of Climate Change Induced Heat Waves in Urban Winnipeg. Prairie Perspectives: Geographical Essays. Vol. 11:99-117.

Duram LA, KG Brown. 1998. Insights and Applications Assessing Public Participation in U.S. Watershed Planning Initiatives, Society & Natural Resources: An International Journal. 12(5):455-467.

Dwivedi P, JRR Alavalapati. 2009. Stakeholders' Perceptions on Forest Biomass-Based Bioenergy Development in the Southern US. Energy Policy. 37(5):1999-2007.

ECOTEC.1999. The Impact of Renewables on Employment and Economic Growth. ECOTEC Research and Consulting Ltd. Altener contract 4.1030/E/97-009.

Energy Information Administration (EIA). 1998. Challenges of the Electric Power Industry Restructuring for Fuel Suppliers. US DOE WA.D.C.

Energy Information Administration (EIA). 2008. Renewable Energy Consumption and Electricity Preliminary 2007 Statistics. US DOE. WA DC.

Elkington J. 1998. Cannibals with Forks: The Triple Bottom Line of 21st Century Business. New Society Publishers.

Environmental Protection Agency (EPA). 2009. Regulatory Announcement: EPA Proposes New Regulations for the National Renewable Fuel Standard Program for 2010 and Beyond. EPA-420-F-09-023

Esses VM, GR Maio. 2002. Expanding the Assessment of Attitude Components and Structure: The Benefits of Open-Ended Measures. In: W Stroebe & M Hewstone (Eds.), European Review of Psychology. Vol 12:71-102. Chichester, UK: Wiley.

Fazio RH & CJ Williams. 1986. Attitude Accessibility as a Moderator of the Attitude-Perception and Attitude-Behavior Relations: An Investigation of the 1984 Presidential Election. The Journal of Personality and Social Psychology. Vol 51(3):505-514.

Fishbein M, I Ajzen. 1975. Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading, MA: Addison-Wesley.

Ford KE, KA Glatzel, RE Piro. 1990. Watershed Planning and Restoration: Achieving Holism Through Interjurisdictional Solutions. In Environmental Restoration: Science and strategies for Restoring the Earth, Ed. J. Berger, 312-320. Washington, DC: Island Press.

Galinato SP, DL Young, CS Frear, JK Yoder. 2009. Will Washington Provide its own Feedstocks for Biofuels? Working Paper. Dept. Biosystems Engineering, Washington State University. Pullman, WA.

Geer JG. 1991. Do Open-Ended Questions Measure "Salient" Issues? Public Opinion Quarterly. Vol. 55:360-370.

Given LM (Ed.). 2008. The SAGE Encyclopedia of Qualitative Research Methods, Volume 2. Thousand Oaks, CA: SAGE Publications.

Glaser BG, AL Strauss. 1967. The Discovery of Grounded Theory: Strategies for Qualitative Research, Chicago, Aldine Publishing Company.

Harris SG, BL Harper. 1997. A Native American Exposure Scenario. Risk Analysis. Vol. 17(6): 789-795.

Haugtvedt CP, DT Wegener. 1994. Message Order Effects in Persuasion: An Attitude Strength Perspective. Journal of Consumer Research. Vol. 21(1):205-218.

Kaplowitz MD, J Hoehn. 2001. Do Focus Groups and Personal Interviews Reveal the Same Information for Natural Resource Valuation? Ecological Economics. Vol. 36:237-247.

Katz D. 1960. The Functional Approach to the Study of Attitudes. Public Opinion Quarterly. Vol. 24(2):163-204.

Khan J. 2001. Siting Conflict in Renewable Energy Projects in Sweden: Experiences from the Siting of a Biogas Plant. Paper presented to New Perspectives on Siting Controversy Conference, 17–20 May 2001, Glumslov, Sweden.

Kiousis S. 2005. Compelling Arguments and Attitude Strength: Exploring the Impact of Second-Level Agenda Setting on Public Opinion of Presidential Candidate Images. The Harvard International Journal of Press/Politics. Vol. 10(3):3-27.

Krotscheck C, F König, I Obernberger. 2000. Ecological Assessment of Integrated Bioenergy Systems Using the Sustainable Process Index. Biomass and Bioenergy. Vol. 18:341-368.

Krueger RA. 1998. Analyzing & Reporting Focus Groups Results. London, UK: Sage Publications.

Krueger RA, MA Casey. 2000. Focus Groups. A Practical Guide for Applied Research (3rd Edition). Thousand Oaks, CA: Sage Publications.

Krueger RA, JA King. 1998. Involving Community Members in Focus Groups. London, UK: Sage Publications.

Kvale S. 1996. Interviews: An Introduction to Qualitative Research Interviewing. London: Sage Publications.

Lahmann EL. 2005. Biodiesel in Oregon: An Agricultural Perspective, Honors Baccalaureate of Science in Environmental Economics, Policy, and Management. University of Oregon.

Lavine H, M Snyder. 1996. Cognitive Processing and the Functional Matching Effect in Persuasion: The Mediating Role of Subjective Perceptions of Message Quality. Journal of Experimental Social Psychology. Vol. 32:580-604.

Löfstedt, RE. 2002. Good and Bad Examples of Siting and Building Biosafety Level 4 Laboratories: a Study of Winnipeg, Galveston, and Etobicoke. Journal of Hazardous Materials. Vol. 93:47-66.

Magar SB, P Pelkonen, L Tahvanainen, T Toivonen, A Toppinen. 2011. Growing Trade of Bioenergy in the EU: Public Acceptability, Policy Harmonization, European Standards and Certification Needs. Biomass and Bioenergy. Vol. 35:3318-3327.

Maio G, Haddock G. 2009. The Psychology of Attitudes and Attitude Change. London: SAGE Publications.

Marshall MN. 1996. Sampling for Qualitative Research. Family Practice. Vol. 13(6)522:525.

Mason CL, R Gustafson, J Calhoun, BR Lippke, N Raffaeli. 2009. Wood to Energy in Washington: Imperatives, Opportunities, and Obstacles to Progress. Report to the Washington State Legislature. University of Washington, Seattle, WA.

Miles MB, Huberman AM. 1994. Qualitative Data Analysis, 2nd Ed. Newbury Park, CA: SAGE.

Miller JM, DAM Peterson. 2004. Theoretical and Empirical Implications of Attitude Strength. The Journal of Politics. Vol. 66(3):847-867.

Morrison M. 2007, January. PESTLE Analysis Tool (PEST Analysis) – History and Templates. Rapidbi.com. Retrieved December 24, 2012, from http://rapidbi.com/the-PESTLE-analysis-tool/

Patton MQ. 1990. Qualitative Evaluation and Research Methods, 2nd Ed. Newbury Park,CA: SAGE.

Pausas JG, JE Keeley. 2009. The Role of Fire in the History of Life. Bioscience. Vol. 59(7):593-601.

Petty RE, DT Wegener, LR Fabrigar. 1997. Attitudes and Attitude Change. Annual Review of Psychology Journal.

Petty RE, Cacioppo JT. 1986. The Elaboration Likelihood Model of Persuasion. Advances in Experimental Social Psychology. Vol. 19:123-205.

Petty RE, Krosnick JA, (Eds.) 1995. Attitude Strength: Antecedents and Consequences. Mahwah, NJ: Erlbaum.

Pickens J. 2005. Attitudes and Perceptions. In: Borkowski N (Ed.): Organizational Behavior in Health Care. Sudbury, MA: Jones and Bartlett Publishers; pg. 43-75.

Pires ST. 2011. Social Perceptions of the Biofuel Industry in the Southeastern US. North Carolina State University; pg. 4-8.

Plate RR, MC Monroe, A Oxarart. 2010. Public Perceptions of Using Woody Biomass as a Renewable Energy Source. Journal of Extension. Vol. 48(3):1-15. Article number 3FEA7.

Rakos C. 1998. Lessons Learned from the Introduction of Biomass District Heating in Austria. E.V.A., Austrian Energy Agency: Vienna, Austria.

Saldaña J. 2010. The Coding Manual for Qualitative Researchers. California, Sage Publications.

Savvanidou E, E Zervas, P Tsagarakis. 2010. Public Acceptance of Biofuels. Energy Policy. Vol. 380:3482-3488.

Selfa T, L Kulcsar, C Bain, R Goe, G Middendorf. 2010. Biofuels Bonanza? Exploring Community Perceptions of the Promises and Perils of Biofuels Production. Biomass and Bioenergy. Vol. 34 Special issue on Sociopolitical Dimensions of U.S. Bioenergy Development.

Shavitt S, MR Nelson. 2002. The Role of Attitude Functions in Persuasion and Social Judgment. In: Dillard JP, M Pfau. (Eds.) The Persuasion Handbook: Developments in Theory and Practice. Pg. 137-153. Thousand Oaks, CA: SAGE.

Sissine F. 2007. Energy Independence and Security Act of 2007: A Summary of Major Provisions. Accession Number: Library of Congress, ADA475228.

Smith M, J Bruner, R White. 1956. Opinions and Personality. New York: Wiley.

Snyder M, KG DeBono 1985 Appeals to Image and Claims About Quality: Understanding the Psychology of Advertising. Journal of Personality and Social Psychology. Vol. 49(3):586-597.

Stidham M, V Simon-Brown. 2011. Stakeholder Perspectives on Converting Forest Biomass to Energy in Oregon, USA. Biomass and Bioenergy. Vol. 35:203-213.

Strauss A, J Corbin. 1990. Basics of Qualitative Research: Grounded Theory Procedures and Techniques. Newbury Park, CA: Sage Publications, Inc.

Union of Concerned Scientists (UCS). 2006. How Biomass Energy Works. Cambridge MA. http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-biomass-energy-works.html

Ulmer JD, RL Huhnke, DD Bellmer, D Dwayne Cartmell. 2004. Acceptance of Ethanol-Blended Gasoline in Oklahoma. Biomass and Bioenergy. Vol. 27(5):437-444.

Upham P, S Shackley. 2008. Local Public Opinion of a Proposed 21.5 MW(e) Biomass Gasifier in Devon: Questionnaire Survey Results. Biomass and Bioenergy. Vol. 31:433-441.

Upreti BR. 2004. Conflict over Biomass Energy Development in the United Kingdom: Some Observations and Lessons from England and Wales. Energy Policy. Vol. 32: 785-800.

Van der Horst D, P Sinclair, R Löfstedt. 2002. Options Méditerranéennes. Series A, 48:123-130.

Wegener DT & JR Kelly. (2008) Social Psychological Dimensions of Bioenergy Development and Public Acceptance. Bioenergy Research. Vol. 1:107-117.

Werner CM, J Turner, K Shipman, FS Twitchell, BR Dickson, GV Bruschke, WB von Bismarck. Commitment, Behavior, and Attitude Change: An Analysis of Voluntary Recycling. Journal of Environmental Psychology. Vol. 15(3):197-208.

West G. 2007. Canadian Attitudes Toward Government Intervention Policies in the Biofuel Market. Agricultural Institute of Canada Conference. Edmonton, Alberta.

Wiser RH. 2007. Using Contingent Valuation to Explore Willingness to pay for Renewable Energy: A Comparison of Collective and Voluntary Payment Vehicles. Ecological Economics. Vol. 62:419-432.

Zhang Y & BM Wildemuth. 2009. Qualitative Analysis of Content. In B. Wildemuth (Ed.) Applications of Social Research Methods to Questions in Information and Library Sciences. pg. 208-219. Westport, CT: Libraries Unlimited.

Zografakis N, E Sifaki, M Pagalou, G Nikitaki, V Psarakis, KP Tsagarakis. 2010. Assessment of Public Acceptance and Willingness to pay for Renewable Energy Sources in Crete. Renewable and Sustainable Energy Reviews. Vol 14:1088–1095.

APPENDIX A: Key Informant Interview Script

KEY INFORMANT SCRIPT

Stakeholders and biofuels: revealing knowledge, perceptions, and attitudes surrounding residual-based biofuels.

Opening Remarks:

I've already given an introduction in my email exchange with you, but I'll just go ahead and reiterate the topic of this interview today is just a discussion on the implementation of a forest-residual based biofuels industry in Washington State. Your response with be anonymized before it's reported; this is ensured by using a code name and omitting any identifying information in the transcripts from this interview. This is an IRB-approved project, and your privacy is ensured with the signing of the consent form.

So now I want to take a minute and explain how this session will operate. We will begin with open discussion on this broad topic of using forest-residuals for biofuels, then focus in on specifics of potential effects, then finish with a summary of everything discussed. If you think of the name of anybody else that could contribute insight with participation in an individual interview or focus group, please let me know.

Open Questions (5-20 min):

- Could you talk a little bit about your organization and your work with it?
    - *Probe: e.g. services provided, issues of concern, current projects or research, etc.*

Key Questions (90-130 min):

- When you think of biofuels, what comes to mind?
    - What do you think about utilizing forest residuals? Clean wood chips?

- What are you biggest personal concerns regarding the implementation of a residual-based biofuels industry?
    - *Probe: do you think forest residuals should be utilized? Clean wood chips?*
    - *Probe: what are (your affiliated stakeholder group)'s biggest concerns?*

- What do you perceive as the positive effects of having a residual-and/or clean wood chip-based biofuels industry within the state of Washington?
    - *Probe: Specifically, what about a biorefinery?*
    - *Probe: what will (your affiliated stakeholder group) think of it?*

- What do you perceive as the negative effects of having a residual-and/or clean wood chip-based biofuels industry within the state of Washington?
    - *Probe: Specifically, what about a biorefinery?*
    - *Probe: what will (your affiliated stakeholder group) think of it?*

- What are your perceived obstacles and constraints of initiating and managing a residual-based biofuels industry in Washington State?
    - *Probe: And what about (your affiliated stakeholder group)?*

Summary of issues raised in Key Questions-Moderator/Interviewer (5-10 min):

- Summary
- I am also conducting focus group interviews, is there anyone you can think of who could contribute and give insight in those interviews?
- Keeping in mind that our goal here is to better understand how residual-based biofuels will work in Washington. Is there anything that I missed or that you would like to add before we close?

Ending (2-3 min):

Thanks for participating, this information will be completely transcribed, interpreted and reported by June of next year for use as recommendations for decision- and policy-makers. If you'd like to be kept up to date with progress, please let me know and I'll add you to a periodic update list. If there's anything you can think of, any further questions, or people for me to talk to, please just call or email me, my information is on the consent form.

APPENDIX B: Key Informant Consent Form

KEY INFORMANT INTERVIEW CONSENT FORM

Stakeholder Knowledge, Perceptions and Attitudes Associated with Forest-Residual and Clean Wood Chip Based Biofuels in Washington State

You are invited to be in a research study that will explore the human dimensions of sustainable biofuels production in Washington State. You have been selected as a potential participant because of the insight that you may be able to provide on this particular subject. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Stanley Asah, Assistant Professor, and Caitlin Singer, a student, both of the School of Environmental and Forest Sciences at the University of Washington.

Background Information

The purpose of this study is to identify obstacles and prevention/mitigation of obstacles through the identification of and information provided by knowledge, attitudes, and perceptions to inform policy and processes of residual-based biofuels. The main objectives are to: identify foreseeable social effects (both desirable and undesirable) of biofuels production in Washington state, using forest residuals and clean wood chips as feed stock, inform alternatives for planning, mitigation, and biofuels production and distribution processes, and improve social outcomes by providing outreach and informing mitigation to communities that may be impacted by a local biorefinery.

Procedures:

By agreeing to participate in this study, we will ask you to do the following things:

- In a one-on-one interview, you will be asked questions regarding your attitudes toward, knowledge and perceptions of bioenergy and biofuels, its: production, sustainability, capability and potential.

The entire session is anticipated to take roughly one hour.

Risks and Benefits of being in the Study

Your participation will help to identify participants for focus group interviews, as well as create a template for a future public survey.

Confidentiality:

The records of this study will be kept private. Information that would make it possible to identify you will not be included in any report or publication that may result from this study and the audio-records will be destroyed as soon as they are transcribed. Information will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Washington. If you decide to participate,

you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:
The researchers conducting this study are: Stanley Asah and Caitlin Singer. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them in Seattle at 206-685-4960, stasah@u.washington.edu; csinger@uw.edu.

Printed name of study staff obtaining consent	Signature	Date

Subject's statement

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask one of the researchers listed above. If I have questions about my rights as a research subject, I can call the Human Subjects Division, of the University of Washington, at (206) 543-0098. I will receive a copy of this consent form.

Printed name of subject	Signature of subject	Date

Copies to: Researcher
Subject

APPENDIX C: Focus Group Interview Script

FOCUS GROUP SCRIPT

Stakeholders and biofuels: revealing knowledge, perceptions, and attitudes surrounding residual-based biofuels.

Opening Remarks:

Hello and welcome everyone. I'm Caitlin, the face behind the emails and phone calls. I'd like to start things off by going around the table and having everyone say their names.

***

Great! Well, I've already given an introduction in my invitation sent to you, but I'll just go ahead and reiterate the topic of this focus group today is just a discussion on the implementation of a forest-residual based biofuels industry in Washington State. Your response with be anonymized before it's reported; this is ensured by using code names and omitting any identifying information in the transcripts from this interview.

So now I want to take a minute and explain how this session will operate. We will begin with open discussion on this broad topic of using forest-residuals for biofuels, then focus in on specifics of potential effects, then finish with a summary of everything discussed. Throughout this process, if names of any other stakeholders you think would provide insight on this topic pop up, please write them down; I'll collect these lists at the end.

We have a fairly full agenda today, so I apologize in advance if I have to cut off a discussion at any point. I don't mean to be impolite, but there may be times when I have to lead the conversation back on path so we have enough time to talk about everything there is to discuss.

Open Questions (2-3 min):

- (Open discussion) What comes to mind when you think of biofuels?
    - *Probe: What about forest residual-based biofuels? Clean wood chips?*

Key Questions (60-100 min):

- What do you perceive as the positive effects of having a residual-and/or clean wood chip-based biofuels industry within the state of Washington?
    - *Probe: Specifically, what about a biorefinery?*

- What do you perceive as the negative effects of having a residual-and/or clean wood chip-based biofuels industry within the state of Washington?
    - *Probe: Specifically, what about a biorefinery?*
    - *Probe: what are your biggest personal concerns?*

- What are some obstacles and constraints in attempting to initiate a residual-based biofuels industry in Washington State?

Summary of issues raised in Key Questions-Moderator/Interviewer (5-10 min):

- Summary
- We want to better understand how a residual-based biofuels industry can be most effectively initiated and managed to induce public favor, your comments in this focus group interview will help us to better achieve this.
- Keeping in mind that our goal here is to better understand how residual-based biofuels will work in Washington. Is there anything that I missed or that anyone would like to add before we close?

Ending (2-3 min):

Thanks for participating, this information will be completely transcribed, interpreted and reported by June of next year for use as recommendations for decision- and policy-makers. If you'd like to be kept up to date with progress, please let me know and I'll add you to a periodic update list. If you could please hand me the names of stakeholders you provided and if there's anything you can think of, any further questions, or people for me to talk to, please just call or email me, my information is on the consent form.

APPENDIX D: Focus Group Interview Consent Form

FOCUS GROUP INTERVIEW CONSENT FORM

Stakeholder Knowledge, Perceptions and Attitudes Associated with Forest-Residual and Clean Wood Chip Based Biofuels in Washington State

You are invited to be in a research study that will explore the human dimensions of sustainable biofuels production in Washington State. You have been selected as a potential participant because of the insight that you may be able to provide on this particular subject. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Stanley Asah, Assistant Professor, and Caitlin Singer, a student, both of the School of Environmental and Forest Sciences at the University of Washington.

Background Information
The purpose of this study is to identify obstacles and prevention/mitigation of obstacles through the identification of and information provided by knowledge, attitudes, and perceptions to inform policy and processes of residual-based biofuels. The main objectives are to: identify foreseeable social effects (both desirable and undesirable) of biofuels production in Washington state, using forest residuals and clean wood chips as feed stock, inform alternatives for planning, mitigation, and biofuels production and distribution processes, and improve social outcomes by providing outreach and informing mitigation to communities that may be impacted by a local biorefinery.

Procedures:
By agreeing to participate in this study, we will ask you to do the following things:

- In a focus group interview, you will be asked questions regarding your attitudes toward, knowledge and perceptions of bioenergy and biofuels, its: production, sustainability, capability and potential.

The entire session is anticipated to take roughly two hours.

Risks and Benefits of being in the Study
Your participation will help to create a template for a future public survey.

Confidentiality:
The records of this study will be kept private. Information that would make it possible to identify you will not be included in any report or publication that may result from this study and the audio-records will be destroyed as soon as they are transcribed. Information will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:
Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Washington. If you decide to participate,

you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:
The researchers conducting this study are: Stanley Asah and Caitlin Singer. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them in Seattle at 206-685-4960, stasah@u.washington.edu; csinger@uw.edu.

Printed name of study staff obtaining consent	Signature	Date

Subject's statement

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask one of the researchers listed above. If I have questions about my rights as a research subject, I can call the Human Subjects Division, of the University of Washington, at (206) 543-0098. I will receive a copy of this consent form.

Printed name of subject	Signature of subject	Date

Copies to: Researcher
Subject

APPENDIX E: Focus Group Confirmation Email

CONFIRMATION EMAIL

[Participant's name]

Thank you for agreeing to participate in the focus group that the Human Dimensions of Natural Resource Management Lab at the University of Washington is holding on **[date and time] at [location]**. Enclosed in this email is a map and directions that show you how to get to [location]. We will be meeting in their [meeting space name], and [if there is staff at a front desk that can show where meeting space is] will be happy to show you where that room is.

As I explained in our earlier [telephone call/email], the purpose of this group is to hear your opinion on biofuels. You will be part of a group of six to eight people from the local area who are all [a part of your stakeholder group]. I know that people have a great many different ideas on this topic, and I am very interested in hearing your thoughts on this subject.

The session will begin at [begin time] and will end at [end time]. I know how valuable your time is, and will respect everyone's schedules by both starting and ending on time. So, please allow yourself enough time to reach [location] by [time]; if you arrive after the discussion has started, I may not be able to include you.

I will provide some light snacks of [e.g. cookies, fruit, coffee, etc.] and pay you $40.00 for your participation. As I told in in our [telephone conversation/email exchange], I will be tape recording your discussion in order to keep a careful record of the things that I hear from you and the others. I will, as I promised, take every step to maintain your privacy.

Once again, I am glad you have accepted our invitation to participate in this group. Of course, the success of any group depends on each of its members, so I am counting on you. If you cannot attend for any reason, please call me at (602)696-0550 or email me at csinger@uw.edu as soon as possible.

I look forward to meeting with you on [date].

Sincerely,

Caitlin Singer

Graduate Student

APPENDIX F: Pre-Focus Group Survey

PRE-FOCUS GROUP SURVEY

1. What is your affiliation within the forest-residual based biofuels industry? (Mark all that apply).

- ☐ A government organization
- ☐ A Native American tribe
- ☐ A biofuel-focused industry
- ☐ A residential community
- ☐ The political industry
- ☐ A non-government organization

Rate your knowledge about biofuels ***(Circle one)***	**None**						**A lot**
2. How much do you know about biofuels?	1	2	3	4	5	6	7

3. Where should the wood used to make biofuel come from? (Mark one).

- ☐ Forestry operation left-overs (ex: slash piles after harvest, or mill residues.)
- ☐ Forest thinnings (ex: for improving growth, or reducing wildfire risk.)
- ☐ Trees grown specifically as an energy crop.

4. A woody biofuel industry in Washington State will (Mark all that apply):

- ☐ Provide jobs.
- ☐ Reduce dependence on foreign fuel.
- ☐ Increase pollution.
- ☐ Negatively affect species diversity.
- ☐ Counteract development pressures on forest & agricultural land.
- ☐ Improve our regional economy.
- ☐ Reduce global climate change problems.
- ☐ Be sustainable.
- ☐ Damage our forests.
- ☐ Increase food prices.
- ☐ Negatively affect human health.
- ☐ Improve forest health.
- ☐ Take resources away from better renewable energy/fuel sources.
- ☐ Hurt other forest-related industry.
- ☐ Increase global climate change problems.
- ☐ Support rural economies hurt by the recession.

5. Please mark the highest level of education you have completed (Mark one):

- ☐ Up to High School diploma or the equivalent (ex: GED).
- ☐ College, University, Vocational, or Technical School diploma (ex: Associate/Bachelor's).

- ☐ Postgraduate degree (ex: Master's/Doctorate).

6. Please mark your annual income:

- ☐ Less than $50,000
- ☐ $50,000 to $149,999
- ☐ $150,000 or more

7. Please mark your age range:

- ☐ 18 to 25 years
- ☐ 26 to 45 years
- ☐ 45 to 65 years
- ☐ Over 65 years

8. If you have interest in receiving periodic updates on the results of this focus groups and the rest of my research, please provide your email address below:

APPENDIX G: Human Subjects Review – Focus Groups

Date: 4/26/2012
PI: Dr. Stanley Asah
Assistant Professor
School of Environmental & Forestry Sciences
CC: Caitlin Singer
RE: HSD study #42866
"Public and Stakeholder Knowledge, Perceptions and Attitudes Associated with Forest-Residual Based Biofuels in Washington State"

Dear Dr. Asah:

The University of Washington Human Subjects Division (HSD) has determined that your research qualifies for exempt status in accordance with the federal regulations under 45 CFR 46.101/ 21 CFR 56.104. Details of this determination are as follows:

Exempt category determination: **2**

Determination period: **4/26/2012 - 4/25/2017**.

Although research that qualifies for exempt status is not governed by federal requirements for research involving human subjects, investigators still have a responsibility to protect the rights and welfare of their subjects, and are expected to conduct their research in accordance with the ethical principles of *Justice, Beneficence* and *Respect for Persons, as* described in the Belmont Report, as well as with state and local institutional policy.

Determination Period: An exempt determination is valid for five years from the date of the determination, as long as the nature of the research activity remains the same. If there is any substantive change to the activity that has determined to be exempt, one that alters the overall design, procedures, or risk/benefit ratio to subjects, the exempt determination will no longer be valid. Exempt determinations expire automatically at the end of the five-year period. If you complete your project before the end of the determination period, it is not necessary to make a formal request that your study be closed. Should you need to continue your research activity beyond the five-year determination period, you will need to submit a new *Exempt Status Request* form for review and determination *prior to implementation*.

Revisions: Only modifications that are deemed "minor" are allowable, in other words, modifications that do not change the nature of the research and therefore do not affect the validity of the exempt determination. **Please refer to the Guidance document for more information about what are considered minor changes.** If changes that are considered to be "substantive" occur to the research, that is, changes that alter the nature of the research and therefore affect the validity of the exempt determination, a new *Exempt Status Request* must be submitted to HSD for review and determination *prior to implementation*.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events or any problem that may increase the risk to the human subjects and change the category of review, notify HSD promptly. Any complaints from subjects pertaining to the risk and benefits of the research must be reported to HSD.

Please use the HSD study number listed above on any forms submitted which relate to this research, or on any correspondence with the HSD office.

Good luck in your research. If we can be of further assistance, please contact us at (206) 543-0098 or via email at hsdinfo@uw.edu. Thank you for your cooperation.

Sincerely,

Bailey Bell
Human Subjects Review Coordinator
(206) 221-7918
bbell3@uw.edu