Chapter 2

Public opinion and wood energy

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HIGHLIGHTS

- Public opposition may delay or prevent wood energy projects, while support from local communities can facilitate and encourage timely operation of local projects.
- The development of markets and policies influences public opinion on bioenergy. Public opinion also influences markets and policies in a circular pattern.
- Citizen and stakeholder participation in bioenergy policies and public investments in bioenergy facilities have a powerful role in shaping public opinion on wood energy.
- Media, politicians, public figures, and celebrities, industry and lobby organizations, and NGOs are important influences on public views on wood energy.
- In many Western countries, including the US, the public has expressed preference for wind and solar systems over wood energy production as renewable energy sources.
- In Europe, public discourses around wood energy are aligned around several main frames: potential for green economic growth, energy security, rural development, and climate change mitigation.

- Air and noise pollution, loss of local or natural forests, higher electricity or fuel costs, and negative impacts on rural and forest-dependent people are typical public concerns associated with wood energy; however, communities hope to benefit from local wood energy projects.
- Perceptions of the ecological sustainability of wood energy, the equity of bioenergy policies, and the fair distribution of costs and benefits within and around wood energy webs are key determinants of public support for wood energy development.
- Field-based participatory research enables a comprehensive and dynamic understanding of public opinion of wood energy that can guide efforts to maximize social, ecological, and economic sustainability, enhance communicate with stakeholders, and provide a foundation for collaborative planning in bioenergy sites.
- Extension and outreach activities and inter-stakeholder dialogues can play a pivotal role in filling information gaps and encouraging public support for wood energy.

2.1 Introduction

As wood-based bioenergy continues to develop around the world, it will utilize forestlands in new ways and will have different effects on a number of stakeholders, including forest landowners, local communities, extant industries, policymakers, investors, and others. As more stakeholders become involved in the wood energy web, and as the general public becomes more aware of it, understanding public perceptions of and reactions to wood energy development will become increasingly important. In attempting to disentangle the multiple societal and environmental implications of wood energy development, which occur simultaneously in many places and on many scales, it is critical to acknowledge the variety of wood energy feedstock sources, methods of conversion from wood to energy, and products and end uses. Public perceptions of wood energy development can vary greatly based on these factors, as well as on personal knowledge of and experience with extant forest-based industries and emerging bioenergy technologies.

While current research efforts tend to focus on the biophysical (e.g. technical, chemical, engineering, agronomic, logistical) factors affecting the use of wood as a primary feedstock for bioenergy, relatively few studies have explored public perspectives on wood-based bioenergy. In this chapter, we review studies that document opinions regarding the positive and negative impacts of wood energy expressed by the public and other stakeholders, as well as present the opinions on wood energy of several prominent environmental and health nongovernmental organizations (NGOs) that

directly influence the public. We will also discuss how bioenergy policies and projects affect various groups of stakeholders differently. We organize the existing literature using an integrative analytical framework that acknowledges a diversity of perspectives and values, governance mechanisms and processes, and issues involving power and equity; we then condense these issues into a SWOT analysis that identifies the ways that the public perceives strengths, weaknesses, opportunities, and threats presented by further development of wood-based bioenergy.

2.2 Public opinion matters

There is growing recognition among various stakeholders, including industry representatives, researchers, policymakers, and others, that public opinion of bioenergy has important implications as bioenergy technologies develop and become operational (Wegener and Kelly, 2008; Plate et al., 2010; Susaeta et al., 2010; Dale et al., 2013; Johnson et al., 2013; Myllyviita et al., 2014). As noted by Virginia Dale, Director of the Center for BioEnergy Sustainability at the US Oak Ridge National Laboratory, at a conference hosted by the Bioenergy Systems Research Institute at the University of Georgia in May 2013: "These [bioenergy developments] must be socially acceptable. If people go to the pump and don't choose ethanol or if they don't want these facilities in their areas, this isn't going to work."

Though often overlooked by developers of bioenergy technologies, broad public support for bioenergy is critical at all stages of development, from planning to implementation, and it is instrumental to the successful establishment of a bioenergy industry for several reasons. First, public opposition can delay or derail specific bioenergy projects, while public support from local communities can facilitate and encourage timely operation of local projects. Second, while opposition to bioenergy development can limit the advancement of bioenergy policies by influencing policymakers to strengthen restrictions on or reduce incentives for bioenergy entrepreneurs, public enthusiasm can encourage policymakers to support and incentivise bioenergy development. Third, although weak consumer demand for bioenergy products can hinder development of both industries and policies, positive public opinions on wood-based bioenergy may increase demand, boost industry supply, and foster related development projects and bioenergy-friendly policies.

In the development of a bioenergy plant, like the implementation of any conservation or development project, certain stakeholders often have more power to shape outcomes than others. Even when the overall results are deemed positive, there are some who benefit more than others, and those who do not benefit at all or who bear disproportional costs. For example, the owners of and investors in a wood energy facility (such as a wood pellet mill) may become wealthy as the facility becomes operational at scale, while some of workers there are paid low wages; residents who live near the facility may be harmed

by increased noise and traffic and declining air quality as a result of numerous heavy transport vehicles. As Dale et al. (2013: 282) note: "a project can result in 'winners' and 'losers' who may be highlighted or overlooked depending on how the steps, sectors, and population segments are defined in the analysis." An approach that strives toward sustainability recognizes the potential for unequal distribution of benefits and costs associated with bioenergy development and seeks to incorporate the perspectives of all stakeholders, aims to give voice to underrepresented perspectives, and looks for solutions that address the needs of marginalized and minority stakeholders (Schelhas and Lassoie, 2001; Aguilar, 2012; Dale et al., 2013; Johnson et al., 2013). This is not only ethically desirable, but also pragmatic because marginalized stakeholders are often vocal and respond in a variety of different ways, including lawsuits or protests.

Local communities can, and have, organized against wood energy facilities and have delayed or prevented their construction (Upreti, 2004; Upham and Shackley, 2006; McCormick, 2010; Plate et al., 2010). Van der Horst et al. (2002: 123) describe "strong local opposition which resulted in a negative planning decision" for several biomass-fuel power plants in the UK (in Wales and Wiltshire). In the US, Maiorino (2013: 8) reports that:

> The US Chamber of Commerce stated that in 2011 more than 350 energy projects were delayed or abandoned due to public opposition, and the economic impact of these projects was estimated at about $1.1 trillion in GDP and 1.9 million jobs a year.

Upreti (2004: 788) believes that opposition by local communities is a major obstacle to biomass energy development, and that much of the problem stems from different framings of the costs and benefits of bioenergy development, mostly in terms of environmental justice:

> developers of biomass facilities often disseminate information about their proposed facilities from a utilitarian ethics perspective (e.g. focused on the economics and technical feasibility of the proposal) while opposition tends to come from a rights-based or equity perspective focused on the public risk perception.

Delays and abandonment (or relocation) of bioenergy projects are seen as successes by community opposition groups and as failures or setbacks by specific companies and by the biomass and renewable energy sector as a whole.

Opposition to bioenergy, often spurred and endorsed by the popular media, can challenge the legitimacy of bioenergy and limit public policy options (McCormick, 2010; Johnson et al., 2013). Failures of proposed bioenergy facilities, whether due to public opposition, lack of funding for necessary research and development, or technological problems in scaling up, lead to

further public disillusionment, coloring the way people feel about the potential of future success with bioenergy. In a study assessing public preference for forest-based energy in the southeastern US, Susaeta et al. (2010: 708) note that:

> Understanding present and future individual preferences for bioenergy is an important tool for policymakers. Our results support the initiation of a consistency policy instrument such as the Renewable Fuel Standard (RFS), aiming to produce 15.2 billion gallons of renewable fuels by 2012. However, it also underscores the need for federal or state governments to continuously reinforce in consumers the environmental benefits associated with biofuels. Although we find that individuals are willing to pay a premium for biofuels, periodic revisions of these studies are needed to ensure policies reflect changing public perceptions and preferences.

Politicians, ultimately accountable to the public, carefully and strategically choose the policy options they promote and the rhetoric they use to sell them to the public. However, politicians responsible for legislating bioenergy policies often find themselves caught between constituencies and are themselves directly influenced by their own perceptions of both bioenergy and public opinions on it.

Finally, as noted by Dale et al. (2013), public opinion about bioenergy directly affects markets and public policies. Development of markets and policies in turn influences public opinion on bioenergy in a circular pattern. Several studies have specifically addressed factors affecting consumer acceptance of ethanol-blended gasoline, including fuel cost, environmental impacts, vehicle performance, and effect on food prices (Ulmer et al., 2004; Skipper et al., 2009). Wegener and Kelly (2008: 114–115) note that:

> For many new energy technologies, new regulatory bodies and statutes will be necessary, and policies governing the economic risks for investors will have direct effects on whether private investment occurs and to what extent. As the next generation of energy sources comes online, customer acceptance may also determine the extent to which policy-makers and industry support the widespread development, and ultimately the economic feasibility, of the new technologies.

Extensive boycott of bioenergy products and facilities could influence preferences beyond local or regional boundaries, decrease demand, and discourage future investments in wood-based bioenergy (see Figure 2.1). On the other hand, if consumers exhibit preferential behavior toward bioenergy, the industry will be encouraged to expand further. For instance, as purchases of flex-fuel vehicles (i.e. motor vehicles that can take up to 85 percent ethanol by volume) continue to increase,[1] the industry will be encouraged to develop.

Figure 2.1 Signs displayed by gasoline stations, Mississippi, USA

Both scenarios are dependent on the widespread availability of ethanol-free gasoline and of E85, which are both fairly limited in the US, thus restricting consumer choice (Bajpai, 2013). Consumer choice is also ultimately limited by policies mandating blending in transport fuels and the phasing in of energy produced from renewable sources into the existing energy portfolio. There is currently much policy uncertainty regarding the future of ethanol blending mandates in the US,[2] which will affect consumers' options and choices at the pump. Comparative examples from Brazil and Sweden show that consumers' price-sensitivity varies in different areas, and the lack of international markets for blend-fuels may lead to rising E85 prices and drive consumers to shift back to ethanol-free gasoline (Pacini and Silveira, 2011).

Several researchers have noted that both public participation in decision-making processes regarding bioenergy policies and public investment in bioenergy facilities are powerful factors influencing support for bioenergy, while exclusion (or perceived exclusion) from these processes is likely to cause negative feelings about bioenergy development and encourage opposition to both policies and individual industries (Devine-Wright, 2007; Neary and Zieroth, 2007; Fleeger, 2008; Nielson-Pincus and Moseley, 2009; Wright and Reid, 2011; Johnson et al., 2013; Maiorino, 2013). The network of bioenergy stakeholders is increasing and becoming more diverse as technologies develop and as policies affect choice and behavior; these new stakeholders have divergent, and sometimes conflicting, values and ideas about the sustainability of bioenergy that are shaping their perceptions and driving their actions. Johnson et al. (2013: 351) say that sustainability goals are "value-driven [and] will vary across affected parties and be contested." They also state that:

> Negotiations that include diverse perspectives will be more likely to identify social values and issues that are perceived to be important, and being part of a decision process often leads to greater acceptance even if particular

> views do not prevail. Although sustainability does not mean that every perspective will "win," it does mean that environmental, economic, and social goals are recognized as critical to the system as a whole . . . Bioenergy, which brings together very different social, policy, and technical communities, epitomizes the needs of diverse decision making processes. (Johnson et al., 2013: 351)

The participation of individual investors, as well as public investment, in wood energy projects is also critical for the development of new wood-based bioenergy technologies. Aguilar (2009: 2298) focuses on the role of private investors in the economic sustainability of wood energy, stating that: "Favorable prospects or energy prices coupled with policies that promote competitiveness may facilitate investments in the development of the wood-based energy sector."

Opposition to bioenergy often takes the form of what is known as Nimby (Not in My Back Yard) behavior. Nimbyism presents well-documented challenges for development of renewable energy technologies, including woody biomass facilities (Devine-Wright, 2011). While Nimbyism is typically associated with cases in which "middle-class suburban residents oppose any development that might negatively impact their property values and lifestyle" (Vandehey, 2013: 248), Nimbyism should not be immediately discounted or dismissed. Sincerely addressing the concerns expressed by those people most directly, and most negatively, affected by bioenergy projects represents the heart of environmental justice. As Van der Horst et al. (2002: 125) explain:

> It may be tempting for scientists to dismiss local public concern about such a seemingly benign development as a biomass-to-energy plant. Local public opposition may be labelled as NIMBY ("Not In My Back Yard") behaviour, and most health and safety fears may stem from ignorance. The pragmatic need to "appease the public" in order to secure planning permission, however, means that these concerns cannot idly be brushed aside as selfish or stupid. A closer look may in fact reveal that many concerns can be explained and understood in less dismissive terms.

Maiorino (2013: 8), a public relations strategist, suggests that companies siting facilities in local communities be more proactive in their early engagements with communities in order to gain initial support. Effective communication and the development of trust between bioenergy industry representatives, development planners, scientists and technical experts, and local community members are essential to the successful and sensitive resolution of public concerns (Van der Horst et al., 2002).

Participatory research processes that directly address the information needs of specific stakeholders can play an important role in understanding and addressing stakeholder concerns. Johnson et al. (2013: 346) state that:

"Understanding stakeholder motivations is central to this task, though the increasing diversity of bioenergy stakeholders and the uncertainty concerning the development of future bioenergy supply chains complicate this challenge." Participatory research, in which researchers design not only the project outputs in collaboration with members of the focal community, but also the research questions and the methods used to answer them, is a challenging approach, but can ensure that research efforts are both ethical and relevant (Tuhiwai Smith, 1999; Hitchner et al., 2009; Hitchner, 2012; Beebeejaun et al., 2013; O'Brien et al., 2013). Researchers, especially in partnership with universities, extension agents and outreach specialists, and other local actors, can also play a pivotal role as conveners of inter-stakeholder dialogues in which participants share and discuss multiple perspectives and priorities related to bioenergy (Plate et al., 2010; Hämäläinen et al., 2011; Johnson et al., 2013).

2.3 Factors influencing public opinion

Public opinion regarding wood energy is influenced by many factors and sources of information (see Figure 2.2). Arguably, the single greatest influence on members of the general public is the media in its multiple forms, including television, Internet news sources, newspapers, magazines, radio, and blogs (Wright and Reid, 2011). Media sources contain various types of information, from theoretical and expert knowledge to practical and experiential knowledge. The media affects the recipients' knowledge on the subject matter, but more importantly, their attitudes toward it. Both knowledge and attitudes shape citizens' decision-making, for example, when they are asked to express their opinions on biodiesel plant plans, or consumers' choices when they evaluate whether the higher price of ethanol-free gas is justified by higher energy density (and increased gas mileage per gallon) and potential prevention of engine damage caused by ethanol. In these situations, the opinion is affected by how meaningfully the bioenergy alternative is described and how openly the impacts of the choice to the individual and to the surrounding production and consumption systems are assessed.

Popular media stories about bioenergy are often negative, many focusing on the adverse effects of biofuels on the global food supply, whether biofuels are produced directly from food crop feedstocks or from feedstocks such as wood that may require the clearing of more arable land as biofuel demand increases. Professional media sources, such as trade and academic journals and university research publications, in turn, tend to promote certain industries and companies and provide updates on the state of the field; in many cases, they tend to focus on positive technology and policy developments and breakthroughs. For example, the Finnish magazine *Practical Farmer* promotes the discourse of wood-based bioenergy and decentralized local wood energy systems with a positive and encouraging tone (Huttunen, 2013: 47–51). Popular magazines, journals, and newspapers aimed at a highly educated audience in

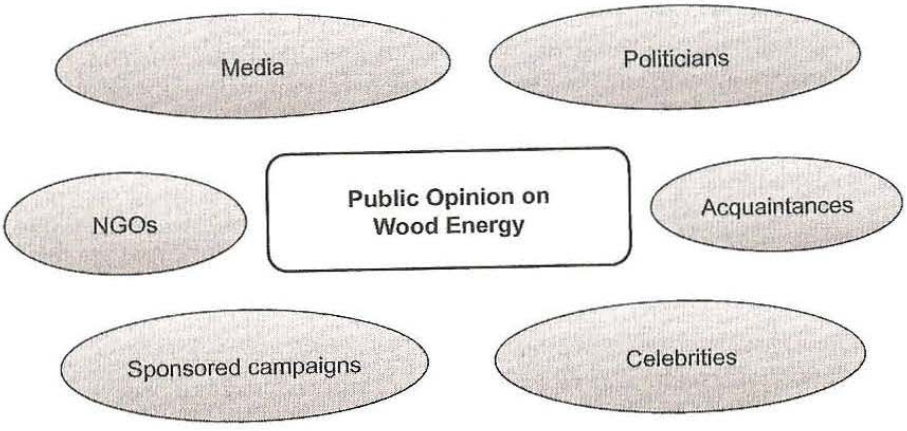

Figure 2.2 Framework identifying information sources affecting public opinions of bioenergy

the US and Europe, such as *The Economist*, *Forbes*, and *The Guardian*, have presented various perspectives in articles about wood energy (*The Economist*, 2013; McMahon, 2013; Starkey, 2013).

The media also plays a role in encouraging support for or opposition to bioenergy projects in particular communities. Referring to public protests or concerns regarding the siting of local bioenergy facilities, Sims (2003: 365) notes that "social barriers need to be overcome in order to obtain local support and resource and planning consents, particularly where a waste-to-energy plant is planned, often being subject more to emotional judgment in the media rather than to any scientifically-based reaction from a well-informed public." Skjølsvold (2012: 513) provides insight into the source of moral claims and emotional judgments found in popular news media; he claims that most studies of media coverage of renewable energy "describe the media as a watchdog, siding with the public on controversial issues where authorities and industry are adversaries whose interests are questioned by the news media." Elaborating on that point, he investigates how popular newspapers in Sweden and Norway, two countries in which bioenergy plays a vastly different role,[3] seek to ascribe meaning to bioenergy. He states that:

> The newspapers are likely to evaluate bioenergy normatively, ascribing meaning that contains judgment. The newspaper coverage can be read as part of the collective domestication of bioenergy; as producers of meaning and sites of domestication, the newspapers take part in the technology diffusion process.
>
> (Skjølsvold, 2012: 513)

So although it is well understood that drama sells newspapers (and television and Internet advertising slots), the motivations for media outlets to portray the story one way or another are complex and, especially in the case of small, local newspapers, highly dependent on individual writers and editors.

There has also been heavy media attention on high-profile scandals in renewable energy such as "the Solyndra debacle" (Hemingway, 2011; McLendon, 2012; Devaney, 2013) and notable failures such as Range Fuels, which would have been the world's first commercial-scale cellulosic ethanol facility, using pine trees as its feedstock, but which produced only one batch of methanol before going bankrupt. Cases such as these have received ample press coverage and have had a significant impact on how people view the viability of large-scale renewable energy (Hitchner and Schelhas, 2012). In a study on media coverage of biofuels in the *New York Times* from 2006 to 2008, Wright and Reid (2011: 1397) note shifts in the media framing of biofuels, as "biofuels specifically, and renewable energy more generally, is a topic that is mobilizing people around environmental and lifestyle values"; however, they also note that media framing of biofuels is "teeming with friction and struggle because of the unsettled nature of biofuels." Similarly, media discourse analysis from the Netherlands between 2000 and 2008 (Sengers et al., 2010) also provides evidence of shifts in media discourse on biofuels, from a positive focus on opportunities for economic and technological advancements to a more negative one focused on threats to the environment and human-well-being. This discursive shift in the media has significantly contributed to public resistance to biofuel development.

Politicians can influence the general public when they speak about renewable energy, including wood-based bioenergy, as an alternative to fossil fuels. The issue of national security also is a common topic in the discourse of politicians that emphasizes replacing petroleum imports with locally generated energy. In the US, energy security and energy independence have long been part of the rhetoric of politicians, particularly those seeking the White House, dating back to Richard Nixon (Bryce, 2008). This language has intensified in the US since the terrorist attacks of September 11, 2001. The call for energy independence crosses party lines. For instance, in 2006, George W. Bush lamented the US's "addiction to oil," while in 2007, Barack Obama called for the need for Americans to be free from the "tyranny of oil" (Bryce, 2008). President Obama is currently promoting an "all-of-the-above" strategy for reducing inputs of foreign oil, including government support for bioenergy research and development (Organizing for Action, 2013). In a speech given on June 25, 2013, President Obama revealed his Climate Action Plan, which directly aims to reduce emissions from power plants (especially coal-based plants) and promote the development and commercialization of next-generation biofuels such as cellulosic liquid transportation fuels by supporting the Renewable Fuel Standard, which requires blending of renewable fuels into petroleum-based fuels (Neeley, 2013). On the other side of the Atlantic Ocean, the EU's Energy

Action Plan also highlights energy security, which in the European case is heavily connected with geopolitics and (inter)dependence with Russian gas pipelines (Umbach, 2010). Within this frame, renewable energy, including wood-based bioenergy, has become a specific EU policy domain, but the Union still struggles with public acceptance of governance efforts and deeper integration of European energy policy (Hildingsson et al., 2012). As noted by Cacciatore et al. (2012: 38): "Citizens rely on their ideological beliefs as heuristic cues when coming across debates in the political arena; as a result, certain subgroups can be highly susceptible to persuasive appeals by political elites."

Other public figures and celebrities have highlighted the ecological and social benefits of bioenergy, particularly of biodiesel and ethanol. Many musicians advertise the fact that they run tour buses on biodiesel or personally drive flex-fuel or hybrid vehicles. A short list includes Willie Nelson, Bonnie Raitt, Daryl Hannah, Neil Young, Pearl Jam, Red Hot Chili Peppers, Sheryl Crow, Nora Jones, and Korn. Actors and TV personalities such as Jay Leno, Woody Harrelson, Morgan Freeman, Julia Roberts, Orlando Bloom, Emily Blunt, and Claudia Schiffer have also been outspoken on the benefits of bioenergy (de Guzman, 2007). Chuck Leavell, best known as a keyboardist for the Rolling Stones, lives in the southeastern US on a forest plantation and is a vocal and influential proponent of wood-based bioenergy.

There have also been public awareness campaigns on bioenergy targeting specific groups of people; one particularly interesting campaign promoting bio-ethanol in the US involves National Association for Stock Car Auto Racing (NASCAR) fans, a conventionally conservative group not commonly associated (by non-fans) with environmental values. NASCAR is facilitating a collaboration between American Ethanol and the Richard Childress Racing Team and employing well-known current and former drivers as spokespeople for the company and the industry to educate race fans about the positive aspects of corn-based ethanol; they are reporting success in this persuasive endeavor (Wegener and Kelly, 2008; Smith, 2011; American Ethanol, 2012). As this case exemplifies, trade and lobby organizations, consisting of and funded by industry partners, have heavy influence on the general public, and both "Big Oil" and "Big Ethanol" spend millions of dollars on advertising in the US to convince people that ethanol is either a very good thing or a very bad one (Mick, 2013a, 2013b).

Environmental NGOs have expressed a range of stances, from staunchly opposing wood-based energy (Dogwood Alliance, Natural Resources Defense Council, Greenpeace) to more measured views (National Wildlife Foundation, Sierra Club) that see bioenergy as an energy option if appropriate measures are taken to ensure sustainable forest management and renewability. Meanwhile, a number of public health organizations, including the American Lung Association (ALA), American Academy of Family Physicians (AAFP), and Physicians for Social Responsibility (PSR), have all publicly commented on the negative effects of wood-burning energy production facilities on human

health. Their positions are more fully explored in the section of this chapter on NGO stakeholders. Other sources of information on wood energy within communities include: local foresters and extension agents, industry representatives, friends, neighbors, landowners' associations, civic clubs, municipal and regional leaders, and community interest groups (Plate et al., 2010; Rossi and Hinrichs, 2011).

2.4 Conceptual background: ACSC (Advancing Conservation in a Social Context) Integrative Framework

The term "public opinion" calls to mind the relatively simple results of opinion polls that are often reported in the media. Empirical research on public perspectives on energy technologies—including but not limited to renewable energy—have typically relied on quantitative social science methods such as mail surveys and questionnaires and "only on rare occasions are they informed by theoretical frameworks from social science disciplines" (Devine-Wright, 2007: 3). In addition to the demographic data (age, gender, income, etc.) and the contextual data (type and scale of energy technology, as well as spatial context and institutional structure) that other research studies on public opinion have documented, Devine-Wright (2007) draws from environmental psychological theory (Black et al., 1985; Guagnano et al., 1995) and adds a third level of analysis, which he calls "social-psychological" (which includes knowledge and direct experience, environmental and political beliefs, and attachment to place) (see also Wegener and Kelly, 2008). Delshad et al. (2010: 3414) also call for more attention to the ways that biofuels are "framed" by various actors; they claim that: "There is also no research on which broader normative 'frames' (i.e. narrative arguments linking biofuels to ideals like civic duty, economic security, or environmental protection), including those present in the media and scientific discourse about biofuels, shape public attitudes." They also note that it is unclear in the literature whether, or in which cases, public opinion is based on solid scientific information, and "most studies provide little information about *why* individuals support or oppose" biofuels (Delshad et al., 2010: 3416, emphasis in original).

In order to gain a more nuanced understanding of not only how members of the general public view bioenergy, but also the reasons why, it is vital to examine how public opinion is formed, how it differs across groups of people, and how it operates in social and political contexts to influence decision-making. As mentioned previously, a multiplicity of influences shapes people's perceptions about bioenergy; however, people are exposed to them in different ways and react differently, based on personal experiences, forms and levels of knowledge, types and levels of education, and integration into a specific social circle of friends, family, peers, and colleagues whose opinions they hear and take into consideration.

To address the complexity resulting from many unique perspectives that make up "the public" and "the stakeholders" in bioenergy development, we use the Integrative Framework developed by the Advancing Conservation in a Social Context (ACSC) research initiative (Brosius and Campbell, 2010; McShane et al., 2011; Zia et al., 2011; Hirsch et al., 2013). ACSC was premised on the recognition that conservation problems are complex and that decisions about conservation and development inherently involve trade-offs (Faith and Walker, 2002; Adams et al., 2004; McShane and Wells, 2004; Dahlberg and Burlando, 2009). These trade-offs are experienced and understood from multiple perspectives (Brosius and Russell, 2003; Koontz and Johnson, 2004; Norton, 2005; Robinson, 2011), and each perspective highlights certain elements of complex problems while obscuring or ignoring others (Hirsch, 2009; Hirsch et al., 2011; Hirsch et al., 2013). ACSC members collaboratively produced an Integrative Framework to help navigate this complexity and promote multiple and context-dependent pathways for problem solution (see Figure 2.3).

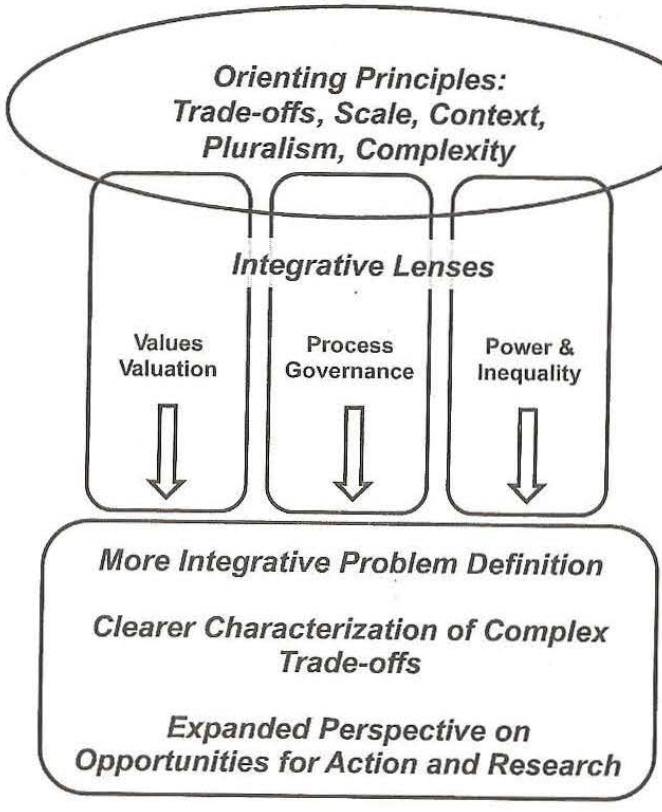

Figure 2.3 The ACSC Integrative Framework examines issues through different lenses to make evident complexity and trade-offs

Source: Hirsch et al. (2013)

We suggest that the ACSC Integrative Framework is a useful conceptual and analytical tool that can help clarify the factors influencing public opinion on bioenergy (Hitchner and Schelhas, 2012; Hirsch et al., 2013). We have adapted it for use in this chapter as an analytical framework for examining the literature to date on public opinion of bioenergy, wood energy in particular. Each of the three conceptual lenses of the Integrative Framework—values and valuation, process and governance, and power and inequality—focuses attention on specific aspects of public opinion on wood energy. Doing so provides a more dynamic understanding that takes into account the often changing or seemingly contradictory nature of public opinion on wood-based bioenergy and highlights how decision-making processes engage public opinion and stakeholders:

1. The *values and valuation* lens highlights the multiplicity of values underlying opinion about an issue, the ways that different values may relate to each other and are comparable, and the patterns of distribution of multiple values across stakeholder groups.
2. The *process and governance* lens exposes the range of processes through which different perspectives are engaged in decision-making, focusing on who defines the public interest and how they do so.
3. The *power and inequality* lens brings into focus the ways that complex problems, underlying values, and decision-making processes are carried out and interpreted against historical and structural patterns of inequality in which groups of people have more or less opportunity to express their values or participate in decisions.

Viewing public opinion of wood energy through these three lenses enables a nuanced understanding that takes into account the multiple perspectives and ways of engagement of different stakeholders. It is designed to open up new avenues for informed problem definition, discussion, and decision-making as wood energy development continues worldwide.

2.4.1 Values and valuation: individual public opinion and values

Public opinion about bioenergy is complex, as different components of a bioenergy system touch on a wide array of issues pertaining to people and the environment. Debates about these issues are rooted in multiple, and often conflicting, values and systems of valuation, as well as in specific social and ecological contexts. Given the multiplicity of technologies and feedstocks associated with bioenergy, it is also unlikely that people will have a fully formed opinion of wood-based bioenergy that holds steady across a wide range of circumstances. Rather, producing energy from renewable sources is an instrumental way to provide a key ingredient of modern life, and bioenergy

will be evaluated in comparison with fossil fuel and other renewable energy options in terms of the way it affects a number of core values such as human health and well-being, risk and security, forest and landscape values, and the global environment and climate. West et al. (2010) grounded their study of public perception of renewable energy policies in the UK in cultural theory, enabling them to assess opinions on these policies in connection with worldviews, personal energy consumption behaviors, views on the causes and effects of climate change, and valuation of landscape aesthetics. Kempton et al. (1996) suggest that people hold core values in mostly incommensurable value spheres, and that the way values are compared and traded off across these value spheres is highly context-dependent. In situations where decision-makers must try to balance human well-being and environmental protection, the specific social and ecological contexts often affect the ways that stakeholders frame issues and draw upon certain value spheres in order to influence outcomes.

Perceptions of bioenergy, positive and negative, are often context-dependent, and responses vary with place, demographics, knowledge, and personal and shared experiences (Kempton et al., 1996). It is also not uncommon for people to present multiple and contradictory positions, as they are influenced by multiple sources of information and experience (Schelhas and Hitchner, 2012; Strauss, 2012). At the same time, researchers have argued that the public is generally unfamiliar with wood-based bioenergy, with large proportions of respondents in surveys indicating that they are not informed or knowledgeable (Wegener and Kelly, 2008; Halder et al., 2010, 2012; Plate et al., 2010). Low knowledge levels and weak preferences do not provide a strong basis for predicting people's behaviors or guiding policy development (Wegener and Kelly, 2008; Monroe and Oxarart, 2011). Nevertheless, sufficient research on public opinion and bioenergy across a diversity of bioenergy types has been done for us to begin to frame out the issues and value conflicts.

2.4.1.1 General opinion of biofuels and wood bioenergy

Previous studies on public opinion of biofuels have focused on various issues and have addressed different public concerns. Studies using choice experiments generally find people willing to pay a modest price premium for biofuels to address concerns about environmental issues and national security (Solomon and Johnson, 2009; Giraldo et al., 2010; Susaeta et al., 2010; Pires, 2011; Loureiro et al., 2013). There are misgivings regarding the use of food crops for biofuels (e.g. corn ethanol) and the potential this might have to raise food prices and negatively affect poor people (Delshad et al., 2010). Interestingly, there was equal or greater concern about the environmental impact of cellulosic energy. Delshad et al. (2010) documented concerns that collecting corn stover from the fields for use as a feedstock would lead to erosion; participants in this study also believed that cutting down trees for energy "just sounds like a

bad idea" (Delshad et al., 2010: 3420). This study also noted that people question the general renewability and energy efficiency of cellulosic energy, as well as the potential for pollution as a result of its production and use. In other studies, wood-based bioenergy's promises of renewability and energy efficiency and lowered emissions of greenhouse gases and other pollutants have also been questioned (Phelan, 2009; McCormick, 2010; Timilsina and Shrestha, 2011).

Delshad et al. (2010) found that people support government policies promoting bioenergy in the US because they perceived a need to diversify energy resources and because they believed that producers are disadvantaged by market conditions while taking risks for society's benefit. However, this support was tempered by opposition to government regulation in general and beliefs in free markets. Meanwhile in Europe, where bioenergy is generally highly accepted, bioenergy experts perceived that the prevalent concerns regarding the potential negative effects of forest bioenergy could be best mitigated by harmonizing European standards and developing certification systems, which would be assets for a competitive and sustainable bioenergy market (Magar et al., 2011). That may not be sufficient in all regions and all consumer groups, as evidence from Estonia (Ehrlich and Roodi, 2013) shows that at least for now, 80 percent of consumers are not willing to pay the price of renewable energy.

Stakeholders involved with forest bioenergy development rank it highly for its potential to promote energy security, because of the availability of forest biomass, and because it does not compete directly with food production (Dwivedi and Alavalapati, 2009). Nonetheless, there are indications that the general public prefers other forms of renewable energy and other sources of biomass to wood bioenergy. For example, Savvanidou et al. (2012), studying public opinion in Greece, found that people first preferred to save energy, then preferred other forms of renewable energy, before supporting biofuels. An Italian example (Cicia et al., 2012) shows that national survey respondents favored wind and solar energy above wood-based bioenergy. In a general survey of the US, overall opinion of biofuels was high (78.6 percent agreed that the use of biofuels in general was a good idea), but that the use of wood or wood chips, with a 55.4 percent favorable rating, lagged behind corn ethanol (70.6 percent) and switchgrass (69.9 percent) (Wegener and Kelly, 2008). Delshad et al. (2010) found that in a county in Indiana, deep in the Corn Belt of the US, there was majority support for biofuels (62 percent), but that this trailed support for energy conservation (82 percent) and solar energy (97 percent). Similarly, Pires (2013) found that in the southeastern US, trees were the least acceptable sources of biofuels (with GMO trees less acceptable than conventional trees), ranking behind various agricultural crops, wastes, and algae.

People express a variety of potential benefits and concerns related to bioenergy. Monroe and Oxarart (2011) found, in a survey in a Florida county,

that the respondents believed that the most important benefits from a biomass electricity project were use of waste wood and maintenance of local forests, while the most important concerns were loss of local forests, air pollution, and higher electricity costs (note the complex and conflicting opinions about bioenergy's impact on forests). Söderberg and Eckerberg (2013) found that four general "frames" are used to advance bioenergy in Europe: potential for green economic growth, enhancement of energy security, development in rural areas, and as a mechanism to address and mitigate climate change. Within these frames, potential conflicts arise related to several issues: maintenance of natural forests, concerns for forest-dependent people, and climate change impacts. There was also recognition of the potential benefits of reducing fire risk and creating opportunities for new mixed tree/crop plantings to enhance landscape biodiversity and sustainable land use. Söderberg and Eckerberg (2013) note that managing trade-offs and synergies will depend on rules, standards, and incentives, and that there are concerns with how sustainable bioenergy practices will be defined. Peele (nd*b*) discussed bioenergy with agricultural and environmental stakeholders in the Midwest and northeast US and found that while the two groups shared concerns about soil and agricultural sustainability and markets, the environmentalists had concerns about climate change and the use of GMO plants that were not shared by farmers. In Norway, Sopha et al. (2010) found that households using wood pellet heating and households using electric heating differed with respect to demographic factors, communication among households, the perceived importance of heating system attributes, and the applied decision strategy, suggesting considerably different policy intervention strategies for these two groups. In Finland, Jalas and Rinkenin (2013) analyzed the daily routines of domestic heating system users and recognized that while broader domestic use of wood is compromised by time and convenience limitations, wood-based heating systems may create meaning and rhythm in rural dwellers' everyday lives. Rouvinen and Matero (2013) studied Finnish homeowners' preferences and showed evidence that investment price is the main attribute affecting domestic heating system selection, but that non-financial attributes also had a considerable effect, shedding light not only on the homeowners' attitudes, but also on the operational environment: what the alternatives are and what is easily available.

2.4.1.2 Communities and bioenergy facilities

Research on bioenergy facilities of all types finds a mix of opinions on local impacts of bioenergy development, both positive and negative. Selfa et al. (2011) studied communities with ethanol plants in Iowa and Kansas and found that, in general, facilities were seen as adding jobs to the local economies, but not reducing local poverty. While most people felt that facilities had benefits that were greater or equal to costs, they expressed concerns about odors, air

pollution, truck traffic, and health effects. In areas of water scarcity, people were worried about the increased demand for water that feedstocks and facilities would require. While there were concerns about the long-term viability of the biofuels industry and fears that the town might suffer in a future downturn, people still do not want their communities to be passed by in the development of the emerging bioenergy industry (Selfa et al., 2011). In studies of biomass power plants in the UK, there were objections to truck traffic, fears of facilities turning into regional waste handling facilities, and a tendency to associate biomass electricity with incinerators or other sources of dirty energy. These types of concerns are often exacerbated by a lack of trust in developers and development agencies (Upreti, 2004; Upham and Shackley, 2006; Nielson-Pincus and Moseley, 2009; Stidham and Simon-Brown, 2011).

2.4.1.3 Woody feedstocks and forest issues

Some of the complexity of public opinion about bioenergy results from the diversity of feedstocks and methods of producing them, in addition to related land use and environmental concerns. In general, there is a clear preference for using waste wood and forest thinnings over trees grown specifically for bioenergy (sometimes called purpose-grown wood) (Plate et al., 2010; Pires, 2011). A number of researchers have tried to estimate the "social availability" of biomass from forests by modifying figures on total biomass availability, taking into account harvesting constraints, competition from other wood markets, and, in particular, forest owner objectives (Butler et al., 2010; Markowski-Lindsay et al., 2012; Wilnhammer et al., 2012; Gan et al., 2013). Butler et al. (2010) found that social factors (e.g. whether forest landowners prioritized recreation, aesthetics, and nature conservation, as opposed to timber production) were the most important potential reducers of biomass availability, with total reduction of more than 75 percent estimated for four northeastern states in the US. Markowski-Lindsay et al. (2012) found that higher prices for biomass would increase landowner willingness to sell biomass, but only modestly. Shivan and Mehmood (2010) found that landowners with high interest in wildlife and passing forestland on to their heirs are less supportive of bioenergy harvests, while forest landowners whose primary focus is on timber production are generally interested in bioenergy. Rossi and Hinrichs (2011) found that farmers have reservations about the influence and control of large corporations with interests in corn-based ethanol fuel. This could be an issue in forestry as well, as many timber producers consider trees as row crops on longer rotation. These studies demonstrate a divergence of support for and concerns about industrial bioenergy development among different types of landowners and crop producers. Most timber in the US is sold under short-term contracts for a one-time harvest of a specific timber tract, and bioenergy facilities may need long-term supply contractors to satisfy investors. However, Wilnhammer et al. (2012) found that even timber-oriented members of forestry

organizations were reluctant to sign long-term supply agreements because they like to maintain flexibility of harvest management over time. Finally, there are concerns in many regions about poorly developed biomass markets, logistics and supply problems, and the economics of using mechanized harvesting systems in smaller forest tracts and in fragmented landscapes (Puy et al., 2008; Rämö et al., 2009; Wilnhammer et al., 2012). At the same time, many recognize the potential benefits of bioenergy markets for addressing forest health and fire issues (Aguilar and Garrett, 2009; Monroe and Oxarart, 2011).

2.4.2 *Process and governance: decision-making processes and stakeholder perspectives*

In conjunction with the different values and systems of valuation held by various stakeholders, it is necessary to examine the various institutional frameworks, legislative structures, and regulatory mechanisms involved with decision-making about biofuels at different spatial and temporal scales. Public opinion on these governance mechanisms varies widely, and it is important to note that various stakeholders have different motivations for (and methods of) influencing the opinions of others. In this section, we will first describe several policies and regulations related to wood energy very briefly (see Chapter 7 for more information on public policy instruments influencing wood energy use in the US and Europe) and then focus on the ways that several prominent environmental and health organizations have expressed opinions and strategically framed issues in the public sphere as a means of influencing public opinion and decision-making processes. We have chosen to focus on these organizations, as opposed to other stakeholders such as industry representatives, lobbyists, and landowner associations, because of their potential influence on members of the public who are generally not as knowledgeable about or involved with existing forestry or bioenergy industries.

Special interest groups, such as NGOs, lobby organizations, or multi-stakeholder groups that aim to influence bioenergy policy (such as the Roundtable on Sustainable Biomaterials) operate at different scales (community, regional, national, international). Numerous studies regarding governance of biofuels have been conducted at different spatial and temporal scales: global (Hitchner, 2010; Maclin and Dammert Bello, 2010; Van der Horst and Vermeylen, 2011), national (in this case, the US) (Bourgeon and Trueger, 2010; Gillon, 2010; Bailis and Baka, 2011), and regional (e.g. the southeastern US) (Evans and Cohen, 2009; Abt et al., 2010; Bailey et al., 2011). In the US, the US Energy Policy Act (EPACT) of 2005 and the Energy Independence and Security Act (EISA) of 2007 mandate the use of renewable energy sources. EPACT established a mandatory Renewable Fuel Standard (RFS), which was expanded by EISA. EISA mandates a sixfold increase of ethanol usage in the US by 2022 (to 36 billion gallons a year, of which only 15 billion gallons can be corn ethanol; advanced biofuels, including cellulosic ethanol,

account for the other 21 billion gallons) (Halvorsen et al., 2009). However, the US lacks a national bioenergy policy, and states have individual mandates and incentives for bioenergy development. For example, Minnesota required that the amount of ethanol in gasoline increase from 10 percent to 20 percent in 2013, and that by 2015, 25 percent of ethanol must be cellulosic, while Wisconsin has a goal of 25 percent renewable transportation by 2025 (Halvorsen et al., 2009). Michigan offers E85 infrastructure development grants, fuel tax reduction for high blend fuels, and renewable energy tax incentives (Halvorsen et al., 2009), while the Missouri Qualified Fuel Ethanol Producer Incentive subsidizes ethanol made from Missouri agricultural products (Aguilar and Garret, 2009).

Bioenergy governance in the EU, which has been intensively developed since early the 2000s (Rohracher et al., 2004), includes mandates for renewable energy that directly affect production of wood-based bioenergy products (especially wood pellets) in North America and around the world (di Lucia, 2010; Sharman and Holmes, 2010; Upham et al., 2011). Several studies have noted concerns among members of the general public in Finland (Pätäri, 2010), the United States (Selfa et al., 2011), and other countries that the forest bioenergy business is dependent on policy and that prospects could change quickly with policy change; the unpredictability of policy, particularly in the EU, is a factor heavily influencing public opinion about the long-term viability of forest-based bioenergy. Also, Söderberg and Eckerberg (2013) note that EU bioenergy policy potentially conflicts with EU targets for biodiversity conservation and land use change, which further complicates public perceptions of the ecological sustainability of forest-based bioenergy.

Certification is a form of market-based governance that is being incorporated into bioenergy development in order to ensure renewability and sustainability of energy feedstocks. There are numerous certification systems for forest and forest products in place around the world; these include (but are not limited to): SFI (Sustainable Forestry Initiative), FSC (Forest Stewardship Council), American Tree Farm, SmartWood (Rainforest Alliance), PEFC (Programme for the Endorsement of Forest Certification), and the Green Gold Label (Woodwork Institute, 2004; Newsom and Hewitt, 2005; Newsom et al., 2006; Overdevest and Rickenbach, 2006; Van Dam et al., 2008; Ginther, 2011; Gan and Cashore, 2013). Requirements or incentives for certification will influence landowners' forest and agriculture management decisions, as well as public perceptions of wood-based bioenergy. Monroe et al. (2011: 82) note that: "One way to mitigate concerns about forest sustainability may be through forest certification systems that establish criteria for sustainable forest management." However, others cite concerns about the certification of sustainable biofuels because of extra cost and burden to producers (Selfa et al., 2011: 1387). As noted by Magar et al. (2011), there appears to be a tension: while bioenergy experts tend to see certification as a solution, entrepreneurs or landowners may see it as a problem. For the general public, though,

certification could be a way to ensure sustainability and thus mitigate possible concerns and improve the general social acceptability of wood-based bioenergy.

2.4.2.1 Environmental and health NGO framings of wood-based bioenergy

While some influential organizations have circulated position papers expressing stances that are firmly in favor of or opposed to biofuel development, many recognize that the ecological, economic, and social sustainability of forest-based bioenergy is highly context-dependent. Scale matters, and many environmental NGOs that oppose large-scale bioenergy development recognize the benefits of a small-scale, locally produced and consumed energy source. At the same time, because of the high cost of building new biofuel production facilities, large-scale production is often necessary to justify the expense (and often to meet the requirements for subsidies and other financial incentives). Feedstock also matters. For example, many environmental NGOs and members of the public are more supportive of native grasses and trees as a feedstock than genetically modified ones that may harm surrounding ecosystems. However, private companies are investing heavily in biotechnology, and policymakers often feel pressure to support these developing technologies and entrepreneurial companies. In this section, we will briefly summarize the positions on wood-based bioenergy taken by several prominent environmental and health NGOs in the US and the EU and the framings that they use to describe the benefits and threats of wood-based bioenergy in attempts to influence the general public.

The issue of carbon and its relation to climate change is a major concern among environmental NGOs, and several of these that oppose using wood for energy particularly question "the myth of carbon neutrality"; these include, but are not limited to, the Dogwood Alliance, Greenpeace, Carbon Trade Watch, Energy Justice Network, and the Partnership for Policy Integrity. Many have noted that while they support efforts to reduce use of fossil fuels, they question the use of wood as an energy source. Several major international environmental NGOs in Europe (or with branches in the EU)[4] have collaborated and issued joint statements on wood energy, outlining their particular concerns:

1. the long "payback period," during which more carbon is released into the atmosphere than is sequestered by replanted trees, which is critical as we get closer to the "tipping point" in climate change;
2. inaccurate GHG accounting systems that mistakenly assume zero net emissions from biomass energy;
3. destruction of forests in areas both close to and far from biomass facilities; and
4. the limited nature of sustainably produced biomass.

(FERN et al., 2012)

A joint White Paper produced in 2012 by Friends of the Earth, Greenpeace, and the Royal Society for the Protection of Birds (RSPB) echoes these concerns, specifically in reference to the 2012 UK Bioenergy Strategy, which called for developments in bioenergy that will "deliver genuine carbon reductions that help meet UK carbon emissions objectives to 2050 and beyond" (RSPB et al., 2012: 2). In 2009, five prominent environmental NGOs in Europe[5] wrote a joint letter to the Director General of the Directorate-General for the Environment of the European Commission urging the European Commission to require legally binding sustainability criteria for producers of biomass used for heating and electricity similar to the legally binding criteria for liquid biofuels and to refuse to compromise by promoting voluntary standards (FERN et al., 2012).

The US-based National Wildlife Federation (NWF) acknowledges that "bioenergy is one homegrown source of renewable energy that could help meet some of our energy needs," but cautions that "it must be produced in a way that has long-term economic viability, helps address climate change, and protects and enhances habitats and ecosystems" (Glaser and Glick, 2012: 1). NWF claims that: "Future bioenergy development should encourage ecological restoration and improve wildlife habitat through the use of ecologically beneficial biomass feedstocks such as waste materials and sustainably collected native plants and forest residues" (Glaser and Glick, 2012: 2). They are concerned about the escape of exotic, invasive, and/or genetically modified organisms (GMOs) that are current or potential bioenergy feedstocks, especially energy grasses such as miscanthus, Napier grass, and giant reed, as well as trees such as eucalyptus. Although several commercialized versions of these species have been genetically modified via a gene slice that is supposed to restrict their ability to reproduce, some question whether proof of their sterility has been ascertained (Glaser and Glick, 2012: 18–20). NWF applies the phrase "the myth of sterility" in their widely distributed report on bioenergy as a way to influence the public to question the industries' claims that sterile hybrids will not pose any harm to native ecosystems. Numerous other studies also demonstrate public concern around the world about GMOs, whether as food sources or energy feedstocks (Finucane, 2002; Nap et al., 2003; Miles et al., 2005; Delshad et al., 2010), and NWF strategically employs "the myth of sterility" to tap into widespread concerns held by the public about the invasiveness potential of genetically modified species and their potentially disastrous effects on local ecosystems.

The Dogwood Alliance, an especially vocal opponent of wood-based bioenergy in the US, states that "cellulosic ethanol, when looked at under close scrutiny is at minimum a false solution and, in the worst case scenario, a disaster for our forests that will exacerbate global climate change rather than combat it" (Quaranda, 2008: 1). Their report claims that increased demand for wood as an energy feedstock will lead to more forest destruction, "immense" water use for irrigation and refineries, water pollution, soil erosion, soil

compaction, reduced soil fertility, and increased air pollution. Industries' perceived need to reduce lignin in trees via genetic manipulation "could open the proverbial Pandora's Box of unintended genetic mixing of laboratory and wild trees" (Quaranda, 2008: 4), which could not only change natural trees, but also facilitate the spread of "super pests and diseases" and threaten the rights of landowners to even own the trees on their property (Quaranda, 2008: 7). They also claim that local communities face threats from the wood energy industry, including forest destruction, noise pollution, degradation of air and water quality, decreased property values, negative impacts on local forest recreation and tourism, and increases in dangerous truck traffic in rural areas (Quaranda, 2008: 8). In 2013, the Dogwood Alliance joined with 75 other environmental NGOs, including many local and regional NGOs, as well as large international NGOs such as Rainforest Action Network, Environmental Working Group, and BirdLife Europe, to call for an immediate moratorium on using whole trees for pellet production and in utility-scale biomass facilities, including co-firing with coal in existing power plants (Dogwood Alliance, 2013).

Greenpeace Canada is strongly opposed to using wood from natural forests as an energy feedstock, though they also noted a focus on scale in relation to the sustainability of wood-based bioenergy. They released a report in October 2011 (Mainville, 2011: 3) that explained that the assumption:

> on which bioenergy is premised—i.e. that woody biomass is infinitely available and that burning it is clean and carbon neutral—does not stand up to scientific scrutiny and needs to be revisited . . . Forest biomass cannot and should not replace fossil fuels on a large-scale.

The report does note that small-scale forest bioenergy can be sustainable: "Using mill waste and residue, such as sawdust and non-commercial wood chips, to replace fossil fuels for local, small-scale heating systems is the most efficient use of woody biomass" (Mainville, 2011: 2). However, they claim that using wastes from sawmills and logging residues is a gateway to using whole trees from large-scale clear-cuts of natural forests; they also state that "there is no such thing as 'waste' in a forest" and that large-scale extraction of all woody materials from a site has devastating and long-term effects on soil fertility, wildlife habitat, and the ability of forests to mitigate damage from acid rain. While they say that biomass-based energy is in no way worse than using fossil fuels, they advocate policies incentivizing energy conservation and wind, solar, and geothermal energy options.

Health organizations have also expressed concern over the effects of the combustion of wood for energy on members of the public, especially in areas where biomass burning facilities are located. They claim that particulate matter emissions from biomass burning facilities and trucks delivering wood to the facilities are harmful to health; they often cite a 2004 Scientific Statement by the American Heart Association entitled "Particulate Matter Air Pollution and

Cardiovascular Disease," which was updated in 2010 (Brook et al., 2010). In a letter to the House Committee on Energy and Commerce in 2009, the American Lung Association (2009) stated:

> The Lung Association urges that the legislation not promote the combustion of biomass. Burning biomass could lead to significant increases in emissions of nitrogen oxides, particulate matter and sulphur dioxide and have severe impacts on the health of children, older adults, and people with lung disease.

State chapters of the American Lung Association (ALA) have publicly opposed the construction of other biomass facilities in their respective states (ALA Massachusetts, 2009; ALA Georgia, 2010; ALA Florida, 2011); likewise, other health organizations such as the American Academy of Family Physicians (2010), Physicians for Social Responsibility (2010), Massachusetts Breast Cancer Coalition (2009), Massachusetts Medical Society (2009), and Florida Medical Association (2010) have also passed resolutions in their own organizations and disseminated information on the negative effects of burning biomass on public health. Public opposition by citizens' groups to wood energy facilities is often supported by public organizations such as these, which lend both scientific expertise and professional authority to opponents' arguments.

2.4.3 Power and inequality: who has the power to decide, and who are the winners and losers?

Various stakeholders (and the issue framings that they employ) have the power to guide bioenergy governance and decision-making processes and to influence public opinion on bioenergy, and this differential access to power is often rooted in historical structures and patterns of inequality. Here, we will summarize several aspects of power and inequality in bioenergy development identified in the literature on public perceptions of bioenergy:

1. environmental justice and differential effects of bioenergy development on vulnerable populations (including poor, minority, and elderly communities);
2. scalar distribution of the costs and benefits of bioenergy development; and
3. fairness and equity of various bioenergy policies, incentives, and mandates.

Perceptions of the general public related to these aspects of wood-based bioenergy development often have a strong impact on the social acceptability of wood energy in general and are often the most direct drivers of public opposition to specific wood energy facilities.

2.4.3.1 Environmental justice concerns

Bioenergy development has different effects on various stakeholders, from individual landowners and local communities to industry leaders and policymakers. In natural resource management and economic development, racial and ethnic minorities have often borne a disproportionate share of the impact or received few opportunities (Schelhas, 2002); this is also true for other vulnerable populations such as children and the elderly. It is not uncommon for the individual interests of minority stakeholders to be neglected when pursuing broad goals such as forest conservation or energy independence that are defined as being in the public interest (Schelhas and Pfeffer, 2008). Racial and ethnic minorities and limited resource landowners have often been underrepresented and underserved in forestry-related developments in the southeastern US (Schelhas, 2002; Schelhas et al., 2003). In particular, this is true both for African-American forest landowners (Schelhas et al., 2003) and African-American employees in forest product industries (Bailey et al., 1996; Bliss et al., 1998).

Bullard (2011) raises particular concern about racial equity related to the development of clean, green, and renewable energy, including biomass in the southeastern US, noting that facilities have been sited in poor black neighborhoods. Bullard (2011) has cautioned that "'green' biomass (like energy crops)" can have environmental justice impacts and expose poor and minority communities to more toxins from fertilizer application in bioenergy crop plantations and pollution of air and water surrounding biofuel production facilities (see also Fast, 2009; Hill et al., 2009). In a well-publicized case in Gadsden County, Florida in 2010, the Concerned Citizens of Gadsden County publicly opposed the Adage Biomass Project in Gretna, Florida (leading to its termination), which was to be located "in very close proximity to a 100 percent minority student population at Gretna Elementary School and a State of Florida women's prison, as well as residential neighborhoods and churches" (Floridians Against Incinerators in Disguise, 2010). Citing the links between incinerator dioxin and infant health, one of the most vocal opponents, Dr. Edward Holifield of Tallahassee, Florida, asked the Gadsden County Commission: "How high does black infant mortality have to get in Gadsden County, Florida before people are concerned?" In addition to racial minorities, other vulnerable populations are also exposed to potential air pollution from biomass facilities. In Florida, M.D. Marc Yacht (2012), retired Director of the Pasco County Health Department, noted that a new biomass-to-electricity facility, Gainesville Renewable Energy Center biomass electrical conversion project, would particularly endanger the state's high percentage of elderly residents, as well as people with existing lung and respiratory illnesses.

Several health organizations have also expressed skepticism over whether biomass energy companies will abide by standards of air pollution control that are adequate for protecting human health. For example, in a letter to

the leaders of Lowndes County, Georgia in 2010, the American Lung Association in Georgia (2010) states that:

> It should be noted that there appears to be a pattern nationwide of biomass plants being proposed for rural areas away from cities, where less protective pollution control restrictions and weaker permitting requirements apply. Plant proponents will say that they "meet the air pollution requirements," but the requirements themselves tend to be more lax.

Concerns such as these are often also directly related to environmental justice issues regarding why particular sites are chosen for biomass incinerators, and as mentioned, the siting of locations can have both real and perceived negative impacts on populations that are considered to be especially vulnerable and/or underrepresented in decision-making processes.

Further complicating the environmental justice aspects of bioenergy development are cases where industries, NGOs, city and county planning boards, and some local community members have collaborated in order to bring wood energy facilities into rural, minority, and underserved communities in order to provide jobs, promote rural development, and even set up profit-sharing mechanisms with communities, only to be met with opposition from other community members, as well as outside health and environmental NGOs. Such is the case in Jefferson County, Georgia, where a citizen group, Jefferson Environmental Defense Initiative (JEDI, a chapter of BREDL, or Blue Ridge Environmental Defense League) opposed the construction of North Star Jefferson Renewable Energy, LLC, a biomass facility that was located there largely as a result of efforts by the US Endowment for Forestry and Communities, an organization dedicated to the "health and vitality of the nation's working forests and forest-reliant communities" (www.usendowment.org/). The Endowment specifically chose this predominantly African-American area in order to benefit this underserved community and engaged the community early in the process and throughout the development process. The North Star website says of this partnership:

> North Star is excited about partnering with US Endowment for Forestry and Communities and the Development Authority of Jefferson County for this project. US Endowment, through Community Wealth Through Forestry, Inc., believes that a partnership with North Star can serve as a national model for "community asset creation" to not only provide new, family supporting jobs in the communities in which the projects are developed, but also provide a new market for low-value wood to benefit family forest owners in addition to acting as a hub to attract new businesses and jobs. We are aligned with these partners to bring both short term and long term jobs to the Jefferson County while stimulating the local economy.
>
> (http://northstarrenewable.com/index.php/projects/north-star-jefferson/faqs)

There was regional and local opposition to the plant, likely exacerbated by its permit to use up to 20 percent tire-derived fuel. Awareness of this led to heightened concerns about air pollution, particularly with regard to a nearby school, and environmental justice, because of the high poverty rate and the high percentage African-American population living near the plant (Jefferson Environmental Defense Initiative, n.d.; Zeller, 2012). An agreement was eventually struck to allow the plant to move forward, adding $1 million in additional costs through the installation of air monitoring equipment at the school, additional emissions control equipment, and direct payments to the litigating environmental organization (Howard Parish, 2012). This case exemplifies the complexities of environmental justice concerns about the siting of wood energy facilities, showing that even community engagement and promise of economic development may be insufficient in preventing opposition from some stakeholders.

2.4.3.2 Scalar distributions of costs and benefits

There are complex interactions between areas that supply raw materials for biofuels and areas that import them; this has led to scrutiny of extractive economies for their inequitable distribution of the costs and benefits of bioenergy development (Hornborg et al., 2007). For example, much of the demand for biofuels occurs in the global North, while the majority of biofuels are produced in the global South. The Global Forest Coalition (2010: 2) note that: "The demand for industrial wood bio-energy is causing large areas, especially in the South, to be taken over by monoculture tree plantations to serve the interests of the North." Marginalized indigenous communities are also disproportionally negatively affected by global demand for natural resources, exacerbated by growing demand for bioenergy. In 2010, 73 global, regional, and local NGOs and indigenous peoples' organizations representing 33 countries from Belgium to Sierra Leone called for the EU and EU member states to "immediately abandon all support measures for large-scale wood-based bioenergy production and agro-fuel production." They state that:

> Much greater pressures on forests and other ecosystems, on soils and freshwater as well as more land-grabbing for tree plantations are the certain consequence of a new global market in wood for bio-energy. The main victims are Indigenous Peoples and other forest-dependent peoples in the South, in particular women, who depend on access to forests for fuelwood and other local bio-energy sources for their families.
>
> (Global Forest Coalition, 2010: 2)

Despite public protests across the UK against large-scale biomass energy facilities, the government continues to import biomass and burn it, and "by 'overlooking' the emissions and land-related effects from growing biomass, a market is built on increasing deforestation, land grabs and carbon colonialism" (Zacune, 2012: 2).

Similar dynamics are playing out within the global North as well, as much of the current pellet production in the southeastern US supplies European markets (Sikkema et al., 2011; Dwivedi et al., 2011). The NGO Carbon Trade Watch criticizes subsidies from the UK government promoting wood-based biomass energy and the role of the UK government in importing biomass from areas in the US and Canada "that have already experienced high levels of deforestation and forest degradation from bioenergy" (Zacune, 2012: 2). In addition to directly increasing demand for wood from North American forests, European mandates requiring wood-based bioenergy:

> competes with North America's own wood bio-energy expansion as well as with previously established pulp and paper manufacturers. This displacement of North American paper production increases the likelihood of massive pulp mill and plantation expansion in South America, South-east and East Asia and southern Africa as well as in Russia.
>
> (Global Forest Coalition, 2010: 2)

Indirect land use change as a result of increased production of bioenergy (both first-generation biofuels from food crops and next-generation biofuels from non-food sources) is a major driver for landscape change in some of the world's most biodiverse and endangered habitats (Fargione et al., 2008; Searchinger et al., 2008; Keeney and Hertel, 2009; Lapola et al., 2010; Meyfroidt et al., 2013).

As noted, there is greater public acceptance of wood-based bioenergy that is locally produced and consumed, rather than exported to other countries. A rather successful bottom-up emergence of wood-based bioenergy cooperatives and local heating systems has been seen in last two decades in Finland, where primary wood energy production is part of sustainable farming livelihood and benefits both individual entrepreneurs and the wider community (Okkonen and Suhonen, 2010; Huttunen, 2012). According to Åkerman et al. (2010), introducing "young forest" as a new forest management category in Finland enabled the establishment of new discourse practices that have evidently shaped general opinions of wood-based bioenergy and contributed to an institutional renewal in which small-scale bioenergy production has received an acknowledged space within the large technological system of forestry, previously dominated by the large-scale pulp and paper industry. Yet the sustainability impacts and shifts in power relations need careful attention in these circumstances as well in order to maintain the public acceptance of wood-based bioenergy systems.

2.4.3.3 Perceptions of the fairness of bioenergy policy

The question of who pays for, and who benefits from, bioenergy development is at the forefront of many people's concerns; several studies have revealed

how members of the public have expressed profound misgivings about how bioenergy policy shapes the development of bioenergy technologies and facilities. Delshad et al. (2010: 3420) found that "participants focused primarily on issues of fairness and equity in their thinking about biofuels policies"; they generally supported government initiatives supporting bioenergy development, including subsidies for producers who were at a disadvantage in the market and were taking financial risks that could benefit society. However, "many participants described a philosophical opposition to government regulation, which they saw as an unfair and unacceptable intrusion into the free market" (Delshad et al., 2010: 3420). Many Americans oppose government intervention in markets, particularly the subsidies given by the government (and funded by taxpayers) to developing industries to meet government mandates for renewable energy; these are sometimes perceived as closed-door deals between politicians, lobbyists, and CEOs. Bryce (2008: 11) says that "ethanol is one of the biggest frauds ever perpetuated on US taxpayers," and the literature suggests that many people in the US agree with him.

Many respondents in Delshad et al.'s (2010) study also questioned the fairness of a cap and trade system that "would be subject to corruption and cheating, and would give large companies an unfair advantage over smaller firms" (Delshad et al., 2010: 3421). Delshad et al. (2010: 3422) suggest that "the prevalence of fairness concerns about cap and trade in particular stands out and suggests a difficult path toward public acceptance of such a policy" and that:

> new policies that are perceived as "fair and equitable," more development of second-generation biofuels, and more alignment of elite and public attitudes and frames on these issues may be necessary for biofuels to continue to expand their role in US energy policy over time.
>
> (Delshad et al., 2010: 3423)

Aguilar and Saunders (2010: 78) also note that: "Regulatory measures should be accompanied by education and consultation programs that can promote sustainable forest management and tax incentives that can improve the competitiveness of renewable energy feedstocks with lower levels of bureaucracy." Politicians and policymakers recognize the need to clearly articulate to the public the policy choices that promote economic development without showing favoritism to large companies.

2.5 SWOT analysis: factors affecting public opinion of wood energy

Several researchers have applied SWOT (strengths, weaknesses, opportunities, and threats) analysis to various aspects of bioenergy development (Rauch, 2007; Liu et al., 2011) or combined SWOT analysis with other types of analysis,

including AHP (Analytical Hierarchy Process) (Dwivedi and Alvalapati, 2009), ANP (Analytic Network Process) (Catron et al., 2013), multi-criteria decision-making (MCDM) methods (Scott et al., 2012), and scenario analysis using computerized group support systems (GSS) (Heinimö et al., 2007). We have paired SWOT analysis with the Integrative Framework developed by ACSC in our review of current literature from multiple sources: peer-reviewed scholarly articles, book chapters, NGO "gray" literature, and news articles from the popular media and trade magazines. The SWOT analysis depicted in Figure 2.4 shows the strengths and weaknesses that are internal to wood

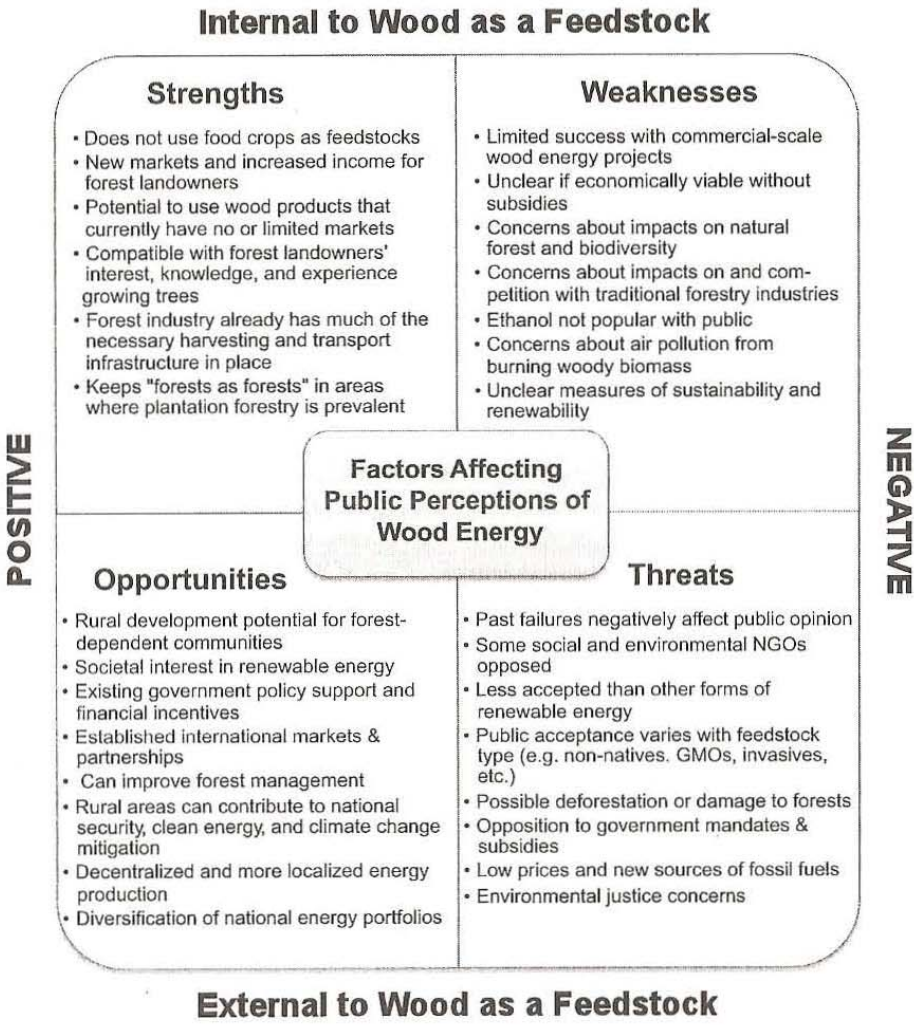

Figure 2.4 Strengths, weaknesses, opportunities, and threat analysis of factors affecting public perception of wood energy

as a bioenergy feedstock and the opportunities and threats that are external to wood as a bioenergy feedstock. The SWOT analysis summarizes the key themes in the literature on public opinion, examined through the three Integrative Framework lenses of values and valuation, process and governance, and power and equity, and shows complex trade-offs that need to be recognized and taken into account in planning for development of wood-based bioenergy.

2.6 Conclusions

Our review of the literature on public opinion of wood-based bioenergy exposes gaps in understanding of the myriad ways that perceptions of the ecological and economic impacts of wood energy are colored by people's experiences, worldviews, value systems, and access to knowledge and resources. While there is much technological and economic complexity and uncertainty regarding bioenergy development, much of the inherent complexity is social in nature. We find that the social complexities of the wood energy web have not been adequately addressed in the literature to date.

Public acceptance of forest-based bioenergy is highly contingent on how people interpret and understand the sustainability of energy produced from biomass. Sustainability seeks to maximize synergies and minimize trade-offs across environmental, economic, and social domains, and understanding the ways that various stakeholders perceive and talk about sustainability in relation to wood energy is a critical component of encouraging public support for wood energy. By applying an integrative analytical framework designed to view conservation and development issues from multiple perspectives and make potential trade-offs and synergies explicit for use by stakeholders and policymakers, in conjunction with a SWOT analysis that elucidates positive and negative factors both internal and external to forests as a source of energy feedstock material, we show how members of the public perceive wood energy and what factors have influenced their perceptions.

A review of existing research using the Integrative Framework developed by ACSC is useful for determining gaps in research and identifying fruitful new avenues for research that emerge from looking at wood bioenergy through the three lenses. Gaps in current understandings of the complex and interrelated factors that influence public opinion on wood energy represent opportunities for outreach and education for various stakeholder groups, as well as for more comprehensive scientific research assessing sustainability concerns. Following the Integrative Framework, we have organized the literature review around three areas:

1. research on public opinion that examines values expressed by individuals based on personal knowledge and experience, shared community values, and values based on concerns of the impacts of wood energy on forests (values and valuation);

2. governance structures related to wood bioenergy and the ways that organized interest groups frame issues in the public sphere as a way of influencing public reaction and decision-making processes (process and governance); and
3. studies emphasizing whose voices and issue framings are heard in these different forums, and how these patterns reflect historical structures and patterns of inequality (power and inequality).

This broad approach to public opinion, taking into account diverse values, governance processes, and equity concerns, is critical because of the multiple values and perspectives at play. Analyses should also recognize and elucidate the multiplicity of and dynamics between various stakeholders and pay particular attention to the multi-scalar dimensions of forest-based bioenergy development.

We advocate a mixed-methods approach to investigating case studies in communities where wood energy facilities are currently operating, as well as in communities where such facilities are proposed or have failed (Hitchner and Schelhas, 2012; Schelhas and Hitchner, 2012). An array of complementary qualitative and quantitative methods, including ethnography and socio-economic modeling, can be used to more fully examine what factors influence public opinion of wood energy in different areas and under different circumstances. We find that the application of the Integrative Framework to case study research can illuminate influences, both direct and contextual, that other methods may overlook, by clarifying and analyzing multiple values and systems of valuation, formal and informal governance mechanisms and processes, and historical and contemporary exercises of power and resulting inequalities. Such an approach to field-based research enables a comprehensive and dynamic understanding of public opinion of wood energy that can guide efforts to maximize social, ecological, and economic sustainability, focus attention on areas where negative impacts of bioenergy development need to be addressed, improve our ability to communicate with stakeholders, and ultimately lay critical groundwork for bioenergy development by providing a foundation for collaborative planning in bioenergy sites.

2.7 Notes

1. By the end of 2012, there were 10.7 million flex-fuel vehicles (FFV) in the US, which represented about 4.7 percent of the market for light duty vehicles. However, 9.2 percent of the vehicles manufactured in the US were FFVs, and as of October 2013, that percentage had increased to 15.7 percent, representing an increase in demand for both FFVs and ethanol (Eichberger, 2013).
2. On December 5, 2013, over 140 industry representatives and other stakeholders addressed policymakers at a public hearing as the EPA (Environmental Protection Agency) is considering altering the Renewable Fuel Standard to reduce the requirement to blend 18.15 billion gallons of renewable fuel with petroleum-based fuels to just 15.21 billion gallons. If this proposal is successful, many would consider it a significant win

for lobbyists for the petroleum industry and their allies (Podkul, 2013). The public comment period for this debate ran through late January 2014, and a final ruling is expected in June 2014.

3. He notes that: "Given the prominence of bioenergy in Sweden and its marginal position in Norway, the two countries are interesting as contrasts" (Skjølsvold, 2012: 513).
4. FERN, BirdLife Europe/Royal Society for the Protection of Birds (RSPB), ClientEarth, European Environmental Bureau, Greenpeace.
5. FERN, Suomen Luonnonsuojeluliitto (Finnish Association for Nature Conservation), Forests Monitor, The Woodland League, Friends of the Earth Europe.

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