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WISCONSIN NON-INDUSTRIAL PRIVATE FOREST LANDOWNERS AND
WOOD-BASED BIOENERGY

By

Jennifer L. Dunn

A DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

In Environmental and Energy Policy

MICHIGAN TECHNOLOGICAL UNIVERSITY

2018

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This dissertation has been approved in partial fulfillment of the requirements for the Degree of DOCTOR OF PHILOSOPHY in Environmental and Energy Policy.

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Table of Contents

Preface.....	v
Acknowledgements.....	vi
Abstract.....	vii
Chapter 1: Introduction.....	1
1.1 Background.....	1
1.2 Overview of Dissertation Chapters.....	3
1.2.1 Chapter 2 Overview.....	4
1.2.2 Chapter 3 Overview.....	5
1.2.3 Chapter 4 Overview.....	7
1.2.4 Chapter 5 Conclusion.....	8
1.3 References.....	8
Chapter 2: Wisconsin, USA Forest Landowners' Acceptance of Woody Bioenergy.....	13
2.1 Introduction.....	13
2.2 Background and Literature Review.....	15
2.2.1 Renewable Energy Support.....	15
2.2.2 NIPFs and Woody Biomass Harvesting.....	18
2.3 Methodology.....	21
2.4 Results.....	22
2.4.1 Ecosystem Services.....	22
2.4.2 Perceptions of Bioenergy Production.....	23
2.4.3 Trusted Entities and Information.....	28
2.5 Discussion.....	31
2.6 Conclusion.....	33
2.7 References.....	34
Chapter 3: Wisconsin NIPF Landowners' Intent to Harvest Woody Biomass for Bioenergy Production.....	46
3.1 Introduction.....	46
3.2 Literature Review.....	47
3.2.1 Values.....	48
3.2.2 Knowledge.....	49
3.2.3 Attitudes.....	49
3.2.4 Landowner Characteristics.....	50
3.3 Methods.....	52
3.4 Results.....	54
3.4.1 Respondent Demographics.....	54
3.4.2 Consideration of Harvesting Biomass.....	55
3.4.3 Knowledge.....	56
3.4.4 Attitudes toward bioenergy impacts.....	56
3.4.4.1 Attitudes toward economic impacts.....	57
3.4.4.2 Attitudes toward land access impacts.....	57
3.4.4.3 Attitudes toward environmental impacts.....	58

3.4.4.4	Attitude toward societal impacts.....	59
3.4.5	Forests and Ecosystem Services	60
3.4.6	Predictors of Harvest-related Attitudes.....	61
3.5	Discussion	65
3.6	Conclusions	66
3.7	References	68
Chapter 4: Collaborative Governance and Wisconsin’s Biomass Harvesting Guidelines		75
4.1	Introduction	75
4.2	Literature Review	77
4.2.1	Collaborative Governance Outcomes	77
4.2.2	Background.....	83
4.2.2.1	Biomass Harvesting Guidelines	83
4.2.2.2	Case Study	85
4.3	Methods	86
4.4	Results	87
4.4.1	Sharing Knowledge.....	88
4.4.2	Open and Authentic Dialogue.....	88
4.4.3	Power Shaping Process	91
4.5	Discussion	93
4.6	Conclusion.....	95
4.7	References	97
Chapter 5: Conclusions		109
Appendix A. Chapter 2 Interview Protocol		113
Appendix B. Chapter 3 Survey		119
Appendix C. Chapter 4 Interview Protocol.....		134

Preface

The research included in this dissertation was conducted under the supervision of Professor Kathleen E. Halvorsen in the Environmental and Energy Program, Department of Social Sciences, Michigan Technological University, between June 2014 and April 2018. Everything included in this dissertation is my own work, except where I cite others' work or quote interviewees.

The National Science Foundation's Partnerships in International Research and Education (NSF PIRE) program and Michigan Technological University's Ecosystem Science Center (ESC) funded the research conducted in this dissertation. As part of this project I worked with multiple researchers; therefore, each chapter of the dissertation has multiple co-authors. The next few paragraphs detail my role in the research and writing of each manuscript.

Chapter 2: Researchers on the NSF PIRE project team conducted this work. Multiple students at MTU conducted the interviews in June 2014. After the data was collected, I transcribed, coded, and analyzed the data. I worked with my co-authors to develop the theme for this manuscript. As the lead author, I was responsible for preparing the manuscript with oversight from my co-authors, who are also members of the PIRE team.

Chapter 3: This chapter uses quantitative data from a survey conducted by the PIRE team in June of 2015. I participated in the survey design, data collection in the field, and analysis of the data. I am the lead author on this manuscript with oversight and guidance from faculty. I was responsible for writing the initial draft of the paper and sought out guidance from my co-authors.

Chapter 4: This chapter uses qualitative data from interviews conducted in 2014 and 2017. I created the interview protocols with guidance from faculty and collected the data with the help of an undergraduate student and another researcher on the NSF PIRE project. I was responsible for transcribing, coding, and analyzing the interviews with the assistance of an undergraduate student. As the lead author of this chapter, I identified the theme of the paper and wrote the initial draft.

Jennifer Dunn

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I wanted to acknowledge the National Science Foundation (NSF) Partnerships in International Research and Education (PIRE) and the Michigan Technological University Ecosystem Science Center (ESC) for providing the financial support for this research and my education. Thank you to the other researchers on the PIRE project for the being such wonderful and supportive colleagues. I truly have enjoyed my time working with and learning from each of you.

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Abstract

Wood based bioelectricity production is expanding due to its ability to reduce greenhouse gas emissions compared to conventional fossil fuel resources. U.S. non-industrial private forest landowners (NIPFs) are key to the production of wood-based bioelectricity since they own 59% of the forestland in the country that could supply bioelectricity feedstocks (The National Association of State Foresters 2018). This is particularly important in states like Wisconsin with a mandatory renewable portfolio electricity standard (RPS). My dissertation focuses on issues around Wisconsin bioelectricity production including related NIPF views and the creation of the state's sustainable biomass harvesting guidelines. In Chapter Two, I present findings from analysis of NIPF interviews showing that they support local bioelectricity production while holding concerns about negative social and ecological impacts. Chapter Three focuses on findings from a survey conducted of NIPFs close enough to a local bioelectricity plant to supply it with biomass feedstock. I found that they perceive the plant as having negative environmental but positive socioeconomic impacts and that environmental membership was negatively associated with support for local bioelectricity. Chapter Four presents findings from my study of Wisconsin's biomass harvesting guidelines (BHG) creation process. These findings focus on the degree to which the process adhered to Collaborative Governance (CG) guidelines and how this process impacted outcomes. In combination, these three chapters enhance our understanding of the sustainability dimensions of Wisconsin's RPS and suggest strategies related to the success of state and federal renewable energy and bioelectricity goals.

Chapter 1: Introduction

1.1 Background

Renewable energy production has increased over the last two decades as policymakers and scientists alike recognize the complexity of climate change and the necessity of adaptation and mitigation strategies to lessen the impacts of climate change (Matisoff, 2008; Wiser et al., 2007). In the U.S. the most widely used policy tool enacted by 29 state governments to reduce greenhouse gas (GHG) emissions is the renewable portfolio standard (RPS) (Rabe, 2006; Wiser et al., 2016). An RPS mandates that utilities within the state provide a certain percentage of their electricity produced from renewable energy sources (i.e. solar, wind, bioenergy, etc.). One of the renewable energy options that replaces conventional energy sources is bioenergy (Guo et al., 2007). Bioenergy is energy produced for heat, power, or liquid transportation fuels from some type of biological material from plants or animals (Guo et al., 2007). The biological material is often referred to as the bioenergy “feedstock”. This dissertation focuses on feedstocks derived from woody biomass harvested from forests. Woody bioenergy is seen as an attractive replacement for fossil fuels because it is locally available, can create jobs, and improve domestic energy security (Aguilar et al., 2011; Cook & Beyea, 2000; Halder et al., 2015a). However, there are significant barriers to producing this energy source including feedstock availability, feedstock sustainability, and production costs (Becker et al., 2009).

Wisconsin's RPS, created in 1999 and amended in 2006, set a goal of having 10% of electricity from all state electric providers come from renewable energy sources by 2015 (NC Clean Energy Technology Center, 2015; Public Service Commission of Wisconsin, 2018). According to the RPS, from 2015 on, the state's electric providers must maintain an additional 4% above the 2015 baseline of renewable energy in their portfolios. In order to meet the RPS's goals, several utilities have turned to focusing on the production of bioenergy due to the large supply of woody biomass in the state.

Wisconsin has about 17 million acres of forestland covering roughly half of the state. About 9 million of these acres are owned by non-industrial private forest landowners (NIPFs) (Becker et al., 2009; Schmidt, 1997; WIDNR, 2015). NIPFs are forest landowners unassociated with the forest industry, such as individuals and families (Munsell & Germain, 2007; SAF, 2008).

Increased woody biomass harvesting for bioenergy production could potentially benefit landowners, the forest industry, electricity providers, and Wisconsin's economy and environment. However, many have concerns about the negative impacts of woody biomass harvesting on forest sustainability, biodiversity, and local communities (Becker et al., 2009; Grigal, 2000). Wisconsin NIPFs could help the state meet its RPS goals and produce more renewable energy. Without NIPFs' social acceptance of bioenergy and the willingness to supply biomass, Wisconsin's bioenergy industry cannot grow, as public owned forests account for only 31% of the forestland in the state (Becker et al., 2013; Becker et al., 2009).

Therefore, the second and third chapters of this dissertation focus on Wisconsin NIPFs' social acceptance of bioenergy production and the factors that impact their willingness to supply biomass for bioenergy production. The fourth chapter of this dissertation focuses on a policy created by governmental and non-governmental actors to address concerns related to biomass harvesting's negative environmental impacts. This policy is Wisconsin's 2008 Biomass Harvesting Guidelines (BHG) (revised in 2012). The guidelines are best management practices that are voluntary for most landowners. However, they are mandatory for harvesting on state and federal forests, private lands enrolled in Wisconsin's popular Managed Forest Land (MFL) program, and for landowners and companies with forest certified under the Sustainable Forestry Initiative or Forest Stewardship Council (Bronson et al., 2014; Herrick et al., 2009). The fourth chapter of this dissertation looks at how state and non-state actors created the BHGs using a collaborative governance (CG) strategy. By employing CG, the policymakers were able to create a successful management tool aimed at protecting forests and environments while facilitating sustainable biomass harvesting for bioenergy production to meet the state's RPS. The remainder of this chapter provides an overview of Chapters Two through Four, each of which is designed to be a manuscript to be submitted to a peer-reviewed journal.

1.2 Overview of Dissertation Chapters

This section will begin with a brief introduction to the literature reviewed in these three chapters and gaps my research aimed to address. My research focused on three key research areas: social acceptance of wood-based bioenergy, factors that impact

landowners' intent to harvest biomass, and collaborative governance as a policy-making strategy. My dissertation presents results from qualitative and quantitative studies investigating Wisconsin forest landowners' roles in wood-based bioenergy production for heat and power. Wisconsin was selected as part of a larger project focused on five forest-related bioenergy projects across the Americas (e.g. Brazil, Mexico, Argentina, Canada, and the U.S.) (Dunn et al., In Review). Each country had a case study concentrated on a type of wood-based bioenergy feedstock. The Brazil and Mexico cases studied Palm Oil as a bioenergy feedstock, whereas Argentina was focused on eucalyptus, and the U.S. and Canada studies focused on Northern hardwoods. In Wisconsin, the case was selected around a recently opened co-generation biomass power plant in Rothschild, which relies on woody biomass residues to produce electricity.

Chapter Two draws on interviews with NIPF landowners to identify their social acceptance of wood-based bioenergy. Chapter Three uses survey data to identify the perceptions, values, and landowner characteristics that impact Wisconsin NIPF landowners' intent to supply biomass for bioenergy production. Lastly, Chapter Four uses data from qualitative interviews to identify some of the processes of collaborative governance, a policymaking strategy used to create Wisconsin's best practices for woody biomass removal. Chapter Five synthesizes my findings and discusses study limitations.

1.2.1 Chapter 2 Overview

Forests provide a source of renewable feedstock to produce bioenergy (Fischer & Schrattenholzer, 2001; Wright, 2006). The production of bioenergy has recently increased dramatically, mostly because it can reduce greenhouse gas emissions compared

to conventional fossil fuel energy sources, helping to slow climate change (Cook & Beyea, 2000; Wright, 2006). However, in order to meet expanding biomass needs, private forest landowners will need to supply biomass feedstocks. Our objective for this chapter was to understand the landowners' perceptions of local bioenergy and to understand how these perceptions impact their acceptance of local industrial-scale bioenergy production. We conducted interviews with NIPFs in Northern Wisconsin who are in close proximity to the newly opened co-generation bioenergy facility in the summer of 2014. We used purposive and snowball sampling to recruit the 30 NIPFs for the study (Creswell, 2013; Ritchie et al., 2013; Robinson, 2014). By employing purposive sampling, we aimed to interview a range of demographics such as age and gender, to make sure that diverse views were represented in the data. All the interviews were recorded and transcribed word for word. The interviews were coded and analyzed in NVIVO 11 to identify themes across responses. Analysis of the responses indicated that landowners supported bioenergy; however, they perceived both positive and negative bioenergy impacts. Our findings can give policymakers, scientists, and energy companies a better understanding of the social barriers to NIPF feedstock supplies.

1.2.2 Chapter 3 Overview

As mentioned previously, Wisconsin NIPF landowners have the potential to supply much of the feedstock necessary to produce bioenergy for heat and power and meet the state's RPS. While several studies have investigated the factors impacting landowners' intent to harvest, the study presented here identifies some additional key factors including environmental NGO membership, attitudes toward bioenergy impacts, and ecosystem

service values. For this study, we collected quantitative data about NIPFs within the feedstock supply range of the WE Energies co-generation bioenergy facility in Rothschild, Wisconsin using a survey.

The survey focused on households within a town in Northern Wisconsin and included the surrounding forest landowners (NIPFs). The aim of the survey was to assess the community members and NIPFs attitudes of bioenergy impacts. To construct the sample, we used ArcGIS 10.2 to combine residential address files and parcel data files for the area. We used the “drop off/ pick-up” implementation method for the survey to ensure contact with an individual in each household and improve response rates (Dillman et al. 2009). Given the size of the sample, 497 households, we created clusters of households in groups of 50-100 households to reduce drive time and ensure variance in respondents based on household demographics (i.e. income). Eight clusters focused on the general public (i.e. community members) and four clusters focused on NIPFs. The NIPFs were selected using GIS files from the county to identify forestland owners who had: 1) parcel sizes larger than 10 acres and 2) buildings on their land. We received 290 completed surveys for a 60.5% response rate. For the purpose of this study, we are focused on just the 114 NIPFs out of the 290 respondents.

Using SPSS, we conducted t-tests and ANOVAs to determine what values, knowledge, attitudes, and landowner characteristics could impact an NIPF in the study’s consideration to harvest biomass from their forestland to be used for electricity production. We found that a landowner’s involvement in an environmental NGO negatively impacts their intent to harvest. Additionally, we determined that landowners

perceive harvesting to have a positive impact on their ability to access land that is not their own and ability to maintain ownership of their land. While other variables were not significantly associated with intent to harvest, their relative roles still provide information about NIPFs' forestland-related values and bioenergy perceptions. This study contributes to the literature by acknowledging new variables (i.e. environmental organization membership and attitudes toward bioenergy impacts) and how they could influence a NIPFs consideration to harvest biomass. Lastly, this information is valuable to state policymakers and energy companies who aim to expand biomass feedstock supply to produce bioenergy to meet the state's RPS.

1.2.3 Chapter 4 Overview

My final substantive chapter focuses on Wisconsin's biomass harvesting guidelines. In 2008, a group of state and non-state actors collaborated to create Wisconsin's Best Management Practices (BMPs) for biomass harvesting (Bronson et al., 2014; Herrick et al., 2009). This collaborative governance (CG) approach to natural resource management has been valuable in creating policies related water management, but few studies have focused on forest management using this policymaking tool. Therefore, this study aims to contribute to the literature on collaborative governance by using the Wisconsin Biomass Harvesting Guidelines (BHG) creation to understand the value of CG processes and how they can impact the outcomes of collaborative arrangements.

For this study, we conducted interviews with state and non-state actors to understand how they used collaborative governance (CG) as a policy-making strategy. We used a purposive sampling approach to identify interviewees who were involved in the creation

of the BHGs. The interviews were conducted between October 2014 and April 2017 and were a 30 minutes to an hour in length. The interviews were transcribed verbatim and coded in NVIVO 10 to identify themes across the responses.

We found that the interviewees identified processes (i.e. transfer of knowledge and authentic dialogue) associated with CG as essential in creating the policy and impacting outcomes of the CG arrangement. These findings can help policymakers and scientists better understand the value of this policymaking strategy when used to address solutions to complex environmental problems.

1.2.4 Chapter 5 Conclusion

The final chapter will focus on summarizing the findings from the three manuscripts. It will discuss the limitations to of the studies as well as the overarching connections between each chapter. Lastly, it will end with a discussion on the next steps for research. An appendix highlighting the interview protocols from chapters two and four and the survey from chapter three follows this chapter.

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Chapter 2: Wisconsin, USA Forest Landowners' Acceptance of Woody Bioenergy

2.1 Introduction

Climate change and fossil fuels are inherently connected due to greenhouse gas emissions (GHG) from fossil fuel combustion (IPCC 2014). GHG emissions continue to rise alongside population growth and economic development (Holtz-Eakin and Selden, 1995). To reduce GHG emissions, governments have turned to policies promoting increased renewable energy production (Cory & Swezey, 2007; Engel, 2006; Lutsey & Sperling, 2008; Shove, 2010). Renewable energies can aid in emission reductions, meeting rising energy demand, and enhancing energy security (Haar & Theyel, 2006). For instance, in the United States (U.S.), twenty-nine states and Washington D.C. have Renewable Portfolio Standards (RPSs) aimed at promoting renewable electricity production and consumption, reducing GHG emissions (Barbose, 2016; Tra, 2016; Wiser et al., 2007). An RPS mandates that electricity suppliers produce a certain percentage (for example, 20%) of their electricity from renewable energy sources (i.e. wind, solar, biomass).

Woody biomass is defined here as wood and wood processing byproducts or residues, often referred to as “feedstocks,” that are burned to produce heat or electricity (Becker et al. 2009; Becker et. al, 2013; EIA, 2016). Woody bioenergy accounts for 46% of U.S. renewable energy consumption (EIA, 2016). Its production and consumption occur at household-, small- (for example, school boilers), and utility-scales (Roos et al. 1999).

The work we present here focuses around woody bioenergy development in the state of Wisconsin, USA. It is important to first provide some policy context. Wisconsin's RPS mandates that 10% of the state's electricity production come from renewables, including woody biomass (Brick & Thernstrom, 2016; Wisconsin State Legislature, 2017; Wiser et al., 2007). Utility-scale woody bioenergy production is growing overall, however continued expansion requires reliable feedstock supply and social acceptance (Becker et al., 2013; Halder et al., 2014a). Reliable supply depends on public and private forest landowners and their ability and willingness to supply feedstock. In Wisconsin, nonindustrial private forest landowners (NIPFs), defined as individual and organizational forest landowners unaffiliated with the forest industry, are particularly essential to reliable feedstock supply since they own 61% of the state's forests (Becker et al. 2009; Becker et al., 2013; SAF, 2008; Wisconsin Department of Natural Resources, 2017).

Like many forms of utility-scale renewable energy production, large-scale woody bioenergy projects can be controversial (Banerjee et al. 2017; Eaton, 2015; Fritsche & Iriarte, 2015). There is disagreement about woody bioenergy's ability to reduce GHG emissions and concern about its potential to increase timber harvesting and associated negative impacts (Schulze et al. 2012). The social acceptability of these projects is an important issue in woody bioenergy's expansion because public opposition to projects can delay or prevent project development permitting, heighten concerns and legal action challenging project environmental permit compliance, and reduce the likelihood of local governmental support for bioenergy projects (Alasti, 2011; Wegener & Kelly, 2008; Wüste & Schmuck, 2013). Understanding the woody bioenergy-related views of NIPF

landowners in a place like Wisconsin therefore becomes particularly important to understanding the future of woody bioenergy. This paper presents the results of interviews with Northern Wisconsin NIPFs aimed at understanding their perspectives regarding woody bioenergy acceptability.

2.2 Background and Literature Review

2.2.1 Renewable Energy Support

Renewable energy production is one potential solution to many pressing public policy problems. These include the increased cost and negative environmental impacts of coal, natural gas, and petroleum extraction as conventional, easy to reach supplies are exhausted (Lund, 2007; Murray & King, 2012; Weisser, 2007). The world is also moving increasingly rapidly toward catastrophic global climate change, primarily caused by fossil fuel combustion. Climate change could be mitigated with increased renewable energy production (Bang et al., 2000; Delshad et al., 2010).

However, increased utility-scale renewable energy production cannot occur without social acceptance (Wegener & Kelly, 2008). These projects require local permits and often have obvious, salient impacts on households, neighborhoods, and local communities (Wustenhagen et al., 2007). Carlman (1984), one of the first scholars to discuss social acceptance as a problem in the siting of renewable energy projects, acknowledged that acceptance is “a matter of public, political, and regulatory acceptance” (p.339), indicating that overall social acceptance consists of how the public

and political actors accept the project as well as how the policies or regulations to support the project are accepted.

Researchers have studied renewable energy project social acceptability in many countries (The European Opinion Research Group, 2003). Renewables acceptance is often high, especially when people respond to general renewable energy questions at national scales (Bell 2005; Walker 1995). Unlike fossil fuels, most people consider renewable energies to be a clean and reliable energy source (Walker, 1995).

It gets more complicated at local scales with real-world project implementation. Wolsink (2007) showed that support often exhibits a U-curve of acceptability levels, with initial high support levels that decrease during project siting and increase once the project comes online. Project scale, renewable energy type, and perceptions of potential community, economy, and environment impacts affect public renewable energy acceptance (Batel et al., 2013; Demski, 2001; Devine-Wright, 2007, 2011; Pidgeon & Demski, 2012; Walker, 1995; Walker & Cass, 2007; Wüstenhagen et al., 2007).

With regard to bioenergy specifically, lack of familiarity with this renewable type is a major issue. Halder et al. (2015b), found that the public was, on average, less familiar with bioenergy than other renewable energy forms and that this affected perceptions of it. This finding was further supported by Reiner et al.'s (2006) study of public perceptions of bioenergy in the U.S., Sweden, Japan, and the United Kingdom, which determined that few UK, US, or Japanese residents are familiar with bioenergy. In contrast, over half of their Swedish respondents described themselves as familiar with bioenergy, probably at least in part due to its widespread usage at multiple scales in Sweden.

Farhar (1999) synthesized findings from multiple U.S. surveys and showed that most Americans support renewable energy development. However, support was much higher for wind and solar than bioenergy, which tended to be at the same fairly low levels as fossil fuels (Farhar 1999). This may be partly because utility-scale bioenergy is less familiar than wind and solar (Plate et al., 2010). However, this may be changing over time. Banerjee et al.'s (2017) study of Northern Wisconsin community members and found that three-quarters of those interviewed were familiar with bioenergy. The majority had both positive and negative expectations of local bioenergy production, including concerns about the negative social and environmental (Banerjee et al. 2017).

Trust in decision makers and in information sources can play an integral role in the social acceptance of renewable energy projects. For instance, Plate et al. (2010) found that trust in utilities and public officials was essential to public support for local woody bioenergy development. Local foresters were deemed the most trustworthy source of information about the proposed bioenergy facility, followed closely by environmental groups and cooperative extension staff. Policymakers and the renewable energy industry were, on average, the least trusted source of information (Plate et al., 2010).

Devine-Wright (2007) argues that much existing survey research fails to adequately capture social-psychological factors (i.e. knowledge of and direct experience with the energy production system and political and environmental contexts) that impact an individual's acceptance of a renewable energy. Place attachment, perceived fairness, levels of trust, and contextual factors are among some of the important predictors largely unmeasured in renewable energy surveys. This author also asserts that public attitudes

should not be seen solely as a barrier to renewable energy expansion, but rather that researchers need to better understand reasons for support and engagement (Devine-Wright, 2007).

The renewable energy acceptance literature, however, usually focuses on the general public rather than feedstock producers like NIPFs. This is an important gap because NIPFs' renewable energy acceptance, particularly of woody bioenergy, may differ from the general public's because, among other reasons, bioenergy projects can benefit NIPFs financially (Hofman et al., 2014).

2.2.2 NIPFs and Woody Biomass Harvesting

Although the US NIPF literature is abundant, little is known about their renewable energy perceptions. The existing literature shows that they are heterogeneous with diverse and often complex forest ownership motivations and land management objectives (Joshi et al., 2013; Majumdar et al., 2008; Measells et al., 2005; Schulte et al., 2008). For example, some NIPFs' are motivated to harvest to provide recreational resources, surplus income, or wildlife habitat restoration (Bliss & Martin, 1989a; Butler & Leatherberry, 2004; Butler & Ma, 2011; Young & Reichenbach, 1987). NIPFs own forestland for many reasons that go beyond their timber's market value (Hodge & Southard, 1992a; Ticknor, 1993). For example, Ticknor (1993) found that most Central Indiana forest landowners wanted to protect their forests more than they wanted to derive economic benefits from them. For many NIPFs protecting their quality of life through

aesthetic and recreation values was their primary management objective (Haymond 1988).

Many find it valuable to view these diverse values as ecosystem service benefits (World Resources Institute, 2005). The Millenium Ecosystem Assessment classifies ecosystem services into four categories: provisioning, supporting, regulating, and cultural services (World Resources Institute 2005). For example, key forest ownership benefits like hunting and firewood (Butler et al. 2004) can be defined as provisioning ecosystem services. Landowners who own their forests because they value its aesthetics (Haymond, 1988; Ticknor, 1993) are receiving a cultural ecosystem service from their forests. Supporting ecosystem services are defined as natural cycles that help the environment function (i.e. nutrient cycling and photosynthesis). Meanwhile, regulating services are services that help the ecosystem maintain balance and protect it such as flood regulation and water purification (World Resources Institute 2005).

While these studies highlight the motivations for and the ecosystem services received from forestlands, they also closely connect to factors affecting landowners' decisions about timber harvesting, including for biomass. Prior work has shown that decisions regarding biomass harvesting for energy production are affected by NIPFs' demographic characteristics, management objectives, forest characteristics (including parcel size), and bioenergy knowledge (Becker et al., 2013; Gruchy et al., 2012; Joshi et al., 2013; Joshi & Mehmood, 2011a; Leitch et al., 2013; Markowski-Lindsay et al., 2012). Other factors include experience with previous harvesting and a need for immediate income. Becker et al. (2013) found that biomass in the Upper Midwest is

available based on social and financial (tax incentives or profit) factors. These social factors include landowners' understandings of how biomass was harvested and beliefs about biomass harvesting enhancing energy independence.

Joshi & Mehmood (2011b) found that older Southeastern forest landowners who value their woodlands for aesthetics and wildlife habitat were more willing to supply biomass for energy production if the harvesting restored or enhanced wildlife habitat. Financial factors are also important in understanding availability of biomass for energy production. Markowski-Lindsay et al. (2012a) determined that even when biomass prices were high, landowner willingness to supply biomass could be low. Many factors contributed to this lack of willingness to supply, including landowners' perceptions of harvesting's economic and environmental impacts. Some have found that landowners with written forest management plans were less likely to harvest for biomass (Markowski- Lindsay et al. 2012a). Others have found that NIPFs may favor logging residue removal for bioenergy, even if biomass prices were low, if it improved the look of their forests and restored wildlife habitat (Gruchy et al. 2012). While some of these findings may seem contradictory, in truth they simply reveal the complexity of NIPF values and motivations.

While much is known about NIPFs' intentions and motivations with regard to forest management and willingness to supply biomass feedstock (Becker et al., 2013; Joshi & Mehmood, 2011a; Joshi et al., 2013; Joshi & Mehmood, 2011a; Markowski-Lindsay et al., 2012) much less is known about their general perceptions of local utility-

scale bioenergy projects and how they relate to NIPF interest in supplying feedstock. Our research, as described in the sections that follow, aimed at filling this gap.

2.3 Methodology

Because this is a fairly new research area, we used qualitative interviews to explore the complex factors behind NIPFs' bioenergy perceptions (Demski, 2011; Devine-Wright, 2007). We focused on interviewing NIPFs within the 75 mile radius "feedstock shed" of a cogeneration bioenergy facility located in northern Wisconsin, U.S. because they were in the position to supply biomass to the plant. The bioelectricity plant went online in 2013 with a generating capacity of 50 megawatts to the grid and an expected demand for 500,000 tons of biomass per year (We Energies, 2014). Plant biomass feedstocks were expected to come from clean wood waste and forest residues within a 75 miles radius of the plant (Lydersen, 2015). The radius was selected based on research suggesting that acquiring biomass within this range means the plant would be sustainable (i.e. feedstock transportation emissions wouldn't exceed the emission reductions of producing bioenergy over coal based energy) (Roni et al., 2014).

We combined purposive and snowball sampling strategies to recruit 30 NIPFs via social networks and from public areas (i.e. bowling alley, coffee shop, public library) (Creswell, 2013; Ritchie et al., 2013; Robinson, 2014). We aimed to interview NIPFs across a range of demographic categories, including age and gender, to ensure that diverse views were represented in the dataset. The interviews were recorded and transcribed verbatim. The data were coded and analyzed using NVIVO 11 to identify key patterns across interviewee responses. The interviews are labelled in the 600s, as it is a

part of larger project across North and South America (see Dunn et al. In Review), and the numbers 600-799 were designated to interviews conducted in the U.S.

During our semi-structured interviews, we asked questions about landowner harvesting practices, bioenergy perceptions, environmental values, and knowledge of and support for local bioenergy development (Appendix A). Nineteen (63%) of the interviewees were male. Most (16/30, 53%) had just a high school degree while the rest had at least some college education. Forty-three percent were between 31-50 years while 53% were 51 or older.

2.4 Results

2.4.1 Ecosystem Services

Interviewees were asked to describe the direct benefits they derive from their forests. Results were coded by ecosystem service type and are presented in Table 1. The percentage in the top row indicates the percentage of interviewees who identified at least one of that type of ecosystem service. No interviewees described supporting services such as soil formation, photosynthesis, or nutrient cycling so that column was left out. Provisioning ecosystem services, such as firewood and wild game, were offered as answers most frequently – 90% of interviewees described at least one. The next most frequently volunteered type of was cultural ecosystem services (e.g. aesthetics), while only a few talked about benefiting from their forests provision of regulating ecosystem services.

Table 1: NIPFs Perceived Ecosystem Services from their Forests (N=30/100%)

Regulating (5/17%)	Provisioning (27/90%)	Cultural (16/53%)
Clean Air (5/17%)	Firewood (23/77%)	Aesthetics (8/27%)
	Hunting & Food (9/30%)	Recreation (7/23%)
	Shade (7/23%)	Quiet/ Peace (5/17%)
	Income (5/17%)	Quality of life (1/3%)
	Maple Syrup (4/13%)	Safety (1/3%)
		Wildlife (2/7%)

It was clear that provisioning services were evident and important to most of our interviewees. For instance, one landowner told us: “With all the trees and everything around here, I don’t need A/C.” (Interviewee 606). Most interviewees told us that they heated their homes with firewood from their forests. They described wood as “free” and “cheap” compared to natural gas. However, one interviewee told us that they no longer used firewood from their forests because it is too labor-intensive, so this may decline with age or lack of time. Interviewees often talked about cultural ecosystem services with great pride. For example, one landowner said: “That’s the priceless part, right there [...]. That we can just sit in the living room and look out the window and it’s just woods. You don’t hear anything, there’s no cars and there’s just animals” (Interviewee 627).

2.4.2 Perceptions of Bioenergy Production

We asked the interviewees a series of questions about local woody biomass usage for utility-scale electricity production. Seventy percent (N=21) were familiar with bioenergy. We also asked how they felt about it being produced locally. Sixty percent (18) supported

it, 33% (10) opposed it, and two people were unsure. Regardless of whether or not they supported it, the majority held mixed views about local bioenergy production, believing that it would have both positive and negative local impacts.

Many viewed bioenergy as a clean renewable energy. For example, one said, “I think it’s probably a good thing if we can cut back on some coal use. It’s [wood is] a renewable resource, you can see wood grows like weeds here” (Interviewer 659). Many saw it as a good alternative to fossil fuels. Table 2 summarizes patterns around perceptions of local bioenergy production impacts.

Table 2: Perceptions of Local Bioenergy Impacts (N=30/100%)

Positive Impacts	Negative Impacts
Clean renewable energy source (12/40%)	Sustainability of biomass supply (15/50%)
Beneficial use of waste wood (9/30%)	Price of biomass (11/37%)
Provides jobs and enhances the local economy (8/27%)	Aesthetics of their community (6/20%)
Cheaper than fossil fuels? (6/20%)	Forest habitat loss (4/13%)
Allows forest habitat repair (1/3%)	Air pollution (2/7%)
	Concern it will introduce more governmental regulation on forest harvesting (2/7%)
	Change to the community identity (1/3%)

Despite recognizing the energy source as renewable, several were concerned about the quantity of biomass needed to operate a bioenergy facility and how this would impact their forests and neighboring forests. As one interviewee stated, “I don’t have a problem with that [bioenergy] as long as whenever they’re chopping woods down, somebody’s replanting trees” (Interviewer 623). A common concern was other landowners’ management choices and the potential for them to be reckless or

“irresponsible.” While most were concerned about over-harvesting forests to supply biomass, they never described themselves as contributing to these forest losses; they always placed the blame on other landowners, large timber companies, or the local bioelectricity utility.

When further probed about their perceptions, the interviewees used their own knowledge and previous harvesting experiences to identify the biomass that would be provided to the bioenergy facility. The biomass that would be provided was often called “waste wood.” One stated, “Why not use it. But I don’t know who’s going to go out and collect it all up. It’s a pain in the butt unless you gotta [sic] chipper and semi right there” (Interviewer 643). Continuing this discussion often led to comments about jobs and disposable income. Eight landowners mentioned that a bioenergy market could increase job opportunities in the community and bring in more outside investment. For instance, one landowner said:

I think it’s a good thing, um, a lot of people in the industry was [sic] against it a little but, basically over the years, what with the computer and everything else, the paper industry is dying. To a certain extent there’s a lot of people up here that want to cut that wood to a make living. Well that biomass plant is another outlet for them to get a decent price for what they do, you know. There is a lot of guys that had to get out of the business because they just couldn’t make a business anymore [...]. You only got a

couple of paper mills and they can monopolize on what they pay for the wood. (Interviewee 649)

Many interviewees talked at length about the economic tradeoffs of biomass harvesting and bioenergy production. Some expected local production would increase job opportunities. Others talked about how leaving harvesting residues, such as tops and branches, behind on their land to rot in piles was a waste of resources, while selling them to the local bioelectricity facility could provide them with a few extra dollars. Some believed that bioenergy was cheaper to produce than other renewable energy sources, such as wind energy or solar. Others were skeptical about whether bioenergy would be a cheaper than coal or natural gas in the long run. Their concerns were often grounded in their understanding of energy markets and the price they would receive for a dry ton of biomass. One interviewee mentioned that he believed “wood chips are easy to use as long as they are competitive and don’t require any kind of subsidy and can stand on their own two feet against other alternatives” (Interviewee 637). He went on to discuss how alternatives in general are too expensive to operate and produce compared to conventional sources of energy.

One interviewee believed that other landowners would not be too concerned about the price for biomass as long as it was “fair” and provided some “extra income.” Others argued that the presence of the bioenergy facility would not change how landowners harvested; however, it would alter the supply chain, meaning the products may be used for different purposes based on market prices. Speculation on increased biomass prices

led to discussions about expecting to see more loggers hauling the biomass to the facility rather than to the local mills or leaving it on the land. The last concern related to price was whether it would “pay a living wage” for loggers who would spend extra time and resources to chip and haul it (Interviewee 644). Price discussions also led to expressions of skepticism regarding loggers’ willingness to supply biomass.

While the majority of the interviewees’ discussions focused on bioenergy’s economic impacts, they also described social and environmental concerns. Six interviewees voiced concerns about how biomass removal would affect forest aesthetics. Those who spoke of aesthetics focused on the idea that supplying biomass would mean “clear cutting” or “stripping” the land of its resources and beauty. This concern was evident in one landowner’s remark, “I just hate to see our trees go” (Interviewer 660).

Four individuals were concerned about game habitat loss, while another viewed biomass harvesting as potentially restoring game habitat. One believed that the removal of dead trees and branches could help to stop the spread of Emerald Ash Borer beetles damaging local forests. Two had concerns about whether bioenergy produces fewer greenhouse gas emissions than conventional fuels. Some worried about utility scale bioelectricity production producing localized air pollution.

A few interviewees expressed concerns about bioenergy’s social impacts, mostly related to government regulations and social norms. Two worried that utility-scale bioelectricity would lead to overharvesting forest residues and create pressure for regulations to reduce harvesting biomass. Lastly, two NIPFs mentioned community norms within their community and the lack of acceptance of change. One stated, “A lot of

times people are just against change. You know until they really understand what's going on" (Interviewee 649). This landowner is indicating that while technological advancements may be better, individuals in their community are less likely to accept them unless they are educated about them. In this case, in particular, local community members and NIPFs may be less supportive of bioenergy production in the community despite its benefits because they are not knowledgeable about the renewable energy.

2.4.3 Trusted Entities and Information

Although we asked no questions about trusted information sources, 12 interviewees discussed the sources or organizations they would trust to provide accurate information about local bioenergy production impacts in answer to other questions. Table 3 summarizes the results. University researchers, forestry professionals, and local community members were identified as trustworthy sources of information regarding the bioenergy facility. Lastly, the NIPFs identified the media as both a trusted and non-trusted source of information about the bioenergy plant. This is to be expected due to the range of demographic factors amongst the NIPFs and current polarizing concerns about the media.

Table 3: Trusted and non-trusted sources of information regarding the local bioenergy facility (N=12/100%)

Trusted Sources (8/67%)	Non-Trusted Sources (6/50%)
University Researchers (5/42%)	Government (5/42%)
Local Community Members (1/8%)	Wisconsin DNR (2/17%)
Forestry Professionals (2/17%)	Utility Company (1/8%)
Media outlets (3/25%)	Media (3/25%)

Interviewees also often discussed the role of the government in promoting the use of wood-based biomass for electricity production. Five described a lack of faith in the government to accurately represent what the people need. When asked about elected officials and their qualifications to make decisions about encouraging bioenergy, one landowner stated that they “would hope” they are qualified. When further probed about qualifications, the NIPF mentioned this, “I think we need a third party; someone between the Republicans and the Democrats” (Interviewee 605). This landowner was referring to a neutral party of experts that were qualified to make decisions related to state energy use and production. Another landowner specified that they did not believe the federal government should participate in the state government’s energy decisions, but rather the decisions should be left to the states. They followed this up with a statement about how they think the states “do a better job” with energy decisions and emissions than the federal government. Some interviewees distrusted the federal government and were concerned that they had too much impact on state officials and policies.

Most of those who were concerned about state policies promoting bioenergy development worried that it would give the state justification for telling them how to

manage their forest. This may be because many Wisconsin NIPFs are enrolled in the state's Managed Forest Law, a program designed to encourage forest management and harvesting through tax incentives, which already gives the state some say in how they manage their land. As one landowner said, "the government does control a lot of what we can and cannot do" (Interviewee 605). They further discussed how the appropriate role of the state government is to understand the mechanics of the forests and then make informed decisions about its use. This idea of law driving supply and use, rather than supply driving law was brought up throughout the interviews with the NIPFs. Many interviewees discussed how the decision of the state to encourage bioenergy was made based on "money" and "corruption" rather than motivation to lower emissions. Many expressed distrust of government and these discussions circled back to the issues of supply and sustainability.

In summary, most interviewees supported local bioenergy production, despite holding some negative perceptions about bioenergy. While they believed wood to be a renewable resource and the use of it warranted, they were concerned about the long-term availability of biomass supply to the facility. Other concerns related to the impact it would have on their ability to manage their forestland and how it would change the aesthetics of their community.

Furthermore, some described distrust of state and federal governments due to their policies promoting for renewable energy production, specifically bioenergy. Lastly, although many had at least some negative bioenergy perceptions of bioenergy, they often viewed this emerging renewable energy source as a beacon of hope for their

communities. They believed that biomass harvesting for bioelectricity production could help provide stability for local timber and paper industries and provide long-term jobs. However, even with the existence of a local bioelectricity, they tended to believe that the local forest products industry could not survive if bioenergy costs were not competitive with those for conventional fuels.

2.5 Discussion

Most interviewees were fairly supportive of local bioelectricity production, paralleling findings of research conducted on general public support for renewable energy development (Devine-Wright, 2007; Farhar, 1999). They were also fairly knowledgeable about bioenergy, consistent with the findings of Banerjee et al. (2017) in the same region, and Joshi and Mehmood (2011) in the Southeastern U.S. Our findings are different from those of Shaw (2009) who found that the majority of surveyed South Carolina NIPFs had little to no familiarity of bioenergy, perhaps because they reside in a region with less utility-scale bioenergy production. Our interviewees' familiarity with bioenergy is likely associated with the presence of a local bioelectricity plant, since most of them told us that they heard about plant through either the local news or from their place of employment.

Our results showed that the landowners valued resource-extractive ecosystem services (i.e. provisioning ecosystem services) more than cultural or regulating ecosystem services. This is consistent with prior findings that NIPFs from timber-dependent communities are more likely to care about resource-extractive ecosystem services than other services (Bliss & Martin, 1989b; Erickson et al. , 2002; Racevskis & Lupi, 2006;

Tremblay & Dunlap, 1978). These findings provide a fuller understanding of the basis for NIPF bioenergy support.

However, our interviewees had mixed perceptions of local bioelectricity, similar to findings for the general population reported in Banerjee et al. (2017). Many expressed a mix of support for and concerns about bioenergy. Worries about bioenergy negatively affecting local communities have been found in previous studies of renewable energy project support (Wüste & Schmuck, 2013; Wüstenhagen et al., 2007). Our interviewees' also had concerns about impacts on timber prices and supplies as well as the local environment, similar to the findings of other studies of bioenergy perceptions (Banerjee et al. 2017; Batel et al., 2013; Demski, 2011; Devine-Wright, 2007; Halder et al., 2015).

This study contributes to our understanding of the perceptions, values, and support for renewable energy projects (Batel et al., 2013; Devine-Wright, 2007; Fytili & Zabaniotou, 2017; Hofman et al. 2014; Huijts et al. 2012). While most of our interviewees supported local bioelectricity production, these were interviewees who might benefit from its production providing a market from their lands' biomass, so it is reasonable to question whether their perspectives are shared by the larger community. Banerjee et al.'s (2017) findings from the same area suggest that NIPFs and the general local public shared many beliefs and attitudes toward the local plant regardless of whether they owned forest that could supply feedstock to it.

Lastly, a theme that emerged from this research is the issue of trust between NIPFs state and non-state employees and organizations. A number of our interviewees spoke at length about their lack of trust in state and federal government policies

incentivizing woody bioenergy production. This resonates with prior findings that trust is a fundamental factor in predicting support for renewable energies (Banerjee et al., 2017; Halder et al., 2014; Iams & Wilhelm, 1984; Plate et al., 2010; Van der Horst, Sinclair, & Lofstedt, 2002). Some of the landowners we interviewed viewed utilities and governments as having something to gain from the bioelectricity facility and therefore viewed them as biased. This also makes it unsurprising that many interviewees expressed concerns about the project. These results support those of previous studies (Iams & Wilhelm, 1984; Plate et al., 2010) that found that the most trusted groups and individuals regarding renewable energy projects were those that focused on protecting local environments and communities and lacked financial interests in projects.

2.6 Conclusion

Our research provides insight into the perceptions that NIPFs have about using forest residues for energy production in their community. The landowners' beliefs regarding ecosystem services confirms the work of others about NIPFs' motivations for owning land. Our interviews highlight the conflicting perceptions landowners' have about bioenergy and how this could influence their support or lack thereof for this renewable energy.

Alternative energy technologies are crucial to U.S. federal and state government efforts at climate change mitigation. However, without local project acceptance, success is limited. Therefore, it is crucial to understand the factors behind local support for

renewable energies. This is particularly true when local landowners are integral sources of bioenergy project feedstocks.

This study explored how NIPFs within the biomass feedstock radius of a new bioenergy facility perceive bioenergy develop and its impact on their communities. This was done through interviews with thirty NIPFs to gather information about their bioenergy perceptions and overall support for the local bioelectricity project. Results showed that the majority of interviewed landowners supported the new bioenergy facility even though they had concerns about some of its impacts.

If utilities and decision makers want to continue to meet Wisconsin's RPS, it may be critical to recognize that the suppliers of biomass are still formulating their beliefs about this renewable energy resource. While most research shows general public support for renewable energy, the findings here suggest that this is likely multi-faceted and may only scratch the surface. Further, the basis for social acceptance of feedstock suppliers may be somewhat different from that of the larger public that does not stand to benefit economically from a renewable energy project.

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Chapter 3: Wisconsin NIPF Landowners' Intent to Harvest Woody Biomass for Bioenergy Production

3.1 Introduction

Renewable Portfolio Standards (RPS) are a popular policy tool used to reduce the greenhouse gas (GHG) emissions associated with electricity production across the United States. An RPS mandates that electric utilities produce a certain percentage of their electricity from renewable energy sources (Rabe, 2006), forcing a change from nonrenewable (coal, natural gas, and petroleum) to renewable (wind, solar, biomass) resources used to produce electricity (Cory & Swezey, 2007; Wiser et al., 2007). Wisconsin's 2010 RPS mandated that 10% of electricity produced in the state be renewable by 2015 (Becker and Lee, 2008, Becker et al. 2009, DSIRE, 2016). Like most states', Wisconsin's RPS allows utilities to meet their mandate through bioelectricity produced from woody biomass.

The state's abundant forest resources make woody biomass a practical bioelectricity feedstock. Wisconsin has 16 million acres of forestlands, 9.12 million of which are privately owned (Wisconsin Department of Natural Resources, 2017). Non-industrial private forest landowners, landowners not associated with the forest products industry, therefore play a significant role in biomass supply for bioelectricity and the state's ability to meet its RPS (Becker et al., 2013; Munsell and Germain 2007; SAF 2008). However, this is only true if landowners are willing to harvest their timber, including biomass residuals. Nonindustrial forest landowners' (NIPFs') timber harvesting decisions are often made at household levels; therefore, understanding the factors that

impact their decisions is valuable for policymakers and utility companies aiming to meet the state RPS and lower GHG emissions (Gruchy et al., 2012).

The purpose of this study was to determine factors (e.g. knowledge of bioenergy, attitudes, and values) impacting NIPFs' intent to supply biomass residuals for bioelectricity. We surveyed Northern Wisconsin NIPFs close to a bioelectricity facility. The survey contained questions about respondent demographics, bioelectricity knowledge, and perceived local impacts of bioelectricity production on human communities and ecosystem services. Each question was selected based on the literature and the understanding that a landowner's knowledge, values, and attitudes can impact their harvesting decisions (Becker et al., 2013; Bengston et al., 2009; Davis & Fly, 2010; Erickson et al., 2002; Hodge & Southard, 1992b; Joshi & Arano, 2009; Shaw, 2009). We used statistical tests to determine if attitudes, knowledge, values, and landowner characteristics influenced a landowner's consideration to include residual woody biomass harvesting in their timber harvesting practices.

3.2 Literature Review

NIPF values, attitudes, and demographic factors all play a role in timber and biomass harvesting decisions. The research on timber harvesting decisions is extensive (e.g., Bengston et al., 2009; Butler & Leatherberry, 2004; Butler et al., 2005; Butler & Ma, 2011; Hodge & Southard, 1992; Majumdar et al., 2008). However, much less is known about the factors related to NIPF decisions to harvest residuals for bioenergy production

(Becker et al., 2013; Gruchy et al., 2012; Joshi et al., 2013; Joshi & Mehmood, 2011a; Zachary John Leitch, 2012; Markowski-Lindsay et al., 2012a; Paula, 2009). In addition, much of the existing NIPF research focuses on the Eastern and Southeastern U.S., with research on the Midwest more limited. This is important because we know that NIPF motivations vary greatly by region (Butler et al., 2005).

This research was grounded in the Theory of Planned Behavior (TPB), which argues that an individual's knowledge and attitudes impact their behavioral intent, which is a strong predictor of behavior (Ajzen, 1985a, 1991; Armitage & Conner, 2001). Other studies have utilized the TPB framework to examine factors that impact NIPFs' intent to harvest biomass (Halder et al., 2014; Leitch et al., 2013; Leitch, 2012; Silver, 2015; Silver et al., 2015), including values, knowledge, and attitudes. We define knowledge in this context as NIPFs' perceptions of their level of information. Values are defined as moral beliefs that tend to be stable across one's lifetime and shared across generations (Heberlein, 2012; Spates, 1983). The term attitude is defined as "collections of beliefs and often linked to emotional reactions and willingness to do something" (Halder et al., 2012, p. 248). Each is thought to play a role in NIPF harvesting decisions.

3.2.1 Values

NIPF values related to owning forestland have been well studied (Bengston et al., 2009; Dhubháin et al., 2007). However, research on these values impact biomass harvesting decisions is still limited. Joshi and Mehmood (2011) found that landowners who valued wildlife and recreation tended to favor supplying biomass more than landowners who did

not value wildlife. Their interest in biomass removal may relate to their view that it can be a tool to improve wildlife habitat. On the other hand, Joshi and Mehmood (2010) found that Southeastern NIPFS who valued their land primarily for economic opportunities, such as income generation, were more likely to be willing to harvest biomass than NIPFs who valued their land primarily for its aesthetics. Relatedly, research in the Northern and Southeastern U.S. found that NIPFs' environmental values impacted their intent to supply biomass, with those who were most environmentally-oriented being least likely to harvest biomass for bioenergy (Gruchy et al., 2012; Joshi & Mehmood, 2011; Munsell & Germain, 2007; Silver et al., 2015). These studies show that NIPF values can impact intent to supply biomass, which is a predictor of future behavior (Leitch et al. 2013).

3.2.2 Knowledge

A lack of bioenergy awareness can cause landowners to be less likely to supply biomass because they are unfamiliar with its economic and forest management benefits (Markowski-Lindsay et al., 2012a; Paula, 2009; Shivan & Mehmood, 2010). It can also lead to skepticism about those benefits (Joshi & Mehmood, 2011a; Paula, 2009; Shaw, 2009). For instance, Joshi et al. (2013) showed strong positive correlations between bioenergy awareness and behavioral intent to supply biomass. They also found that NIPFs with larger forestland tracts were more likely to explore management options, making them more likely to be aware of bioenergy opportunities.

3.2.3 Attitudes

Following the logic of TPB, attitudes guide an individual's behavioral intent to supply (Ajzen, 1985a, 1991; Armitage & Conner, 2001). Previous NIPF studies have shown that attitudes influenced NIPF actions related to harvesting, improving wildlife habitat, and participating in recreational opportunities (Beach et al., 2005; Belin et al., 2005; Erickson et al., 2002; Halder et al., 2014b). NIPF attitudes toward woody biomass harvesting impacts can be strongly and positively correlated with their intent to harvest (Becker et al., 2010), while other researchers have had different results. For example, Silver et al. (2015) found that Maine NIPFs perceived biomass harvesting as having positive economic but negative environmental impacts. They were nonetheless generally interested in harvesting biomass. Results regarding the relationship between attitudes and intent to harvest biomass are therefore more mixed than the roles of values and knowledge.

3.2.4 Landowner Characteristics

The demographic variables that influence landowners' intent to harvest biomass include age, gender, education, and political beliefs (Cubbage et al., 2007; Erickson et al., 2002; Young & Reichenbach, 1987). Paula et al. (2011) determined that male forest landowners are more likely to indicate intent to supply biomass because they tend to make the forest management decisions on family forestland. Findings regarding the role of age have been mixed. However, the majority of studies indicate that older NIPFs are more willing to supply biomass than younger land owners (Aguilar et al., 2014; Cai et al., 2016; Joshi et al., 2013; Joshi & Arano, 2009). The role of education is also mixed (Joshi & Mehmood, 2011; Leitch et al., 2013; Shaw, 2009). Education is often used as a proxy for an NIPF's

harvesting knowledge and awareness. However, the expected relationships do not always hold. For instance, Halder et al. (2014b) found that the lower the education level of Croatian and Serbian NIPFs, the more likely they were to be willing to produce and supply forest residues for bioenergy production. Meanwhile, Gruchy et al. (2012) found that the higher the education level of Mississippi NIPFs, the more likely they were to support bioenergy production, because they valued the environment more than those with lower education levels. On the other hand, a recent study in Minnesota, Wisconsin, and Michigan found that education did not impact a landowner's intent to harvest biomass (Cai et al., 2016). The roles of political views and environmental identity or organizational membership have not been studied in previous studies of intent to harvest biomass; however, it has been included in research on intent to harvest timber. Political view can be associated with harvest preferences. One study found that more politically liberal landowners tend to be less likely to harvest than conservative NIPFs (Schaaf & Broussard, 2006). However, this finding was contradicted by another study that found no impact of political views on management choices (Bourke & Luloff, 1994).

Environmental membership can be tied to environmental values and, as described earlier, these have been tied to intent to harvest biomass (Dunlap et al. Jones, 2000; Stern, 2000; Silver et al., 2015). Many studies have, on the other hand shown, that, for most NIPFs, their willingness to supply biomass is associated with their perceptions of its personal economic benefits (Gruchy et al., 2012; Joshi et al., 2013; Joshi & Mehmood, 2011a; Paula, 2009) Nonetheless, interest in biomass supply remains high, for instance

Becker et al. (2013) found that about half of Northern Minnesota and Wisconsin NIPFs were willing to supply biomass for bioenergy production.

Pulling all of this literature together, studies of NIPF landowners' intention to harvest biomass typically focused on landowner's values, knowledge, attitudes, and demographics. Findings regarding which factors impact behavioral intent conflict somewhat; however, differences may be associated with forest type and location. Studies of NIPFs and intent to supply biomass remain limited, particularly in the Midwest and, more specifically for landowners close enough to an existing bioelectricity plant to supply biomass to it (Becker et al., 2013). This study aims to fill this gap, drawing on prior research and focusing on a region proximate to an existing woody bioelectricity plant.

3.3 Methods

The study region was selected as part of a larger project focused on five forest-related bioenergy projects across the Americas (e.g. Brazil, Mexico, Argentina, and the U.S.) (Dunn et al., In Review). We conducted a 2015 survey in and around a Northern Wisconsin town close to a newly opened co-generation bioelectricity plant. The survey was conducted with both individuals who did and did not own forestlands, purposely oversampling for NIPFs to ensure that sufficient numbers responded for analysis. We report here solely on the data from NIPF respondents.

Using Arc-GIS 10.2, we created clustered samples of 50 to 100 households using residential address files. Four NIPF clusters were selected to ensure that landowners were represented in the larger survey sample. The eight remaining clusters were community

members (i.e. the general public). Using the “drop off/ pick up” method (cite), 497 households (both NIPFs and other residents) received the survey and 290 surveys were completed for a 60.5% response rate. The sample size was selected based on Dillman et al. (2009) criteria for sample sizes based on the target population size and confidence interval desired.

We developed a tailored design survey with high visual appeal and emphasized the survey legitimacy through personalized correspondence, personal contact, and explanations for why the survey is useful (Dillman, 2000, 2011). Personalized correspondence came in the form of pre-notification letters that were sent to participants one week prior to the surveying being dropped off. We used the “drop off/pick up method” to ensure we made contact with the residents to increase response rates. To reduce non-response error, the sampled homes were visited three times, at various times of day, with the goal of at least one face-to-face contact with the potential respondent.

The survey included sections on: 1) demographics, 3) bioenergy familiarity, 4) perceived attitudes about bioenergy impacts, and 5) environmental values (Appendix B). Each section was composed of a set of items designed to be combined into indices. The results section describes how each of the indexes were constructed and which statistical tests were used to determine how each values, perceptions, knowledge, and landowner characteristics impacted their behavioral intent to supply biomass for bioelectricity.

One hundred and fourteen survey respondents indicated they were forest landowners, 55 of which came from the landowner clusters and 59 of which owned

forestlands at a different location. With regard to NIPFs, our survey target population was landowners close enough to the bioelectricity plant to supply biomass to it.

3.4 Results

3.4.1 Respondent Demographics

Data from the USDA 2011-2013 National Woodlands Owner Survey (NWOS) allows comparison of landowner characteristics in this study to that of landowners in Wisconsin based on age, gender, education, and political views (Butler et al. 2016). The majority of respondents were either 40-59 (36%) or 60-79 (44%) years of age (Table 4.), similar to NWOS Wisconsin respondents, where 74% were 45-74 (Butler et al., 2016). Thirty-six percent of respondents indicated that they were female, which is higher than the 15% responding to the NWOS survey. Sixty-eight percent of our respondents have some college education or higher, which means our sample slightly over represents NIPFs with this level of education as the NWOS reports that 65% of Wisconsin landowners have this level of education (Butler et al., 2016).

Table 4: Respondent Age Distribution (N=114)

Age	Percentage
18-39	14%
40-59	36%
60-79	44%
80+	5%
Did not identify	0.9%

Lastly, 16% of respondents identified as politically liberal and 25% as politically conservative (Table 5). There are no data available for Wisconsin landowner's political identification; however, in the most recent election (2016), the county voted republican

(57%) (Politico.com 2018). We also asked landowners to identify if they were members of an environmental organization. The results indicate that the majority of landowners (78%) did not belong to any environmental organization.

Table 5: Wisconsin NIPF Landowner Political Views (N=114)

Political Views	Percentage
Liberal	16%
Moderate	37%
Conservative	25%
Did not identify	23%

The next section presents each dependent variable and their construction, also describing the statistical tests used to determine whether or not the landowners' characteristics, knowledge, values, or attitudes impact their behavioral intent. These tests were chosen based on their appropriateness for the type of independent and dependent variables (i.e. categorical and scalar).

3.4.2 Consideration of Harvesting Biomass

The dependent variable (HARVEST) of intent to harvest biomass is measured using the question "have you considered allowing forest resources to be harvested from your lands for electricity production?" Only 98 of the 114 respondents answered the question, of which 89% of them indicated they have not considered harvesting, while 11% indicated they have considered harvesting biomass. This study employed chi-square tests and independent sample t-tests to determine if the two groups of landowners (consideration to harvest and no consideration of harvesting) differed based on their attitudes, values,

knowledge, and demographic characteristics. This was done to identify what factors may impact a landowner's consideration to harvest biomass. The results are listed below.

3.4.3 Knowledge

Two variables were used to measure the landowner's knowledge of bioenergy. The first variable (KNOWOVERALL) measures their basic knowledge of bioenergy by asking the question: Before taking this survey, did you know forest resources can be used to generate electricity? The majority of respondents (81%) indicated that they were knowledgeable about bioenergy prior to taking the survey. The second variable that measures a landowner's knowledge of bioenergy (KNOWLOCAL) aims to understand their knowledge of the bioenergy plant. The question asked: "Before taking this survey, were you aware that electricity was being produced using forest resources by a utility in Rothschild?" The results indicated that 56% (64) of the NIPFs were aware of the plant.

3.4.4 Attitudes toward bioenergy impacts

Four indexes were created to measure the NIPFs attitudes of the impacts that expanding their harvesting practices to include producing materials for bioenergy would have on their community: 1) attitude of bioenergy impacts on the economy, 2) attitude of bioenergy on land access, 3) attitude of bioenergy impacts on the environment, and 4) attitude of bioenergy impacts on society. Each response was assigned a score from -1 (negative impact) to +1 (positive impact), with 0 as neutral. Each index was created using 3 to 7 perception questions and combining them into a scale to measure the landowner's attitude.

3.4.4.1 Attitudes toward economic impacts

The first index (ECONOMY) measures the overall economic impact landowners expect if current forest harvesting activities in their community were expanded to produce materials for electricity production. To create the index, we used three questions aimed at measuring perceived impacts to the economy. The scale range is -3 (strong negative impact) to 3 (strong positive impact) and the mean is 1.65, which indicates that landowners in the region view bioenergy production to have a positive impact on their local economy. The index's Cronbach's Alpha was 0.80, which indicates a strongly cohesive index. Finally, a t-test determined if the sample mean for each item is statistically different from 0 (i.e. neutral), confirming that the landowners think positively about each of the items in the index (Table 6) because they each are statistically different than zero.

Table 6: Attitudes toward economic impacts (ECONOMY)

Q: In your opinion what would be the overall impact on the following aspects of your community and environment if current forest harvesting activities in your community expanded in order to produce materials for electricity production?	Mean	Cronbach's Alpha if Item Removed
Q1. The local economy	0.62**	0.70
Q2. Well-paying local jobs	0.61**	0.66
Q3. Other local economic activities	0.41**	0.78
Cronbach's Alpha of Index= 0.80 Index Mean= 1.65** N= 111		
** statistically different than neutral (0)		

3.4.4.2 Attitudes toward land access impacts

The second index (LANDACCESS) measures the overall impact landowners expect on land access if current forest harvesting activities in their community were expanded to

produce materials for electricity production. The index was created using one question with four items in the matrix aimed at measuring perceived impacts to land access. The scale ranges from -4 (Strong negative impact) to 4 (strong positive impact). The index had a mean of 0.38, which indicates that landowners in the region view expansion of harvesting practices to include supplying biomass for bioenergy production to have a slight positive impact on their access to land. The index's Cronbach's Alpha was 0.71. Lastly, it was found that landowners are ambivalent about the impacts of expanded harvesting activities with the exception of question three in the index (Table 7), where they have a slightly positive view that it will help them maintain their ability to own their land.

Table 7: Attitudes toward Land Access Impacts (LANDACCESS)

Q: In your opinion what would be the overall impact on the following factors if harvesting activities in your community were expanded to produce materials for bioenergy production?	Mean	Cronbach's Alpha if item removed
Q1. Access to land not owned by you	0.11	0.64
Q2. Access to resources not owned by you	0.05	0.56
Q3. Ability to maintain family ownership of land	0.35**	0.63
Q4. Land ownership by people from outside your community	-0.12**	0.75
Cronbach's Alpha of Index= 0.71 Index Mean= 0.38 N=107		
** statistically different than neutral (0)		

3.4.4.3 Attitudes toward environmental impacts

The third index (ENVIRONMENT) measures the environment impact landowners anticipate if forest harvesting activities expanding to include biomass harvesting for bioenergy production. The index was created by adding together the responses from 7 questions aimed at measuring the perceived impacts to the environment. The scale ranges

from -7 (strong negative perceptions) to 7 (strong positive perceptions). The index had a mean of -0.94, which indicates that landowners in the region view expanding harvesting practices to include biomass harvesting to have a negative impact on the environment. The index's Cronbach's Alpha was 0.95. A one-sample t-test found that only the mean for soil erosion (Table 8) was statistically different than neutral, which indicates that landowners view expanding harvesting activities locally to have a negative impact on soil erosion.

Table 8: Attitude toward environmental impacts (ENVIRONMENT)

Q: In your opinion what would be the overall impact on the following factors if harvesting activities in your community were expanded to produce materials for bioenergy production?	Mean	Cronbach's Alpha if item removed
Q1. Clean air	-0.05	0.94
Q2. Bird habitat	-0.14	0.94
Q3. Flood protection	-0.14	0.93
Q4. Soil quality	-0.10	0.94
Q5. Soil erosion	-0.26**	0.93
Q6. Water quality	-0.11	0.94
Q7. Greater risk of natural disaster	-0.13	0.95
Cronbach's Alpha of Index= 0.95 Index Mean= -0.94**		
N= 108 ** statistically different than neutral (0)		

3.4.4.4 Attitude toward societal impacts

The next index (SOCIAL) measures landowners' perceptions of the social impacts forest harvesting activities expanding to include biomass harvesting for bioenergy production would have on their community. The index combines four questions to measure the perceived social impacts to the community. By changing the recreational opportunities or aesthetics of the community this could impact how the community members interact and engages with one another and could change the community's identity. As seen from

Table 9, the Cronbach's alpha is 0.82 and the index mean is -0.13. The scale ranges from -4 to 4. The means for landscape beauty (Q1) and ability of youth to stay in the community (Q4) statistically differed from neutral (0). This indicates that landowners have a slightly negative perception of how expanding harvesting activities to include biomass harvesting would impact their landscapes and a slightly positive perception of its ability to keep youth in the community.

Table 9: Attitudes toward societal impacts (SOCIAL)

Q: In your opinion what would be the overall impact on the following factors if harvesting activities in your community were expanded to produce materials for bioenergy production?	Mean	Cronbach's alpha if item removed
Q1. landscape beauty	-0.40**	0.79
Q2. recreational opportunities	-0.08	0.77
Q3. desire to stay in community	0.10	0.74
Q4. ability of youth to stay in the community	0.25**	0.79
Cronbach's alpha of Index = 0.82 Index Mean = -0.13 N = 111		
** Significantly different from neutral (0)		

3.4.5 Forests and Ecosystem Services

The forest ecosystem services index (FORESTES) measures the landowner's beliefs about how important it is that forests provide ecosystem services (Table 10). Values are believed to help guide behavioral intent and ecosystem services associated with forestland are used to recognize NIPFs values. The index was composed of 11 questions about ecosystem services (e.g. clean water, firewood, productive soils, clean air, etc.). Each item used a three-point scale ranging from -1 (not important) to 1 (important), with neutral as zero.

The sample mean for the ecosystem services index was 8.94 (Table 10), with the total scale score ranging from -11 to 11. From this, it is seen that the NIPFS think forests are important for providing these specific ecosystem services. The Cronbach's alpha for this index was 0.69. The ecosystem services that achieved the highest scores were clean air (0.97) and clean water (0.98) while the lowest score was firewood (0.54). A one-sample t-test found that all the questions means were statistically different from neutral, indicating that landowners tended to view all the ecosystem services from forests as important.

Table 10: Forest Ecosystem Services Index (FORESTES)

Q. People can have different opinions on the importance of forests. How important is it that forests provide the following ecosystem services?	Mean	Cronbach's Alpha if Item Removed
Q1. A visually pleasing landscape	0.89**	0.63
Q2. Recreation	0.80**	0.64
Q3. Clean Air	0.97**	0.63
Q4. Stores carbon or takes carbon out of atmosphere	0.87**	0.62
Q5. Clean water	0.98**	0.63
Q6. Wild foods (e.g. wild game, mushrooms)	0.67**	0.64
Q7. Firewood	0.54**	0.60
Q8. Economic opportunities (e.g. jobs)	0.72**	0.62
Q9. Bird habitats	0.81**	0.58
Q10. Habitat for pollinators of food crops (e.g. bees, bats, moths)	0.83**	0.59
Q11. Productive Soils	0.86**	0.59
Cronbach's Alpha of Index = 0.69 Index Mean = 8.94** N = 107		
**Statistically different from neutral (0)		

3.4.6 Predictors of Harvest-related Attitudes

This section focuses on the results of the t-tests and chi-square tests run with the dependent variable HARVEST. For the chi-square tests, a test was run individually for

each independent variable with the dependent variable HARVEST, which was broken into two categories (considered harvesting and did not consider harvesting). The dichotomous variable and the low sample size made it appropriate to use chi-square for nominal or dichotomous independent variables, whereas the t-test was appropriate for a statistical analysis with scalar independent variables. The result for the chi-square tests can be seen in Table 11. The alternative hypothesis for each test was that there is an association between the independent variable and the dependent variable (HARVEST). For all the variables, if a respondent did not identify a response, the data were excluded from the test. The variable POLITICAL VIEWS was broken into conservative, liberal, and moderate. The expected relationship was that liberals would be more willing to consider harvesting biomass, but there was no significant difference between the two groups (consideration to harvest and no consideration of harvesting) based on their political views. The variable education was broken into two categories those with a high school diploma or lower and individuals with some college education or higher. The chi-square determined that the two groups did not differ based on their level of education.

The variable AGE was recoded into two variables, individuals below the age of 60 and individuals 60 and above. This was intended to determine if those that are retired or closer to retirement are more likely to consider harvesting for biomass than younger landowners. The chi-square determined that age does not impact a landowner's consideration to harvest biomass. KNOWOVERALL was broken into two categories, knowledgeable and not knowledgeable about bioenergy overall. The chi-square test indicated that a NIPFs overall knowledge of bioenergy does not impact their

consideration to harvest biomass. The variable KNOWLOCAL was broken into the same two categories as KNOWOVERALL and the chi-square test demonstrated that a NIPFs knowledge of local bioenergy does not impact their consideration to harvest biomass. The variable GENDER was broken into two categories, male and female and results indicate no relationship between the variables GENDER and HARVEST. Lastly, the variable ENVMEMBER was coded as yes (member) and no (not member). The chi-square test revealed an association between the consideration to harvest biomass and enrollment in an environmental organization. As seen from Table 12, NIPFs who are a member of an environmental organization have a higher likelihood of considering harvesting biomass than those who are not part of an environmental organization.

Table 11: Chi-Square values for variables run with HARVEST

Independent Variable	Chi-square	N	p-value
POLITICALVIEWS	0.07**	79	0.97
EDUCATION	1.31	95	0.25
AGE	0.18	97	0.67
KNOWOVERALL	0.18	90	0.67
KNOWLOCAL	1.64	97	0.20
GENDER	0.36	93	0.55
ENVMEMBER	4.15	97	0.04**
** significant p-value less than 0.05			

Table 12: ENVMEMBER Chi-square Results

	Not a Member of Env. Org.	Member of an Env. Org.	Total
Not Intend to Harvest	92% (70)	76% (16)	89% (86)
Intend to Harvest	8% (6)	24% (5)	11% (11)
Total	100% (76)	100% (21)	100% (97)

The next set of results focus on t-tests run independently between the variable HARVEST and the independent variables listed in Table 13. The null hypothesis for each of these tests is that the two groups of NIPFs (consideration to harvest and no consideration of harvesting) do not differ in their means. For all variables, if a respondent did not identify a response, the data were excluded from the test. Means were expected to differ with respect to the variable ECONOMY because the landowners who consider harvesting biomass may be motivated to do so due to the positive impact it may have on the local economy such as providing local loggers an employment opportunity. However, the results of the t-test indicated no significant difference between the two groups means (p-value= 0.20). For the variable SOCIAL, the t-test resulted in no significant difference between the two groups (consideration to harvest and no consideration of harvesting) based on their attitude of biomass harvesting impacts to the community.

The t-test had the same result for the variable ENVIRONMENT (p-value= 0.85), indicating that the NIPFs consideration to harvest biomass did not differ based on their attitude of biomass harvesting's impact to the environment in the community. Additionally, the t-test demonstrate no significant relationships between HARVEST and the landowner's importance of forest ecosystem services. Despite the low level of significance between most of the variables, the variable LANDACCESS did result in a significant result for the t-test run with HARVEST. The variable LANDACCESS had a p-value of 0.08, which is significant when accepting a 90% confidence interval due to the low sample size. This indicates that landowners who perceive their access to land to be

positively impacted by local woody biomass harvesting are more likely to consider harvesting biomass for bioenergy production.

Table 13: P-values of t-tests run with HARVEST

Independent Variable	p-value	N
ECONOMY	0.20	96
LANDACCESS	0.08**	92
SOCIAL	0.13	96
ENVIRONMENT	0.85	94
FORESTES	0.82	92
** significant p-value less than 0.010		

3.5 Discussion

The purpose of this research was to determine if values, attitudes, knowledge, and landowner characteristics impact a NIPF landowner's consideration to harvest woody biomass for bioenergy production. We used the TPB and previous studies to identify variables that best predict behavioral intent, which is a strong predictor of committed behavior (Ajzen, 1985a, 1991; Joshi et al., 2013; Joshi & Mehmood, 2011; Leitch, 2012; Paula et al., 2011). We found that perceptions of access to land (LANDACCESS) significantly impacted the landowner's intent to harvest, perceiving that it would improve their access to land leading to a higher likelihood they had considered harvesting biomass from their forestland. This is consistent with prior findings that perceptions and attitudes impact on a landowner's intent to harvest (Leitch et al., 2013). In addition, we found that environmental membership was associated with lower intent to harvest biomass.

Consistent with Markowski et al. (2012) and Paula et al. (2011) but inconsistent with Shivan and Mehmood (2012), age was not significantly related to landowner intent to harvest in our sample. Gender was also insignificantly related to harvesting intentions,

similar to several other studies (Becker et al., 2013; Bohlin & Roos, 2002; Brough et al., 2013; Joshi & Mehmood, 2011; Leitch et al., 2013). Findings on education are consistent with the study by Joshi and Mehmood (2011), which found that education, does not impact behavioral intent to supply. Several studies have found bioenergy knowledge significantly impacted a landowners' decisions (Joshi et al., 2013; Paula et al., 2011; Shivan and Mehomood, 2010); however, our findings do not support this, despite measuring knowledge of bioenergy in two ways, knowledge of bioenergy and knowledge of local bioenergy production.

Lastly, we constructed several indexes to measure landowners' attitudes toward expanded harvesting practices to supply biomass for bioelectricity production. We found that our respondent NIPFs felt strongly that local biomass harvesting would have positive socioeconomic impacts on their community. This is consistent with findings of Silver et al. (2015) where NIPFs viewed biomass harvesting as positively impacting their economy by supplying jobs to the forestry sector but negatively impacting the environment.

While only one variable was significant, attitude about access to land, these indexes can provide greater context to policymakers and energy companies who are looking to identify barriers to supply. For example, the majority of landowners perceived expansion of harvesting to negatively impact their environments and communities despite having the potential to provide new job opportunities in small rural communities.

3.6 Conclusions

Woody biomass harvesting for bioenergy production is not a common harvesting practice in Wisconsin; however, lots of discussion about the bioenergy facility in the area makes it

surprising that a little less than half of the landowners surveyed were not familiar with the plant. To expand bioenergy production in the state, policymakers and energy companies must understand the attitudes, values, and landowner characteristics that impact a landowner's consideration to harvest biomass for bioenergy production. Building on existing literature, the objective of this study was to better explain the variables that impact a Wisconsin landowner's intent to harvest biomass. Surprisingly, unlike previous willingness to harvest case studies, several of the landowner characteristics (age, gender, education, and political views) did not impact their intent to harvest. However, further research is needed before reaching a definitive conclusion, as our sample size was small and very few landowners indicated any intent to harvest biomass.

Despite a small sample size, this study contributes to the literature by identifying a new landowner characteristic, membership in an environmental organization, was associated with intent to harvest. Similarly, our study highlighted that a landowner's perception of how their land access could be altered due to harvesting impacts their intent to harvest. Since this study did not take into account price of biomass as an impacting factor in behavioral intent, future research pertaining to this topic is recommended. Nonetheless, the study results suggest that landowners hold positive perceptions of local bioenergy's impact on their access to land and their economy, but negative perceptions of the impact to their local environment and community. Lastly, we know from renewable energy attitudes literature that perceptions and demographic characteristics can impact the acceptance of a renewable energy project in a local community.

3.7 References

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Chapter 4: Collaborative Governance and Wisconsin's Biomass Harvesting Guidelines

4.1 Introduction

Human caused climate change is increasing the complexity of environmental problems, making our ability to effectively adapt and mitigate more difficult (Edenhofer et al., 2011; Fischer & Newell, 2004; Intergovernmental Panel on Climate Change, 2015).

Solving complex natural resource problems often requires multiple management strategies and coordination among diverse groups of stakeholders. As resource management agencies and practitioners grapple with these issues, they have begun employing a new governance strategy, collaborative governance (CG) (Ansell & Gash, 2008; Gray, 1989). This form of governance involves multiple stakeholders joining forces to “engage in consensus-oriented decision making” (Ansell & Gash, 2008, p. 543). While many federal natural resource management agencies have institutionalized this approach, in an age of declining budgets and pressures for increased accountability from the public, state governmental agencies have been slow to adopt it (Cheng, 2006).

For CG to exist, six criteria must be present: 1) a government actor must start the policymaking process, 2) the process must include non-governmental actors, 3) all participants must be involved in the decision-making, 4) the collaboration must occur within a formalized framework, 5) the group meets and makes decisions collectively, and 6) the focus is on the creation of a public policy or management plan (Ansell & Gash, 2008). Based on these criteria, the creation of Wisconsin's Biomass Harvesting

Guidelines (BHG) serves as an example of collaborative governance and is the focus of this study.

Public officials often use CG to prevent policy implementation failures (Ansell & Gash, 2008; Cheng, 2006; Gray, 2000). Within a political climate increasingly antagonistic to regulatory measures, CG offers a powerful tool to both reduce decision-making costs and the likelihood of policy failure. CG processes can also lead to enhanced transfer of environmental problem-related knowledge and information between governmental and non-governmental organizations (Gray 1989). Increased CG usage has led researchers to study the benefits, challenges, outcomes, and processes associated with this policymaking approach (Ansell & Gash, 2008; Emerson & Nabatchi, 2015; Gray, 2000; Imperial, 2005b; Koontz & Thomas, 2006; Lynn Jr, Heinrich, & Hill, 2000; O'Leary & Bingham, 2009; Rogers & Weber, 2010; Scott, 2015).

CG case studies often focus on measuring outcomes to determine whether this form of governance is successful in assisting with policy formation. However, researchers have fallen short in differentiating between outcomes and processes and explaining how processes of CG influence the policymaking process (Imperial, 2005b; Lynn Jr et al., 2000; Rogers & Weber, 2010). Our study aims to fill this gap by examining a CG case used for improving the policy making process during the development of Wisconsin's recommended biomass harvesting guidelines (BHGs) for bioenergy production.

When researchers define CG, they typically group the processes and outcomes together (Ansell & Gash, 2008; Imperial, 2005; Rogers & Weber, 2010). Koontz and

Biddle (2014) and Koontz and Thomas (2006) developed a more advanced approach that differentiates between CG steps using a logic model to describe processes, outcomes, and outputs. This is the approach we use here. Our work also extends CG studies topically. To date, most have focused on watershed management, with minimal application to forest management (Benson, Jordan, Cook, & Smith, 2013; Fish, Ioris, & Watson, 2010; Imperial, 2005b, 2005a; Kallis, Kiparsky, & Norgaard, 2009). We fill these gaps by studying the use of CG in the development of forest-related bioenergy policy creation through analysis of interviews conducted with Wisconsin governmental and non-governmental actors involved in a CG process designed to develop BHGs.

4.2 Literature Review

4.2.1 Collaborative Governance Outcomes

CG research has studied the roles of institutions (Koontz, 2004; Leach, Pelkey, & Sabatier, 2002), trust (Ansell & Gash, 2008), and leadership (Ansell & Gash, 2008; Emerson, Nabatchi, & Balogh, 2012) in policy processes. Additional research has focused on social and environmental outcomes and processes as well as indicators of CG effectiveness and productivity (Ansell & Gash, 2008; Biddle & Koontz, 2014; Leach et al., 2002; Lubell, 2004; Rogers & Weber, 2010). However, little research has focused on the governance processes that impact or alter the policymaking process. In addition, despite the breadth of CG literature, researchers disagree about distinguishing between processes, actions performed, and outcomes (Biddle & Koontz, 2014; Thomas & Koontz, 2011).

CG outcomes can be categorized into short and long-term and benefits and challenges (Emerson et al., 2012; Gray, 2000). Fish et al. (2010) argue that effective collaboration results in reciprocity, relationship building, learning, and creativity. Reciprocity occurs through the sharing of information between actors, whereas relationships can be born out of or strengthened by collaboration. Learning and creativity are a result of the collaborative process, as actors gain insight about the complexity of the problem and are able to manage it more effectively. Fish et al. (2010) highlight each of these outcomes and the benefits and challenges associated with collaboration in water and agricultural management scenarios. However, several of the processes are categorized as outcomes, such as deep learning and improved relationships between organizations, which are not outcomes, but arguably rather processes that help guide the outcomes. This approach falls short in explaining how the processes influence policy creation.

Rogers and Weber (2010) divided CG cases into outcome categories that: 1) improve public agencies' effectiveness, 2) expand organizational capacity through a transfer of technology and development, or 3) improve collaborators' ability to solve complex problems through sharing of resources and networks. Rogers and Weber's study contributed to the growing body of CG literature by focusing on methods to evaluate the value of public engagement. The authors argued that their approach highlighted the benefits of CG, such as increased compliance and the creation of additional governmental procedures (e.g. employee protocols, training templates, etc.). While this study acknowledged the role that CG outcomes played in creating policy, the focus was on

improving and expanding the power of the organizations involved in the CG arrangement (Rogers & Weber, 2010).

Gunningham (2009) conducted interviews with stakeholders involved in three cases in Australia where collaborative governance was employed as a policymaking strategy. They focused on recognizing the benefits and challenges associated with using CG in Australian natural resource management. The author argued that governmental agencies were limited in their ability to achieve their management goals due to legal and resource constraints; therefore, engaging non-governmental actors with local knowledge and resources was essential to boosting compliance and meeting organizational objectives (Gunningham, 2009). The outcomes of this approach tended to be a transfer of power and responsibility to local organizations, which can be problematic if the organizations do not have the resources necessary to carry out governance or implementation. This study demonstrated how CG may lead to improved compliance with the policy and increased trust between local community, non-governmental, and governmental actors through dialogue facilitation.

Thomas and Koontz's (2006) CG logic model differentiates between CG outcomes, outputs, and processes in six stages: 1) inputs, 2) processes, 3) intermediate outputs, 4) end outputs, 5) intermediate outcomes, and 6) end outcomes (Biddle & Koontz, 2014; Thomas & Koontz, 2011). Inputs are resources used in the policymaking process, such as money and stakeholder time. Processes are CG group actions including information sharing, active participation, and formal documentation. Intermediate outputs include "the early products and services" resulting from the CG process such as an action

plan with state goals (Biddle and Koontz 2014, pp.270). If the CG arrangement results in intermediate outputs it often means more time and resources are necessary for the next step, end outputs, to be produced. End outputs are subsequent products and services that came from processes and intermediate outputs earlier in the CG process. An example of an end output is an implemented project or policy that stems from intermediate outputs. Intermediate outcomes precede end outputs and tend to measure or indicate the behavior change of a target population that was impacted by the end outputs, such as the uptake of BHGs by loggers and landowners. Lastly, end outcomes is the conclusion of whether or not the group achieved their desired goals. For example, a group may choose to create a watershed management plan to improve water quality; the end outcome would be whether not they improved the water quality to the level they intended.

As organizations share information, they create a common knowledge base across collaborators, making it easier to resolve, mitigate, or adapt to complex environmental problems (Biddle & Koontz, 2014; Imperial, 2005b). According to Gerlak and Heikkila (2007) and Ansell and Gash (2008), a transfer of information aids the collaborators in identifying alternative approaches or policy solutions. Thomas (2002) and Thomas & Koontz (2011) argue that when collaborators engage in information sharing, scientific uncertainty can be reduced, as the recognition of limitations can lead to clearer and more creative solutions. Thomas (2002) also argues that uncertainty can be reduced by collaborators seeking expertise from individuals or organizations who may be more familiar with a given problem.

Authentic dialogue and open discussions can help guide CG policymaking and outcomes (Gunningham, 2009; Lockwood, Davidson, Curtis, Stratford, & Griffith, 2009). Concerns about policy implementation failure can arise in open discussions among collaborators as the actors become aware of each other's motivations, perceptions, and institutional limitations (Innes & Booher, 2003). Increased collaborator awareness of their organization's barriers forces them to recognize that other groups can provide them with resources and support. This can lead to stronger partnerships and resource sharing, and it can ultimately change the collaborative plan of action and policy implementation (Innes & Booher, 2003). Increased organizational collaborative capacity can be permanent, facilitating involvement in new collaborations (Rogers & Weber, 2010).

Lastly, power dynamics can shape collaborative governance processes (Purdy, 2012). Power is often shared, albeit likely unevenly, between CG participants; however, they may lose or gain power depending upon their resources, their ability to get their voice recognized, and their stake in the problem (O'Toole and Meier, 2004). Participants may also feel powerless to affect group decisions (Broome, 2002). Bryson et al. (2006) argue that two elements of power are important: 1) the power to engage actors' in a collaboration and 2) the ability to manage group power imbalances. One actor, often a public agency, may retain final decision-making power (Kossmann, Behagel, & Bailey, 2016), yet to be successful each CG participant must have equal voice in the decision-making process. If their view, organization, or resources are not valued, their willingness to fully engage in the CG process will diminish (O'Toole and Meier, 2004).

A lack of resources (e.g. legal, staff, financial) is a motivating factor for collaborators to engage in this form of governance. Additionally, CG can help smaller or less impactful actors feel empowered bringing attention to their causes and resources (Day and Gunton, 2003; Gray, 1989). However, some will be hesitant to join a CG arrangement if they already have power and resources and may anticipate gaining nothing in return. Despite this concern, governmental actors tend to believe that the CG process will enhance their ability to reach more local communities and bypass some organizational constraints (Gray, 1989). Ultimately, power dynamics can greatly impact the success or failure of policy creation (Ansell & Gash, 2008; Fish et al., 2010; Kettl, 2015; Purdy, 2012; Rogers and Weber, 2010).

This study aims to highlight the necessity for understanding the processes of CG arrangements by focusing on two processes of CG (transfer of knowledge and open authentic dialogue) and how they influenced the outcomes. By discussing the differences between processes and outcomes in this study, we are demonstrating that a full understanding of CG arrangements is necessary in studying and engaging in CG. Lastly, our study contributes to the growing literature on CG by focusing on a case study related to forest management. Historically, CG studies have focused on watershed management cases; however, watershed issues can differ drastically in how they are approached compared to forest management problems due to different types of actors, different ecological concerns, and differing governing policies (Calder, 2007; Dewulf 2005). Therefore, this study is important to CG literature and provides an example to researchers

and practitioners of the value and challenges of using a CG approach in forest management.

4.2.2 Background

4.2.2.1 Biomass Harvesting Guidelines

As mandated by the federal Clean Water Act, all U.S. states have best management practices (BMPs) designed to reduce the likelihood of nonpoint source pollution of water bodies during forest management activities, such as road building and timber harvesting (Evans, Perschel, & Kittler, 2010). BMPs are typically voluntary and provide guidance to loggers, professionals, and landowners about how to reduce the likelihood of erosion. Low value biomass (for example, tree tops and limbs) is often left in the woods after a typical timber harvest. With increased woody bioenergy production, this material becomes a valuable energy feedstock and may be removed. However, removal can lead to various problems including erosion and nutrient losses. More recently, states have developed BMP guidance in the form of biomass harvesting guidelines (BHG) regarding the amount of woody debris that should remain on the ground after a harvest. BHGs suggest best practices for avoiding erosion and unsustainable nutrient losses when biomass is removed (Evans, Perschel, & Kittler, 2013).

Prior research on BHG creation has focused on defining biomass, perceptions of the ideal amount of biomass residues to leave on the site, methods for harvesting biomass for bioenergy production, and the benefits of supplying biomass (Aguilar & Garrett, 2009; Fielding et al., 2012; Schulte, Tyndall, Hall, & Grubh, 2008). Aguilar and Garrett

(2009) conducted a survey of foresters, biomass producers, and members of the National Council of Forestry Association Executives to understand how they believe woody biomass should be defined. They found that the respondents believe that any policy created (state or national) that promotes woody biomass harvesting should take into account local and regional socioeconomic conditions. Environmental sustainability was also a topic of concern, as respondents were unsure of the impacts biomass harvesting would have on forest productivity, biodiversity, and wildlife.

A survey of stakeholders (i.e. forest managers, loggers, and landowners) in North Carolina found that the majority of the respondents opposed the new BHGs (Fielding et al. 2012). They believed that the BHGs were not necessary and other BMPs, such as riparian management, were successful in protecting the forests. Another study conducted in North Carolina, found that when creating BHGs stakeholders preferences that will be altered by the policy and markets should be taken into account to create feasible and socially acceptable guidelines (Serenari et al. 2015). The stakeholders had concerns about the environment (i.e. damage to wildlife habitat) that in some contexts were more important than certain market concerns, like stumpage price. Other studies have found that loggers were not supportive of BMPs because they required more implementation time leading to loss of time and profit (Bolding et al.2010; Milauskas & Wang, 2006). These studies demonstrate the apprehension that stakeholders have about biomass harvesting and the necessity for policy at some level to protect social, economic, and environmental interests. Lastly, these studies indicate the varying differences in stakeholders' perceptions of what BHGs should and should not contain.

4.2.2.2 Case Study

This case study was part of a larger study of forest-related bioenergy projects across the Americas (Dunn et al. In review). Research interviews alerted the authors to the use of a CG process during the creation of Wisconsin's BHGs. The Wisconsin Council on Forestry set out to create BMPs for harvesting biomass for bioenergy production in part because they anticipated growing biomass markets and wanted to ensure sustainable residue removal. At the request of the council, the Wisconsin Department of Natural Resources (WDNR) took the lead on the construction of the BMPs (Herrick et al. 2009). The WDNR employed a collaborative approach to drafting the guidelines by convening a group of WDNR experts, council members, and non-governmental actors to create the guidelines.

In addition, the WDNR created a stakeholder advisory committee to serve as expert reviewers of BHG drafts (Herrick et al. 2009). Reviewers submitted the guidelines to the Wisconsin Council of Forestry after a revision and approval period. The BHG Committee then completed further guideline revisions after receiving public input on the proposed guidelines. Wisconsin then issued its first set of BHGs in 2008 (Bronson et al. 2014). The guidelines were separated into general and landscape-specific guidelines. The general ones are for all sites where people plan to harvest fine woody biomass, while the site-specific guidelines address harvesting on lands (based on soil type) where nutrient losses would be more of a problem (Bronson et al., 2014; Herrick et al. 2009).

However, the committee developed concerns regarding a lack of scientific evidence backing their recommendations; and therefore, they built a plan for revision into

the policy. This plan required a 2012 revision if sufficient scientific consensus emerged about the impacts of biomass removal (Herrick et al., 2009). The 2012 revisions took place and involved some past BHG committee members as well as new governmental and non-governmental participants (Bronson et al., 2014). The 2012 committee adjusted the guidelines to take account of the best available science, biomass markets at the time, and participant concerns. The revised BHGs altered the original guidelines by switching from requiring 10% of tops and limbs of trees left on the harvest site to specifying that five oven-dry tons of fine woody debris (FWD) per acre must be left on the harvest site (Bronson et al., 2014). This measurement was difficult to visualize for loggers, forest owners, and forest managers, and therefore required extra resources to implement.

At the request of the committee, the WDNR created an additional manual with the help of several non-governmental actors, providing loggers, foresters, and landowners further biomass harvesting information (Bronson et al. 2014). The new BHG manual serves as an information tool for loggers and managers to better predict the maximum amount of biomass harvesting that should occur in different types of landscapes. Our study aimed to understand the processes associated with CG during BHG development and how these processes influenced BHG policy creation outcomes.

4.3 Methods

We conducted semi-structured interviews between 2014 and 2017 with Wisconsin governmental and non-governmental actors involved in BHG creation. We used a purposive sampling approach to recruit 33 interviewees from the individuals listed as participants in the creation and revisions of the BHGs (Bronson et al., 2014; Herrick et

al., 2009). Nineteen interviewees were quasi-governmental or governmental actors (e.g. employees of utilities and state agencies) and 14 were non-governmental actors (e.g. university researchers, NGO staff, forest products employees, landowner association staff, etc.). We asked questions about wood-based bioenergy production in Wisconsin, the individual's and organization's role in creating the BHGs, and the process of creating the guidelines (the complete protocol is included in Appendix C). Questions were also asked about the revision of the guidelines, how the governance process changed for the revision, and what impacts the guidelines had on the forest products industry, landowners, and the community.

The interviews lasted between 30 to 60 minutes and most were recorded. A few interviewees did not want to be recorded – in those cases, extensive notes were taken on all responses. All recorded interviews were transcribed verbatim. Basic demographic data for all interviewees were collected during the interviews, including gender, position, and organizational affiliation. The transcripts were analyzed using NVIVO to identify patterns across the interviewees.

4.4 Results

In this section, we present findings from the interviews to understand the processes that were used in this collaborative governance arrangement and how they influenced the outcomes of this case study. Our results are drawn from analysis of responses to two questions: “How were the BHGs created?” and “What were the advantages and disadvantages to working in a collaborative group to create the BHGs?” We organize this section around three major themes discussed by interviewees in response to these

questions about the CG process: the importance of a shared knowledge base; the prevalence of norms of open and authentic dialogue throughout the BHG creation process; and elements of power dynamics and their impacts.

4.4.1 Sharing Knowledge

In response to the questions above, most interviewees discussed the importance of knowledge sharing during the BHG process. Their comments tended to focus on the need to share information among collaborators to ensure that each member had a basic understanding of the problems BHGs would be designed to prevent. Several interviewees told us that the collaborative setting provided an opportunity for participants unfamiliar with these issues to learn information critical to full participation in the process. For instance, one interviewee explained the process of deciding recommendations for amounts of biomass retention. They said that this discussion provided an opportunity for participants less familiar with nutrient cycling to gain a better understanding of its role in forest health. They explained that there was “not a lot of awareness” of its importance across participants prior to the discussion (Interviewee 1043). By sharing information during the initial meetings, the collaborators were able to correct misconceptions and keep the group focused on the task at hand, creating voluntary harvesting guidelines based on scientific knowledge of harvest impacts.

4.4.2 Open and Authentic Dialogue

Many interviewees also told us that as participants got to know each other and shared information, the CG process encouraged open, informative, and authentic

dialogue. For example, one non-governmental interviewee described the advantages of such a process saying, “The collaborative group was important to allow all stakeholders a voice in the development” (Interviewee 1039). Interviewees described their concerns and issues as respected within the process, which contributed to building trust among members. They saw the approach as making it easy to “buy-in” to the process while protecting their values.

Participants told us that the open dialogue process that developed over multiple meetings allowed organizational representatives to confer with their organizations and constituents between meetings, which helped identify potential compliance and scientific certainty problems and jointly work to design BHGs that overcame them. Concerns about a lack of scientific certainty led most participants to err “on the side of caution” (Interviewee 1043). Interviewees explained that scientific uncertainty made it hard to reach consensus on some decisions. Many believed that the BHGs should ensure that biomass retention was at levels “safe enough to prevent a long-term removal of nutrients” (Interviewee 1036), while others expressed concern that would “handicap the biomass industry” (Interviewee 1042). Without the open dialogue characteristic of a CG process, these discussions might not have occurred. Being able to raise and discuss issues shifted the focus toward creation of guidelines based on available scientific data while ensuring that the guidelines would be adaptable to new scientific insights, each of which is an output of the CG arrangement.

These issues led to plans to increase the group’s knowledge of biomass harvesting impacts on soil nutrients. Non-governmental and governmental participants alike

recognized a necessity for better information and, once the 2008 BHGs were finalized, began conducting research to provide better scientific data that could guide revisions. Discussions helped the group reach the consensus that the BHGs would be revised in four years using new findings about the nutrient cycling impacts of biomass removal. This CG process altered the intended outcomes of the collaboration by adding additional demands.

Logger, forester, and landowner BHG compliance was another key issue raised during the process. Several interviewees said that if the state did not use a CG approach to create the BHGs, the outcome of compliance levels might be lower. They explained that open discussion allowed all participants to express their own and their constituent's concerns about how the BHGs would impact the industry and forest management. Interviewees told us that this dialogue also led to an outcome of group recognition of the importance of outreach designed to teach people how to follow the BHGs, leading to the Department of Natural Resources partnering with the Sustainable Forestry Initiative (SFI) certification program and others to hold workshops on field-based BHG interpretation. The open dialogue led to the creation of workshops, which are categorized as outcomes in CG arrangements. Interviewees explained that during the 2012 revisions, compliance concerns were again raised. As one interviewee described it: "They made some improvements based on research that was completed or conducted over that period between the original implementation. The revisions also clarified for implementers in the field" (Interviewee 1040). Interviewees described the revisions as leading to the simplification of the BHGs, more BHG training workshops, and the creation of companion guidebook for loggers and forest managers to better explain the BHG field

application. They explained that open dialogue shifted group discussion away from just focusing on BHG revision toward improving the guideline effectiveness through creation of additional educational material and employing other policy tools to increase compliance.

4.4.3 Power Shaping Process

However, many interviewees also identified issues around power inequalities within the group and explained that these inequalities sometimes made creating the BHGs difficult. Non-governmental and governmental interviewees alike had issues with power with regard to who controlled and guided discussions, the final decision, and whose input was truly valued. The governmental interviewees each acknowledged that while they held the most power as the “ultimate rule maker,” they had to balance their interests and the interests of others to ensure that the collaboration was successful in not only creating the guidelines, but also in maintaining relationships with non-governmental representatives, who serve as key spokespeople to their constituents. One governmental interviewee (1053) described power issues when they discussed the final consensus and how “some people at the table felt that the final recommendations weren’t their recommendations.” This concern was shared among several interviewees, with one explaining that they felt their input was ignored during the final meeting of the 2008 BHG process. They said, “we came to the last meeting and the [public agency] representative who was in charge said that ‘Well, we think we only need to leave this much behind [on the ground]’” (Interviewee 1033).

This argument and several other interviewee discussions illuminate power issues between WDNR, the agency in charge of the policy creation, and the other BHG process participants. On the other side of the argument, one government participant believed that the group was “not a balanced representation” of the larger, relevant community of interest because community, pulp and paper industry, and landowner representatives outnumbered scientists (Interviewee 1028). This quote shows how a lack of power balance among representatives can be perceived as pushing discussion and decisions in directions favoring particular interests and, therefore, altering both CG processes and BHG focus and credibility. Interviewee 1047, a non-governmental participant, acknowledged in their discussion of the collaboration that it takes “time and patience to work in [a] group” and that at times there were individuals who were not willing to adapt their beliefs to work with the group. This power dynamic made it more difficult for the group to build trust and led to a few instances where the consensus process was “derailed” as collaborators lost sight of the end goal (Interviewee 1045).

Lastly, two groups, loggers and university researchers, were mentioned by several interviewees as groups that particularly struggled with the power dynamics of the CG arrangement. While both groups were involved in the creation of the guidelines, concerns were raised about whether or not their voices were heard and valued by the group. The loggers’ concerns focused on the BHGs potential to alter their harvesting seasons, making it more difficult for them to find jobs during the wet season if certain soils were restricted under the initial BHGs. This concern existed during the revision process as well but was not the focus of the revisions. The revisions were focused on reducing the

types of forest soils that are restricted from harvesting biomass. Over time, loggers began to believe that others in the group did not respect their views and concerns. This led other actors to be concerned about being able to successfully encourage loggers to comply with the BHGs in the implementation stage. University researchers were another group described as becoming disengaged from the process due to a lack of respect from others. They tended to see their concerns and expertise as respected during the original 2008 BHG creation process; however, they believed that this respect declined during the 2012 revision process. One interviewee explained that the BHG group asked for more data in between the 2008 creation and 2012 revisions, but when presented with new data during revisions it was “brushed off” (Interviewee 1053). Ultimately, this led to these researchers disengaging from the revisions process because they believed they lacked power to guide the discussion.

4.5 Discussion

The results of the interviews demonstrate how CG processes shaped outcomes. Interviewees described two elements of the processes as particularly important in creating the BHGs: sharing of knowledge and open dialogue. These results indicate that there is a difference between processes and outcomes of CG, as demonstrated in the literature by Koontz and Thomas (2006) and Biddle and Koontz (2014). As researchers continue to articulate and develop a framework for studying CG arrangements, our findings provide insight into how processes - actions carried out by the collaborative group (Biddle & Koontz, 2014) - can lead to outcomes. This distinction is an issue that previous studies

have fallen short in articulating and where this study can help fill the gap in literature as the knowledge and use of CG continues to expand.

Each of the processes discussed here influenced the outcomes of the CG arrangement. The sharing of knowledge led to a change in focus of the group away from misconceptions and towards creating guidelines that were practical and grounded in scientific data. As found by others, the knowledge sharing process helped the governmental and non-governmental actors identify differing viewpoints and approaches to creating the BHGs (Ansell & Gash, 2008; Gerlak & Heikkila, 2007). This also led to a reduction in scientific uncertainty as group members shared their expertise about the problem and identified gaps in the scientific data (Thomas, 2002; Thomas & Koontz, 2011).

The process of engaging in open discussions also provided an opportunity for the BHG group to address concerns about a complex environmental problem and how policy could address it, complementing the results of prior research (Ansell & Gash, 2008; Innes & Booher, 2003). The open BHG dialogues positively impacted policy process outcomes. The open dialogues led to discussions about scientific uncertainty and compliance, each of which were addressed in the policymaking process, as the collaborators chose to create educational workshops and a guidebook for how to interpret the BHGs in the field. The open dialogue altered the outcomes of the CG arrangement as it led the group to create BHGs that erred on the side of caution. Furthermore, these dialogues resulted in the group agreeing to revise the guidelines in four years based on new available scientific data create by a partnership between several of the actors. This demonstrates that not only

did the process of open dialogue alter the outcomes of CG, but it also led to improved organizational capacity for several of the actors. Improved organizational capacity is cited as an outcome of CG arrangements (Emerson & Nabatchi, 2015; Innes & Booher, 2003). In this case in particular, this process led the actors to go beyond focusing on policy creation to instead head off problems of compliance with the creation of a guidebook and workshops (Rogers & Weber, 2010).

Lastly, the distribution and sharing of power influenced the outcome of the CG arrangement, which is consistent with the findings of Purdy (2012). Purdy (2012) argues that power distribution can shape policy creation by altering who feels empowered in the decision making and whose voice is recognized. In this case, two groups felt a loss of power due to a lack of respect for their concerns, which led to disengagement. This finding is consistent with studies conducted by Broome (2002) and O'Toole and Meier (2004), where actors who feel excluded will either speak out or remove themselves from the policymaking process. In this case, in particular, power distribution impacted the transfer of knowledge. Moreover, during the open dialogue process, several groups felt disempowered, as their concerns were not considered during the BHGs creation and revisions.

4.6 Conclusion

This research identifies distinctive processes arising out of the use of CG as a policymaking strategy in the creation of Wisconsin's BHGs. We add to the CG literature by demonstrating that this form of governance can be advantageous in environmental

management policy fields including forest policy making. Furthermore, collaboration can improve the institutional capacity of the governmental organizations involved through dialogue with local non-governmental actors and their constituents. In CG arrangements, governmental actors build trusts within the community by engaging them in the creation of policies that may impact lifestyles and land management practices. By highlighting the processes involved in this CG case study, we are aiding researchers, policymakers, and environmental managers in understanding the processes of CG and how they can influence outcomes such as policy creation and implementation.

While this case is a successful example of CG, not all cases have this outcome; therefore, we must acknowledge some of the limitations of this study. From the onset of the BHG creation, the Wisconsin DNR and the Council on Forestry set the stage for how the agenda would be run. They did this by facilitating meetings and encouraging non-governmental actor involvement. This case study benefitted from the encouragement of non-governmental engagement from the beginning, which is not always the case. While our study discusses engagement of actors briefly in terms of power distribution, it does not focus on how to engage actors in CG arrangements. More importantly, we do not highlight the lessons learned from a failed case. Lastly, we must acknowledge the monetary cost involved in engaging in a collaborative approach to policy creation. This undoubtedly exists but it was not within our scope and was not mentioned by any of the participants.

The relatively small sample size is typical with qualitative studies; however, we do acknowledge that the results should be interpreted with caution, as they may not apply

to all CG arrangements depending on the size of the group, preexisting relationships, the resources available, and the type of complex natural resource problem they are trying to solve. However, despite the limitations of this study, we have demonstrated the value of collaborative governance in policy making through an example of the creation of Wisconsin's BHGs. CG is a valuable policy tool that continues to emerge in natural resource management and can be effective for creating policies when the setting is appropriate. Trust, open dialogue, and a commitment to a common goal or outcome are arguably necessary for CG arrangements to be successful. Future research on CG arrangements should focus on continuing to distinguish between the outcomes, outputs, and processes of collaboration to gain a better understanding of how the process should be evaluated. In addition, future research should focus on how CG arrangements reduce implementation failures compared to a top-down approach to policymaking.

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Chapter 5: Conclusions

The final chapter of the dissertation highlights the connections between chapters Two, Three, and Four and how they can contribute to our understanding of bioenergy production in the state of Wisconsin. By conducting research at multiple scales (i.e. NIPF landowners and policymakers) we have a better picture of the barriers to bioenergy production, a renewable energy employed by state and national governments' around the world to reduce emissions to lessen climate change's severity.

Chapter Two focused on Wisconsin NIPFs' perceptions and acceptance of local bioenergy production. While the landowners had a mix of negative and positive perceptions of bioenergy, the majority still supported local bioenergy production. Their high support for bioenergy is likely due to awareness of the local bioenergy plant, as the company that owns the co-generation facility held several public meetings prior to construction. Additionally, high support could be associated with the largely positive perceptions of bioenergy that many NIPFs held. They tended to believe that local bioenergy production positively impacts the local economy, could boost their own income, and increases local jobs. While the literature acknowledges that social acceptance of all kinds of renewable energy projects is important, bioenergy is different because without NIPF support procuring sufficient sustainable supplies of woody biomass is impossible. Therefore, it is important to understand the factors impacting NIPF willingness to supply biomass for bioenergy production.

Chapter Three presented results from the examination of these factors. The results from our survey showed that landowners perceived local bioenergy production as causing

negative environmental impacts. However, most forest landowners also believed that local bioenergy production positively impact local communities and economies. In this chapter, we presented results of an assessment of NIPFs' perceptions of, values related to, and knowledge of bioenergy as well as some of their demographic characteristics. We determined that NIPFs' membership in an environmental organization and their perceptions of local bioenergy's land access impacts impacted their intent to supply biomass for bioenergy production. While we recognize that our sample size was small and that this could have impacted the interactions between our variables, our study still provides insight into forest landowners' decision-making processes.

Additionally, Chapters Two and Three contribute to the literature by strengthening our understandings of NIPF perceptions of bioenergy production and their willingness to consider supplying biomass, which is critical to expanding bioenergy production. Lastly, these chapters demonstrate that the decisions to supply biomass and support bioenergy production locally are complex and multi-faceted; therefore, more than one policy tool or approach may be necessary to expand bioenergy production to serve as a mitigation tool for climate change.

Lastly, Chapter Four focused on the policy strategy used to create BHGs to ensure the sustainable production of bioenergy in Wisconsin. Wisconsin's BHGs were created to reduce the environmental impacts associated with woody biomass harvesting. By employing a collaborative governance (CG) approach the stakeholders, state and non-state actors, were able to use the processes of CG to improve their organizational capacity and create the BHGs. The actors identified two processes associated with this CG

arrangement and how each of them led to certain outcomes. This chapter's findings connect back to Chapters Two and Three since these guidelines impact biomass removal from the lands of many NIPFs. This study contributes to the literature by showing how a policy aimed at solving a complex environmental problem was successfully created using the collaborative governance strategy.

Together these three chapters provide a broader understanding of linkages between NIPFs and Wisconsin's bioenergy sector. Each of the chapters focuses on barriers to bioenergy that could impact the production of it in the state of Wisconsin. Chapters Two and Three identify barriers to social acceptance consideration to harvest for NIPFS. Chapter Four focuses on how the BHGs were created to reduce barriers (i.e. feedstock sustainability) for future biomass production. The understanding of landowners' perceptions of biomass harvesting and the creation of the policy to reduce impacts of biomass harvesting on the forestland in the long term can give state policymakers will have a better understanding of how to move forward if they wish to further use bioenergy production to meet the state's RPS.

Lastly, based on my findings, future research related to bioenergy production in Wisconsin could focus on what forms of policy would motivate NIPFs to supply biomass. Researchers could look at other state incentive programs that help to increase biomass supply and whether they would be applicable based on Wisconsin's economy and the NIPFs perceptions. Additionally, future research could focus on how educational programs and outreach can help to alter perceptions of bioenergy in the communities and whether this could impact a landowner's consideration to supply biomass. This research

could aid policymakers in identifying the policy tools necessary to help encourage biomass harvesting from NIPF landowners to help meet Wisconsin's RPS.

Appendix A. Chapter 2 Interview Protocol

INTRODUCTION

1. How long have you lived / worked here? What do you do for a living?
2. How have job opportunities for you changed over the last 15 years in this community?
3. How would you describe your community? What makes it unique?
4. How would you describe the quality of life and livelihoods here?
5. Have you seen changes in the quality of life and livelihoods in this community over the past 15 years? What changes? What has driven these changes?
6. What are the most significant challenges your community faces? [Wait for a response. If they only address one theme like employment in their response then ask “*What about any economic, environmental, political, social, or health challenges in your community*”]
7. What challenges and opportunities do you anticipate for the future of your community?

Forests: Now we would like to talk about forests and forest management in your community.

8. How have people traditionally gained access to forestland in this community? What kinds of forest owners do you have here? (For example are they private/individual/corporate/absentee/renting/ *also size of forest holdings*)?
9. Do you have access to forests? What type of forestland it is? (own forests/have title to/familial connection or rent forestland)?
10. If they do have forestland ask, “how much?”[if people talk about forests in town that their house is on then skip to question 11]
 - a. Where is this forestland located in relation to your community? How do you get there and how long must you travel? How often do you go there per month?

- b. Has the amount of forestland that you have access to changed over the last 20 years? If so, how and why?
- 11. Do you use forestland? [If yes,] In what ways (for example, timber production, firewood, hunting, recreation, etc.)? [If they do not use land then skip to question 11]
 - a. How has your use of forestland changed over the last 15 years [Prompt for example the size management, type management, recreational activities, or yields]? How has the use of forestland changed across generations?
 - b. Is use of forests primarily for household consumption, commercial purposes, both, or other? How do these activities contribute to your household income?
 - c. What, if any, improvements have been made to the forests (prompt for example access roads/trails, hunting stands, new tree varieties, etc.)? When were these improvements made, how were they funded, and why were these decisions made?
 - i. (If applicable) Are fertilizers, pesticides, herbicides, etc., used? If so, how are they obtained? If these products are not used, why was this decision made and what were the criteria (for example expense, availability, risk, environmental concerns, etc.) and has the amount used changed over time?
- 12. How has forest ownership changed [patterns] over the last 15 years around your community? Do most people have clear title to their forestlands? [If not, why not?]
 - a. How has the change in forest ownership [patterns] affected small versus large landholders and communal access to land (for activities like hunting, recreation, gathering etc)?
- 13. Do you think forestland ownership and access is important to future generations? Why or why not?
- 14. How are younger generations involved with forestland use today?
 - a. How do you think your children / future generations within your community will use forests?

Ecosystem Services: Now we'd like to ask you some questions on how forests and the environment impact you, your family, and your community.

15. What do you like about the environment here? In what ways is this environment important to your community? (By environment we mean the landscape and lands and resources)
16. What benefits, if any, do you or your family receive from forests?
17. Of these benefits which are most important to you?
18. How do these benefits affect your community? How do they affect those from outside of your community?
19. Have these benefits changed over past 15 years? [If they say NO skip to #19] If yes how have they changed and why?
 - a. Are they more or less valued today than they were over the past 15 years?
 - b. How do you think these benefits might change in the future? Will the changes be good or bad and why?
 - c. Has the availability of resources (animals and plants) changed over time? [If yes] How and why?
20. What needs to be done to ensure the protection of these benefits for future generations (those benefits from the environment and the forests)?
 - a. [If respondent indicates government interventions in their response ASK]: What types of government policies or programs do you think would be most effective?

Biomass: Now we would like to ask a few questions about [woody biomass production] and the use of biomass.

21. Do you use [wood] in your home? If so what for and how much on an annual basis? Where do you get your wood from?
22. Do you harvest wood on a regular basis from your land? How regularly?
 - a. Who do you sell your wood to?
 - b. Do you have any idea for what purpose your wood is being used?
 - c. Do you harvest wood yourself or give it on contract? Who is your regular contractor?
 - d. Do you know what happens to the tops and branches?
23. Have you heard about local bioenergy development in this area? [If yes:] What have you heard? [If not then explain the idea behind bioenergy transformation and planned and actual uses in the site or from the feedstock]?

24. Do you engage in managing for/harvesting [wood for heat or power production]?
If so, when did you begin, what was the previous land use and at what scale is your annual production? IF NO SKIP to Question #22
- a. Do you plan to harvest more in the future? Why?
 - b. Who purchases your wood?
 - c. What motivated you to engage in [woody biomass] harvesting? (Prompt for example policy changes, income opportunity, diversification of income, other)
 - i. If mention policy--Would you be harvesting without policy/subsidies?
 - ii. What laws, rules, or policies most influence your production practices?
25. Has this bioenergy development [wood to electricity production] positively or negatively affected your community and the environment? [If yes] How? (If they are struggling then say for example on biodiversity, water, cultural, food, soil health, equality, land ownership, or employment)
- a. How has the [wood generated electricity] changed the benefits others who are within or outside your community receive from the forests? Why? What do you attribute these changes to?
 - b. Has harvesting wood for heat and power production changed the possibility or availability to buy or rent land in your community?
 - c. Has harvesting wood for heat and power production changed the possibility for people to use land?
 - d. These changes you have described, how has it affected the identity of your community?
26. How have your feelings toward [wood to electricity production] changed since it was first cultivated in your community or region? Why?
27. Have community members, groups or organizations worked to change how [woody bioenergy] has developed to address community concerns? If so, how and with what success or impact? If not, why not?

Bioenergy: Now we would like to talk about bioenergy/biofuel produced from this feedstock

28. Had you heard about local bioenergy development before this interview? [If yes:] What have you heard? [If not then explain the idea behind bioenergy transformation and planned and actual uses in the site or from the feedstock]

29. Why do you think the use of forest resources for electricity production is being promoted or developed?
30. Do you think the government should encourage [the Rothschild plant] to use [forest resources] for [electricity production]? Why or why not?
31. Do you think that using [forest biomass] to create [electricity] is a good thing? Why or why not?
32. Overall how do you feel about the [use of forest resources to produce electricity] in and around your community? (support or oppose?) Why?

Sustainability: Now we'd like to talk about the sustainability in your community and the harvesting of Wood for bioenergy.

33. What does sustainability mean to you in the context of your community?
34. Have you heard of [forest] sustainability certification? Has it changed the way the [forest biomass] is developed/managed?
35. How could the use of forest biomass for electricity production[] be more sustainable? What would be your vision of a more sustainable [land use type]? What would improve the environmental, social, political, economic dimensions of quality of life?

Groups: Now we have questions about the groups and individuals involved in Woody biomass harvesting and to see if you have questions that we should investigate.

36. Who are the key private firm entities / landowners in developing [the wood to electricity] in the area? What kinds of interactions / experiences have you had with them, to what effect?
37. Related to [woody biomass] production do you have any questions related to social, economic or environmental impacts that you think our research team should investigate? What questions would you like answered?

Demographics: And now a few questions about you

38. How old are you?
39. What is the highest level of education you have completed?
40. INSERT SOME CULTURALLY APPROPRIATE QUESTIONS TO GATHER INFO ABOUT INCOME OR CLASS

Final Questions: Finally to finish just a couple more questions.

41. Are there any other important people, organizations, businesses, or entities we haven't talked about? Are there any other important topics we didn't discuss?
42. Who else in the community should I talk to about these topics? Specifically about [bioenergy feedstock] production.
NOTE: Change this question to reflect potential interviewees you still need to Access in terms of producers, workers, age or gender who might be willing to participate. We don't just want elite or most knowledgeable people in the community.

Thank you for your time and interest in this study.

Appendix B. Chapter 3 Survey

Photo Credit: Chris Henderson

Public Opinion Survey on Wood-Based Electricity Production

Michigan Technological University

July 2015

Funded by the U.S. National Science Foundation

Michigan Tech

Michigan Technological University

Instructions for completing the survey

We ask that the adult in your household with the next upcoming birthday complete this survey. Please complete the following questions to reflect your opinions as accurately as possible. Carefully read each question and indicate your response according to the question's instructions. Please clearly mark your response to each question. This helps ensure that we gather the best information possible.

How to return the survey: A member of our survey team will come by to pick up the completed survey on _____. If you will not be home on this date, please place the completed survey in the doorknob hanger bag provided to you. Hang the bag on your front door doorknob, and a member of our survey team will come by to pick up the survey. Or you may return the survey using the enclosed envelope with pre-paid postage. If you have any questions, or would like to arrange for a different time to return the survey, please call 1-859-321-6898.

Your responses are confidential and your identity will not be shared with anyone. We appreciate your time completing the survey!

Part A: Questions to Begin

1. How many years have you lived in this community? _____

2. What is your age?

☐ 18-39

☐ 40-59

☐ 60-79

☐ 80+

☐ Prefer not to say

Downtown Tomahawk, Wisconsin
Photo Credit: J. Stephen Conn

Part B: Aspects of Nature

3. People can have different opinions on the importance of forests. Below is a list of different aspects of forests that can contribute to human well-being. How important is it that forests provide the following aspects **to your household**? Choose a number between 1 and 5 in terms of importance for each item. Circle only one answer for each item.

Aspects of Forests	Not at all important				Very important
A. A visually pleasing landscape	1	2	3	4	5
B. Recreation (e.g. camping, hiking)	1	2	3	4	5
C. Clean air	1	2	3	4	5
D. Stores carbon or takes carbon out of the atmosphere	1	2	3	4	5
E. Clean water	1	2	3	4	5
F. Wild foods (e.g. wild game, mushrooms)	1	2	3	4	5
G. Firewood	1	2	3	4	5
H. Economic opportunities (e.g. jobs)	1	2	3	4	5
I. Bird habitats	1	2	3	4	5
J. Habitat for pollinators of food crops (e.g. bees, bats, moths)	1	2	3	4	5
K. Productive soils	1	2	3	4	5

4. Imagine that you could “spend” \$100 to ensure that local forests continue providing benefits to you. You may allocate or spend the \$100 in any way you like, but your total spending may not exceed \$100. You might spend all \$100 on one benefit (and \$0 on all others), or you might spend \$50 on one benefit, \$25 on one, and \$25 on another.

Remember, the total dollars you spend must equal \$100. Please indicate how you would divide up the \$100.

\$ Value	Benefit
\$	A. Aesthetic values (e.g. enjoyable sights, sounds, smells, scenery, etc.)
\$	B. Non-motorized recreation (e.g. camping, hiking, snowshoeing)
\$	C. Greenhouse gas storage like carbon dioxide (e.g. through tree growth)
\$	D. Habitat for wildlife (e.g. birds)
\$	E. Habitat for wildlife to help pollinate food crops (e.g. by bees, bats, moths)
\$	F. Hunting
\$	G. Motorized recreational opportunities (e.g. ATV and snowmobiling trails)
\$	H. Prevent soil erosion
\$	I. Timber products (e.g. sawlogs, pulp)
\$	J. Clean water

Part C: Familiarity with Bioenergy

5. Renewable energy is defined as any energy resource that is not diminished over time or is regenerated over a short time scale through natural processes. Before taking this survey, did you know that forest resources (e.g. tree tops, branches, stumps, and/or whole trees) can be a source of renewable energy?

☐ Yes

☐ No

☐ Unsure

6. Before taking this survey, did you know forest resources can be used to generate electricity?

☐ Yes

☐ No

☐ Unsure

7. Before taking this survey, were you aware that electricity was being produced using forest resources by a utility in Rothschild?

☐ Yes

☐ No

8. How important to you is it that the energy you use is produced from domestic sources (from within the United States), as opposed to being imported from another country? Circle one answer.

Not at all important				Very Important
1	2	3	4	5

9. How important to you is it that the energy you use is produced from renewable energy resources? Renewable energy is defined as any energy resource that is not diminished over time or is regenerated over a short time scale through natural processes. Circle one answer.

Not at all important				Very Important
1	2	3	4	5

Part D: Bioenergy Production and Land Use

10. Using forest resources for electricity production has the potential to impact (both positively and negatively) many aspects of ecosystems and communities. In your opinion, what would be the *overall impact* on the following aspects of your community and environment if current forest harvesting activities in your community expanded in order to produce materials for electricity production? Circle one answer for each item.

ECONOMIC IMPACTS

	Very Negative Impact	Negative Impact	Neutral	Positive Impact	Very Positive Impact
A. The local economy	-2	-1	0	+1	+2
B. Well-paying local jobs	-2	-1	0	+1	+2

C. Other local economic activities	-2	-1	0	+1	+2
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LAND ACCESS AND OWNERSHIP

In your opinion, what would be the *overall impact* on the following aspects of land access and ownership if current forest harvesting activities in your community expanded in order to produce materials for electricity production? Circle one answer for each item.

	Very Negative Impact	Negative Impact	Neutral	Positive Impact	Very Positive Impact
D. Access to land not owned by you	-2	-1	0	+1	+2
E. Access to resources not owned by you (e.g. for firewood, hunting, plant collecting, etc.)	-2	-1	0	+1	+2
F. The ability to maintain family ownership of land	-2	-1	0	+1	+2
G. Land ownership by people from outside your community.	-2	-1	0	+1	+2

ENVIRONMENTAL IMPACTS

In your opinion, what would be the *overall impact* on the following aspects of forests if current forest harvesting activities in your community expanded in order to produce materials for electricity production? Circle one answer for each item.

	Very Negative Impact	Negative Impact	Neutral	Positive Impact	Very Positive Impact
H. Ability to store carbon	-2	-1	0	+1	+2
I. Clean air	-2	-1	0	+1	+2
J. Bird habitat	-2	-1	0	+1	+2
K. Habitat for pollinators of food crops (e.g. bees)	-2	-1	0	+1	+2

L. Flood protection	-2	-1	0	+1	+2
M. Soil quality	-2	-1	0	+1	+2
N. Soil erosion	-2	-1	0	+1	+2
O. Water quality	-2	-1	0	+1	+2
P. Greater risk of natural disaster (e.g. floods, fires, drought, etc.)	-2	-1	0	+1	+2

SOCIAL IMPACTS

In your opinion, what would be the *overall impact* on the following aspects of your community if current forest harvesting activities in your community expanded in order to produce materials for electricity production? Circle one answer for each item.

	Very Negative Impact	Negative Impact	Neutral	Positive Impact	Very Positive Impact
Q. Landscape beauty	-2	-1	0	+1	+2
R. Recreational opportunities (hiking, hunting, ATVs)	-2	-1	0	+1	+2
S. Desire to stay in the community	-2	-1	0	+1	+2
T. The ability of youth to stay in the community	-2	-1	0	+1	+2

Please select one response option for the following question.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
U. Overall, I support the expansion of using forest materials for electricity production.	1	2	3	4	5

11. Please indicate your opinion of expanding the use of forest materials for electricity production if the materials came from each of the following sources. Circle one answer for each item.

	Strongly Oppose	Oppose	Neutral	Support	Strongly Support
A. Sawmill and paper mill wastes	1	2	3	4	5
B. Tree parts left on the forest floor after logging	1	2	3	4	5
C. Dedicated harvests of low value trees	1	2	3	4	5
D. Forest thinnings to improve forest health	1	2	3	4	5
E. Forests cleared for agriculture or residential development	1	2	3	4	5
F. County owned forests	1	2	3	4	5
G. Privately-owned forests	1	2	3	4	5

Part E: Environmental Values

12. Please indicate your level of agreement with the following statements. Circle one answer for each item.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. It is humankind's responsibility to protect and care for the Earth and natural resources.	1	2	3	4	5
B. It is humankind's right to use the Earth and its natural resources for our own benefit.	1	2	3	4	5
C. Economic growth and creating jobs should be the top priority, even if the	1	2	3	4	5

environment suffers to some extent.					
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Part F: Climate Change

13. Please indicate your level of agreement with the following statements. Circle one answer for each item.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Local weather has become less predictable.	1	2	3	4	5
B. I have noticed that the number and types of wildlife in the area have changed.	1	2	3	4	5
C. Storms have become more severe in recent years.	1	2	3	4	5
D. I have heard the term "climate change" or "global warming."	1	2	3	4	5
E. I don't know a lot about global warming or climate change.	1	2	3	4	5
F. Climate change is <i>not</i> going to happen.	1	2	3	4	5
G. Global climate change has been blown out of proportion.	1	2	3	4	5
H. Climate change will cause human health problems.	1	2	3	4	5
I. Climate change will cause severe weather.	1	2	3	4	5
J. Climate change will cause economic problems.	1	2	3	4	5
K. Climate change will cause the loss of wildlife species.	1	2	3	4	5
L. Climate change will cause weather pattern	1	2	3	4	5

changes, such as droughts.					
M. No one knows what causes climate change.	1	2	3	4	5
N. Climate change is part of a natural cycle beyond human control.	1	2	3	4	5
O. Rapid increases in greenhouse gases are causing climate change.	1	2	3	4	5
P. Burning fossil fuels is one of the primary causes of climate change.	1	2	3	4	5
Q. The hole in the ozone layer is causing climate change.	1	2	3	4	5
R. Using fossil fuels like coal and natural gas for electricity production contributes to climate change.	1	2	3	4	5

Part G: Governance Questions

14. Please circle one answer for each question below.

	Not at all				Very Much
A. How much of a role do you think government programs <i>played</i> in the development of wood-based electricity generation in your region?	1	2	3	4	5
B. How much of a role do you think the government <i>should</i> play in promoting the expansion of forest resources for electricity production?	1	2	3	4	5

15. Please indicate your level of agreement or disagreement with the following statements. Circle one answer for each item.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. The government (e.g. Wisconsin DNR) will do an adequate job of enforcing laws to protect the environment if harvesting of forest resources for electricity production increases.	1	2	3	4	5
B. Government officials are responsive to the needs of this community.	1	2	3	4	5

Part H: Residential Firewood/Pellet Use

16. Please indicate your level of agreement with the following statements. Circle one answer for each item.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. The use of firewood or wood pellets to heat homes in my community is a good thing.	1	2	3	4	5
B. Use of firewood or wood pellets to heat homes in my community can be a low cost heating source.	1	2	3	4	5
C. Using firewood or wood pellets to heat homes in my community can improve the health of local forests.	1	2	3	4	5

D. Using firewood or wood pellets to heat homes in my community can lessen the effects of climate change.	1	2	3	4	5
E. Using firewood or wood pellets to heat homes can result in better forest management than using wood for electricity production.	1	2	3	4	5

Part I: Demographic Questions

We would like to ask you some final background questions. Your answers to these questions will allow us to determine the representativeness of our sample, and will be kept strictly confidential.

17. Do you or someone in your household own forest land?

- ☐ Yes (please go to Question #18)
- ☐ No (please go to Question #21)

18. How many acres of forest land do you own?

19. Do you allow harvesting of your forests for electricity production?

- ☐ Yes (please go to Question #21)
- ☐ No (please go to Question #20)
- ☐ I don't know (please go to Question #20)

20. Have you considered allowing forest resources to be harvested from your lands for electricity production?

- ☐ Yes
- ☐ No

21. Are you:

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

22. Which of the following categories represents your household's typical yearly total income? Please choose one answer.

- ☐ Less than \$25,000
- ☐ \$25,000-\$49,999
- ☐ \$50,000-\$74,999
- ☐ \$75,000-\$99,999
- ☐ Above \$100,000
- ☐ Prefer not to answer

Photo Credit: Getty Images/OJO Images RF

23. Are you involved with an environmental protection or conservation group (e.g. Friends of Lake Mohawksin, Lincoln County Lakes and Rivers Association, Lincoln County Sports Club, etc.)? Please choose one answer.

- ☐ Yes
- ☐ No

24. What is your highest level of education? Please choose one answer.

- ☐ Some secondary education
- ☐ High school degree
- ☐ Some college or university education
- ☐ Graduated from college
- ☐ Prefer not to answer

25. How would you describe your political attitudes? Please choose one answer.

- ☐ Very conservative
- ☐ Conservative
- ☐ Moderate
- ☐ Liberal
- ☐ Very liberal
- ☐ Prefer not to answer

26. Please indicate which of the following sectors provides the most income to your household. Please choose one answer.

- ☐ Agriculture
- ☐ Wood products and paper manufacturing
- ☐ Forestry or logging
- ☐ Bioenergy production
- ☐ Recreation and tourism
- ☐ Government employment and services
- ☐ Other: _____
- ☐ Prefer not to answer

27. Did the survey provide you with enough information to answer the questions completely and accurately? Please choose one answer.

- ☐ Yes
- ☐ No

Please provide an explanation of your answers or additional information that would help us understand your answers.

Thank you for completing this survey!

Please direct any questions about this survey to:

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Appendix C. Chapter 4 Interview Protocol

A. General

1. What organization do you work for? What is your position?
 - a. What is the purpose of your organization or its mission?
 - i. How does it achieve this? How is it structured?
2. How long have you worked for this organization?
3. Thinking specifically about wood-based bioenergy production in Wisconsin, what kind of involvement does your organization have? How has your organization contributed to the creation of wood-based bioenergy policies in the state?
4. Who else has contributed to the creation of bioenergy policies in the state (**Prompts:** governmental organizations, NGOS, etc.)? And what are their roles?
 - a. how would you assess how these different groups have been involved, and interacted with one another, to make bioenergy policy in Wisconsin? Are there things they've done well? Are there things they could have done better?
5. Who is not involved in policy creation that should be? And why?

B. Public Bioenergy Policies

TRANSITION: I'd like to ask you now about the bioenergy policies set at the state level.

6. What public policies that you know of are related to wood- based bioenergy production in the state?
7. Have you seen any changes to the way forests have been managed in recent years, since the introduction of the biomass harvesting guidelines in Wisconsin?
8. What do you like about the harvesting guidelines? What do you not like about the guidelines?
9. How do the biomass harvesting guidelines promote a sustainable harvest? **[Is it promoting or not? Is it effective or not?]**
10. **[Only those who are familiar with the guidelines]** How have the biomass harvesting guidelines changed since their creation in 2008?
 - a. How did the process of writing the guidelines change?
 - b. Have there been additional actors added to revise the guidelines?

- c. Why do you think revisions were or weren't necessary?
11. I just asked you about what you like and don't like. Now I'd like to ask you about what other people/groups maybe don't like. Has there been any criticism of the harvesting guidelines or other policies related to bioenergy production in Wisconsin?
 - a. If so, by who?
 - b. What are the criticisms?
 12. Which groups do you think are most impacted by the biomass harvesting guidelines? Are there groups that aren't really impacted?
 13. How are the local forest related industries handling the biomass harvesting guidelines? Have they seen any direct changes in their businesses due to the policies?
 14. What has been the response to the biomass harvesting guidelines by NIPF landowners?
 15. Can you talk a little bit about the supply chain of getting biomass to the plant from the forests? (what is the process? what equipment is involved?)
 16. What is the current price of biomass? (dry ton or wet ton) Is it competitive to other energy sources?

C. Certification Schemes- private policy

TRANSITION: Now I'd like to ask you about the role of private certification schemes in bioenergy development in the state.

17. When I say "certification schemes" what comes to mind? **[If don't know what they are, then skip rest of questions in this section]**
18. Have you seen any changes to the way forests have been managed in recent years, since the introduction of certification schemes?
19. What do you like about the certification schemes? What do you not like about them?
20. I just asked you about what you like and don't like. Now I'd like to ask you about what other people/groups maybe don't like. Has there been any criticism of certification schemes in Wisconsin?
 - a. If so, by who?
 - b. What are the criticisms?

21. How are the local forest related industries handling the certification schemes and their effect on supplying biomass for bioenergy production?
22. How do you think landowners have responded to the certification schemes? Do they like them? Do they use them? Why or why not?
23. Do you think certification schemes are fulfilling their purpose of monitoring a market and ensuring sustainable harvests? Why or why not?

D. Certification Bodies – Specific to stakeholders who work with/for certification schemes

(SKIP if the Individuals is not involved with certifications)

24. How is your organization structured?
 - a. What are the benefits associated with this organizational structure?
25. How does your organization define risk?
 - a. How do you define risk? Provide examples of risk?
26. Can you tell me about the process of handling risk?
 - a. Who has the final decision?
 - b. Who is involved?
 - c. Is there an opportunity to adjust to new knowledge?
27. What happens after the risk is assessed?
28. How often are the certification standards revised?
 - a. How are they revised? And who is involved in the process? Is it strictly industry or are scientists and governmental officials involved?

E. Certifications and Biomass

29. What role does certification have in the global bioenergy market?
30. Does the certification impact a landowners' ability to harvest biomass for bioenergy production? (if so, then in what ways?)
31. Has the introduction of biomass harvesting changed the way the certification is administered or managed?
32. Are the current certification standards sufficient to help monitor the biomass market? And ensure forest sustainability?
33. How much does the certification rely on the states or nations (U.S. and Canada) to provide sustainable management practices (i.e. BMPs)?
 - a. Are there places where the government's fall short when it comes to sustainable forestry?
34. What are the weaknesses/ strengths of the certification as it relates to biomass harvesting for bioenergy production?

E. Overarching Questions

35. What does the future look like for bioenergy production in Wisconsin?

36. Do you think there is enough wood in the region's forests to support utility-scale bioenergy production? Why or why not?
37. Who else is involved in creating policies related to bioenergy in the state of Wisconsin?
 - a. Can you provide contact information?
38. What are the barriers to bioenergy expansion in the state?
 - a. Is there market acceptance of bioenergy? (Are individuals investing in the renewable energy or the equipment needed to produce it? Do you see landowners asking for biomass removal on their lands for the purpose of bioenergy production?)
39. Why was working in a collaborative group to create the biomass harvesting guidelines important? (Advantages and Disadvantages)
40. Do you have any questions for us?