Envisioning and Implementing Sustainable Bioenergy Systems in the U.S. South

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Abstract

Recent promotion and development of wood-based bioenergy in the U.S. South have targeted cellulosic liquid fuels for the transportation sector and wood pellets for power generation. Bioenergy development has promised to meet multiple sustainability goals including renewable energy, energy independence, new markets for wood, and rural development. On the other hand, it has garnered opposition from environmental groups for threatening forests and air quality and from conservatives who object to government subsidies and doubt climate science. A team of anthropologists undertook research on narratives, interests, and behaviors of various bioenergy stakeholders. We conducted multi-sited and cross-scale ethnographic research around emerging bioenergy facilities and at extension events, workshops, and conferences attended by landowners, managers, bioenergy industry representatives, and scientists. We also analyzed written materials from websites, news articles, and policy statements. We use the concept of imaginaries to analyze of the promotion of wood-based bioenergy as a new sustainable energy system, while noting the ways the dominant bioenergy imaginary excluded some sustainability goals and

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voices. As a result, counter-narratives emerged, success was limited, and landowners and communities received few of the expected benefits. This case provides important lessons for envisioning and implementing new sustainability technologies.

1 Introduction

Sustainability can be an "empty signifier," a vague term that represents and promotes the integration of diverse goals for society that cannot be articulated through current institutionalized discourses (Brown 2016). It is often promoted by politicians, community leaders, social and environmental activists, and others as an impetus for change. It is a goal that requires a transition from the current system to a new system that addresses the "triple bottom line" (Elkington 1999) of being ecologically sound, socially just, and economically viable. The process of transitioning to sustainability is propelled by a vision which often emerges from both scientific and public discussions and through a combination of discourse, policies, and incentives. The conditions for implementing such a vision tend to run counter to prior policies and existing market conditions and may only be partially realized, yet the process can have a transformative impact in real places. In this paper, we use multi-sited ethnography to address one such sustainability goal: achieving renewable energy through the process of envisioning and implementing a sustainable bioenergy system from woody biomass in the U.S. South.

A significant interest in bioenergy began to develop in the United States (U.S.) and the European Union (E.U.) in the early 2000s. McCormick and Kautto (2013) find that the ultimate goal of a new wood-based bioenergy system is neither the only renewable energy option nor achievable through a technological fix, but rather requires broad attention to sustainability and governance issues. While a review of the ideas, policies, and incentives promoting bioenergy use and production from woody biomass is far beyond the scope of this paper, there are several key factors that can be noted. Brown (2012), representative of public promotion of bioenergy, justifies biofuels production by noting that we have few other options for achieving a renewable energy future, particularly in terms of transportation fuels, that will meet future metrics of environmental, social, and political sustainability. Accordingly, policies in both the E.U. and the U.S. have promoted bioenergy development. In the E.U., a series of energy directives mandated that 20% of each country's energy portfolio come from renewable sources, with woody biomass playing a role in meeting this target (Lantiainen et al. 2014). A wood pellet industry developed in the U.S. in response to E.U. renewable energy targets (Aguilar 2014) and subsidies for electricity production. In the U.S., the 2007 Energy Independence and Security Act (EISA) set ethanol targets that included phasing in increasing quantities of biofuels made from cellulosic feedstocks (Dwivedi and Alavalapati 2009). To meet this target, cellulosic bioenergy development was aggressively promoted by the U.S. Department of Energy and other federal agencies (US DOE 2016). Additional

incentives in agriculture, rural development, and forest sectors also supported these goals (Lantianen et al. 2014), reflecting the fact that promotion of bioenergy was driven by efforts to simultaneously address climate change, promote rural development, and achieve energy independence and security (Bracmort 2015; Mayfield 2007). The U.S. South, a major global producer of wood, is seen as having a comparative advantage in bioenergy, relative to other forms of renewable energy, due to its abundance of woody biomass available for power generation and liquid transportation fuels (Wear et al. 2010).

One way of thinking about the promotion of bioenergy development is through the concept of imaginaries. Eaton et al. (2014, pp. 227–228) draw our attention to the concept of socio-technical imaginaries for renewable energy technologies, including bioenergy derived from woody biomass, with their observation that:

> Imaginaries for bioenergy derive from state actors who envision a future where energy and economic interests will be met with homegrown resources …providing 'green' means to address salient social problems such as the nation's dependence on foreign and domestic fossil fuel supplies, climate change, pollution, environmental degradation, national energy security, and (rural) economic depression. The term *imaginary* connotes the way these visions provide an attainable end goal, or collective vision of a feasible, desirable future social order, provided by technological projects.

Strauss (2006), however, suggests that the concept of an imaginary can tend toward abstraction, reification, and homogenization. She states that imaginaries are most valuable when used to address real, rather than abstract, subjects through person-centered ethnographic methods that specify the extent to which imaginaries are shared across people and social groups. She calls elements of these shared imaginaries, such as ideas and phrases, "conventional discourses" and notes that these are passed among people both intentionally and unintentionally (Strauss 2012). Here we concur with Gasteyer et al. (2014) in suggesting that sustainable bioenergy development in the U.S. South can be understood as a socio-technical imaginary due to the aggressive and proactive promotion of new energy options through public discourse and policy, but we draw on Strauss (2006, 2012) to discuss how this imaginary has had concrete consequences and how different versions or elements of this imaginary have been joined, contested, or altered by particular actors. Numerous actors have been involved in bioenergy development in different ways: some have written science and policy reports, some have convened workshops and conferences, and others have funded or undertaken private and academic sector research on aspects of bioenergy technology, policy, logistics, and economics. Interest groups have also been bought into this imaginary to varying degrees and sometimes promulgated counter-narratives.

Industrial-scale plants for bioenergy production have been proposed, sometimes constructed, and—with uneven success—operated at a commercial scale in specific communities. Research is important to improve our understanding of how people in these communities envision and experience the cycles of development and disillusionment that have characterized bioenergy development initiatives. An ethnographic approach provides an opportunity for in-depth research on multiple actors and perspectives. To this end, we conducted ethnographic research centered on

communities and landowners around proposed and developing bioenergy plants in the U.S. South, as well as at events focused on bioenergy which were attended by different types of actors. Our purpose here is to provide an empirical examination of the perceptions of the sustainability of these bioenergy developments through analysis of broad public discourse on bioenergy and interviews from our field research. Because sustainability often involves similar interactions between socio-technical imaginaries, conventional discourses, and concrete developments on the ground, we suggest that our analysis has broader relevance for sustainability in general.

2 Methodology

Methods. We undertook a study of the social acceptability of bioenergy through ethnography as a response to policy-makers' recognition that technical research alone would not be sufficient for achieving a sustainable bioenergy system. We chose *multi-sited* ethnography because, in a world that is rapidly becoming more globalized and integrated, the idea that a research site can be defined as a bounded set of social relations that can be studied and compared to other such bounded sets of social relations has become increasingly untenable (Falzon 2009; Marcus 1995). Lassiter (2005, p. 93) notes that ethnography is now often conducted in an "ever-changing, shifting, and multi-sited field." Our study of the process of envisioning and implementing sustainable bioenergy involved actors and discourses found in multiple sites, including both places and events, and therefore was well-suited to multi-sited ethnography where people, connections, associations, and relationships are followed across space and time (Falzon 2009). In this interconnected world, field site boundaries are inherently arbitrary and defined by the researcher (Candea 2009), and we chose to focus our research on the process of bioenergy development with field research on the ground around new bioenergy facilities, ethnography at bioenergy events, and analysis of publicly available written materials. Specifically, we focused on the way people talk about bioenergy using the idea of conventional discourses—common ways people talk and think about a topic—situated within the context of commonly shared public cultural discourses and imaginaries linked to the promotion of a new, sustainable bioenergy system (Strauss 2006, 2012). This research focus reflects our interest in using talk as a window into human values and social processes (Quinn 2005), as well as the challenges we encountered in studying a constantly shifting landscape of bioenergy development in the U.S. South, a topic that we found to be both discursive and concrete.

Using participant observation and semi-structured interviews, we conducted ethnographic research in three communities in Georgia and Mississippi with different types of bioenergy facilities. We spent three months living in each of these three main field sites and interviewing many different stakeholders: landowners, community members, local development board members, school board members,

local politicians, cooperative extension agents, loggers and others employed in the forest industry, and employees of bioenergy facilities. We took detailed notes during semi-structured interviews on both questions and responses and immediately transcribed them. We also transcribed fieldnotes about the location of the interview, relevant observations about the interviewee, and our reflections on the interview. We conducted about 175 interviews, lasting between thirty minutes and three hours (averaging about an hour) in these three primary sites. We participated in community activities and temporarily joined local organizations, where we participated in ongoing group activities and introduced ourselves as researchers interested in interviewing community members. In this way, we met directly and were introduced to a number of interviewees. We also briefly visited communities in Georgia, Alabama, and Louisiana that also had bioenergy facilities and conducted about thirty interviews in these areas with extension agents, forest professionals, forest landowners, and employees of bioenergy facilities.

We also conducted event ethnography (Brosius and Campbell 2010) through attendance at a series of eighteen regional conferences and workshops on bioenergy and participation in at least twenty-seven regional and national bioenergy-related webinars and conference calls. This was also a key part of our research methodology, as at these events we focused not only on the content presented during the sessions but also on the observable interactions between various actors. These meetings, which range from fully public to invitation-only, are utilized as venues for public announcements about new technological breakthroughs, biofuel facility openings, or developments in bioenergy policies. We view these events as an extension of community-based fieldwork in the primary and secondary sites; the network of actors that attend these regional workshops and conferences could also be considered a "community." Additionally, we systematically collected on-line and print materials on bioenergy development, including position papers, white papers, commercials, advertisements, news stories, editorials, and blogs to analyze for public, media, and stakeholder framings of bioenergy development. The latter material provides the basis for our discussion of imaginaries.

We used NVivo qualitative analysis software to conduct content analysis of ethnographic data collected in our three primary field sites (transcripts of interviews and fieldnotes) and at bioenergy events (transcripts of formal talks and fieldnotes), as well as on-line and print materials. We analyzed these datasets in order to understand how various actors use specific phrases related to bioenergy strategically in order to evoke images and emotions. Specifically, we examined metaphors and conventional discourse related to bioenergy development, forests, and communities to identify some of the ways that these phrases and ideas travel within and between different actors and influence perceptions of bioenergy.

Research Sites. The three primary field sites for our place-based ethnographic research were Soperton, Georgia; Columbus, Mississippi; and Waycross, Georgia. We chose these communities because they were home to well-developed bioenergy plants with key differences: one a highly publicized liquid fuel plant that had undergone a significant setback (bankruptcy), one the first to produce liquid fuel at

a commercial scale from woody biomass, and one pellet plant purchasing large volumes of woody-biomass from nearby landowners (unlike the liquid fuel plants). These communities, and the bioenergy facilities located within them, are briefly described below.

1. *Soperton, Georgia* (*Range Fuels/LanzaTech*): Construction began on Range Fuels in November 2007, after securing over $400 million in public and private funds. Range Fuels was expected to produce 40 million gallons per year of cellulosic ethanol using gasification technology and yellow pine as a feedstock but only produced one batch of methanol. In rural and economically depressed Treutlen County, the initial announcement of the plant was met with great enthusiasm, as it would bring many jobs and a new market for wood products, and the ground-breaking was attended by high-ranking government officials including the U.S. Secretary of Energy. The local and national implications of Range Fuels' bankruptcy and closure in 2011 have been profound, leading to public anger over what is seen as a waste of taxpayer money. In 2012, LanzaTech purchased the facility at auction for $5.1 million and renamed it the Freedom Pines Biorefinery. LanzaTech has retrofitted the facility for use as a research and development facility that will focus mainly on chemicals produced using proprietary microbes and synthetic biology, though it has recently made the news for producing jet fuel from waste gases from steel mills as a result of a business partnership with Virgin Airline.

2. *Columbus, Mississippi* (*KiOR*): After building a successful pilot plant in Pasadena, Texas in 2010, KiOR built a demonstration facility and then the world's first commercial-scale cellulosic biocrude plant in Columbus, Mississippi, which began production in 2012. It used a proprietary biomass fluid catalytic cracking (BFCC) technique to convert biomass feedstock, specifically southern yellow pine, into crude oil that could be refined into gasoline, diesel, and aviation fuels. KiOR received a twenty-year no-interest $75 million loan from the state of Mississippi as incentive to locate there, in addition to private investor funds. Promises by the company to provide over 1000 jobs by the end of 2015 were not fulfilled, as the facility never reached full capacity and filed for bankruptcy in October 2013 (after we completed fieldwork there). Following the Chap. 11 bankruptcy, there have been a series of class-action lawsuits by shareholders, accusing the company of deliberately misleading them about chances of the company's success. Columbus is a larger community and has a more diversified economy than our other primary sites.

3. *Waycross, Georgia* (*Georgia Biomass*): Georgia Biomass, which began operation in 2011, has the capacity to produce 750,000 tons of pellets per year from local forests, which requires about 1.5 million metric tons of fresh wood per year (Gibson 2010). Pellets, unlike cellulosic liquid fuels, are a proven technology, and we included a pellet plant to gain insight into community and landowner perspectives to actual harvesting of wood for bioenergy. Georgia Biomass is a wholly-owned subsidiary of the German utility company Innogy SE (which is a subsidiary of RWE), and these pellets are shipped from the port in Savannah,

Georgia, to supply biomass power plants and co-generation facilities in Europe. Waycross, while more developed than Soperton, is also rural, with an economy heavily dependent on the forest products industry; the Georgia Biomass plant directly employed over eighty people and created over 300 indirect jobs. In June 2014, the facility was offered for sale as RWE shifted its focus to other renewables. Although rumors of a sale have continued, as best we can determine as of January 2017 the Georgia Biomass facility continues to operate as a subsidiary of Innogy SE.

3 Results and Discussion

3.1 Bioenergy Imaginaries

In the United States, energy imaginaries, which entail energy security and energy independence, have long been part of the rhetoric of politicians, and this language, which crosses party lines, has intensified in the U.S. since the terrorist attacks of September 11, 2001. In 2006, George W. Bush lamented the United States' "addiction to oil," while in 2007, Barack Obama promoted freedom from the "tyranny of oil" (Bryce 2008). This rhetoric evokes emotional reactions in citizens in support of alternate sources of energy and merges with environmental discourses about renewable energy reducing emissions and mitigating climate change, thus strengthening the power of a sociotechnical imaginary promoting bioenergy development (Hitchner et al. 2016). This imaginary came to the U.S. South through a variety of means, including the U.S. DOE's "Billion Ton" reports (Perlack et al. 2005; U.S. DOE 2011, 2016). In another example, the organization 25x'25 (which defines itself as "a diverse alliance of agricultural, forestry, environmental, conservation and other organizations that are working collaboratively to advance the goal of securing 25% of the nation's energy needs from renewable resources by the year 2025") stated, "Liquid biofuels provide an incredible opportunity for farms, ranches and forests to contribute to America's clean energy future" (25x'25 2010, p. 9).

We found more than one bioenergy imaginary in the U.S. South, with certain individuals and organizations promoting alternatives. Different stakeholders promote or subscribe to different imaginaries, and they have different motives for doing so. One is the tendency to see biofuels as a scam, selling an unviable product to enrich its proponents (Hitchner et al. 2016). Government subsidies for biofuels, ranging from those for the Range Fuels plant (Chapman 2012) to military spending on the Great Green fleet, a military effort to develop alternatives to conventional fuels (Cardwell 2012), have been criticized as wasteful government spending. A second imaginary focuses on public health and environmental justice. Supplying pellets to Europe's wood-burning power generating plants, often called "biomass incinerators" by opponents, is sometimes referred to as turning the U.S. into a European resource colony (Schlossberg 2013). Interpreting biomass power plants as

incinerators calls attention to air pollution concerns related to burning wood, and it has raised environmental justice concerns when these plants are located near minority communities (Bullard 2011; Hitchner et al. 2014). A third alternative imaginary revolves around ecological impacts. Questions about renewability and carbon neutrality have been raised (McBride 2011; Phillips 2015). Environmental groups have maintained that bioenergy threatens to push forests—valuable for sustainable forest products, tourism, and as cultural resources—to the brink of disaster by causing irreparable harm through deforestation and degradation (Quaranda nd). Environmental and conservation organizations have expressed concern that bioenergy can have potential impacts such as soil erosion, decreased water quality and quantity, and conversion and deterioration of wildlife habitat in exchange for only modest greenhouse gas reductions (McGuire 2012).

3.2   Communities, Landowners, and Sustainability

Our research enables us to examine the conventional discourses that community members and landowners use when talking about bioenergy and its sustainability, both in general and in relation to concrete bioenergy projects. Here we follow a longstanding practice in sustainability research of organizing our discussion according to economic, ecological, and social dimensions of sustainability.

   Economic sustainability: Facilities using woody biomass tend to be located in forest areas because it often becomes uneconomical to transport raw material, such as logs or chips, over long distances. The poverty that is prevalent in forest-dependent communities in the U.S. South has been linked to low employment levels relative to agriculture and industry (Bliss and Bailey 2005). All of the communities we studied were somewhat hollowed out from their agricultural past, in terms of extensive out-migration of young adults and many empty storefronts in older commercial districts, and all had local development authorities actively pursuing new industry as a means of economic development. In all cases, employment numbers were higher during plant construction than projected for plant operation, and construction jobs were often specialized and likely to go to outsiders. All jobs were appreciated, but jobs for local businesses and people were most desirable; however, they were only partially realized. The closures of the cellulosic fuel plants were obviously detrimental for economic sustainability. In the Range Fuels case, one local electrical contractor who did receive a construction contract was left unpaid when the company declared bankruptcy. Bankruptcies had other effects on communities. Companies constructing plants received government incentives, tax abatements, and other investments, and communities made industrial sites available to them. Bankruptcies provide few benefits while continuing to tie up sites and resources, and they are perceived as setbacks for local development goals and may sour communities on engaging in efforts to attract industry in general. In Soperton, which had little industrial development but high hopes for the compatibility of the Range Fuels plant with local forestry operations, failure was particularly demoralizing (Hitchner et al. 2017). Community members living near plants, and in a few

cases organized interest groups, opposed bioenergy development due to noise, truck traffic, and safety concerns. Nevertheless, in all the sites a broad cross-section of the community viewed a successful bioenergy plant as a positive development that fit well with local economies. It was common however, for community members to complain about government subsidies and intervention in "free markets," although bioenergy proponents often pointed out that the oil and gas industry received many subsidies and that government assistance was therefore necessary to get the bioenergy industry up and running.

Enthusiasm for bioenergy plant proposals was often linked to prospects of better markets for local wood. During the development stages, there was generally talk about plants taking waste wood for which there was no other market, such as tops, limbs, and very small-diameter trees that need to be harvested for forest health reasons. Use of these materials proved difficult due to inefficiencies in transporting whole trees and the high cost of in-woods chipping. As a result, plants ended up essentially purchasing pulpwood (medium sized trees that are easy to harvest and transport, but not yet suitable for lumber). Georgia Biomass was the only plant purchasing significant quantities of wood, and some landowners in that region complained that these purchases had done nothing to improve pulpwood prices. However, foresters involved in wood procurement in that area suggested that it had at least prevented pulpwood prices from dropping to further lows, as a number of pulp and paper plants in the South have closed recently, resulting in increased supply and lowered demand for pulpwood.

At both community and landowner levels, bioenergy plants fit well into community economies but have made only modest economic contributions. The gap between the imaginaries associated with liquid fuels and plant bankruptcies was stark and a cause of disillusionment toward the bioenergy industry in particular and government-promoted energy programs in general among local people. Many people compared these failures to Solyndra, a well-known solar energy failure that received significant federal investment.

Ecological sustainability: One of the sharpest differences between the dominant bioenergy imaginary and various counter-narratives is found in environmentalist claims that bioenergy development threatens forests. The power of the Southern woody biomass imaginary, backed by strong discourse, policies, and subsidies that envisioned cellulosic biofuels playing a major role in both the U.S. energy sector and Southern wood product markets, may have provoked this strong backlash from environmental groups. Foresters we talked to often pointed out that it would always be impractical to collect large amounts of waste wood and sweep up all the woody biomass after harvest, and in fact we did not observe woody biomass harvests that involved any trees other than traditional pulpwood harvests. However, in conferences and workshops, researchers often talked about their experiments with in-woods chipping, short-rotation pines, and exotic species such as eucalyptus, which suggested a level of change to Southern forests in accordance with the large-scale transition to bioenergy envisioned in the imaginary and in line with environmental concerns.

It was also common for forest owners and foresters to say that strong markets for wood products are the best way to "keep forests in forests," by providing economic incentives to landowners to plant and manage forests. Large areas of the South were reforested in the latter part of the 20th century, both through plantations in association with the rise in the forest product industry and through natural regeneration as marginal farmland was abandoned and agriculture intensified on prime farmland or moved to other regions of the U.S. While the relative impact of each of these two factors has not been completely sorted out (see Rudel 2001), wood markets clearly promoted more plantation forestry. But the general term "forest" may mask differences in the way it is used by different stakeholder groups, who may be referring to different forest types (e.g., plantations versus natural regeneration) that provide different mixes of products, as well as ecosystem services and values. Similarly, claims by foresters and landowners that managed forests provide "wildlife" habitat generally refer to commonly hunted species such as deer and turkey, rather than a broader definition of wildlife that would include non-game species and biodiversity.

The contribution of bioenergy to reduction of greenhouse gases is another area where environmentalists often contest the Southern bioenergy imaginary. Life cycle analysis to address this has not been thoroughly explored, and differences in accounting procedures allow each side to make their own claims. Representatives of pellet companies that we interviewed maintained that their analyses showed European electricity generation from Southern wood pellets to be carbon negative, but their data was not made publicly available. For the most part, however, widespread disbelief in climate change in the rural South meant that climate motivations for bioenergy were rarely discussed, particularly in public and landowner events (Schelhas et al. 2014). Instead, bioenergy was promoted for benefits like rural development, new wood markets, and as a domestic substitute for foreign fuel. Sustainability certification for forests and forest products, which seem likely to be demanded for publicly supported bioenergy programs, were of little interest to family forest owners who saw them as outside interference and representative of distrust of their own management. Some of this again revolves around definitions, with forest owners tending to have a more traditional forestry definition of "sustainability" as sustainable yield of forest products, compared to the broader definition generally used in public policy.

Social sustainability: Racial and economic disparities were present in all communities. Local promotion of bioenergy development was generally driven by development authorities, which had some diversity but were often more representative of elite interests. There was also often little transparency in decision-making when bioenergy companies were recruited to communities. The results of this were reflected in low levels of information and even awareness among the general public in communities, and perhaps in a lack of attention to the overall issue of local employment, particularly labor, in agreements negotiated for plant siting.

At the landowner level, even where forest product markets are strong and many landowners sell timber at some point, timber production is rarely a top ownership objective for family forest owners (Butler 2008). Forests are also highly valued at the local level for hunting and wildlife, aesthetics, and watershed values. These

other values, along with the speculative nature of managing for long-term woody biomass, meant that most landowners expressed little interest in alternatives to the plantation systems they were currently using, which were generally 20 + year rotations for loblolly pine, 30 + year rotations for slash pine, and 40 + year rotations for longleaf pine (all native species), with prescribed burning and periodic thinning for pulp and chip-and-saw. Pine trees have been marketable through many larger economic changes for products ranging from naval stores, pulp and paper, and various types of timber markets. Thus a preference for pine trees, along with the long-term nature of forestry decisions and the importance of sawtimber as the major economic driver of plantation forestry, meant that few landowners were interested in exotic species or short-rotation trees. This is likely positive for ecological sustainability, as forestry research on bioenergy often promotes alternative species and shorter rotations.

4 Conclusion

Brown (2016) maintains that "sustainability" as an empty signifier presents opportunities for co-option of the term by powerful interests, as well as opportunities to develop new discourses that stimulate radical change toward sustainability. In the case of wood-based bioenergy, many people saw both their own self-interest and public interest in the bioenergy imaginary, and it gained momentum and funding far beyond what proven technologies and economics would have suggested. A bioenergy imaginary was promoted by interest groups who found support in it for their conventional and institutionalized activities and avoided reordering of societal priorities. As a result, alternative discourses and contestation took place outside of dominant institutional structures, and critical sustainability elements were neglected. At the same time, the imaginary produced very mixed benefits and responses from landowners and communities, suggesting that a slower and more inclusive promotion and development process might have allowed more careful evaluation of options, better accounting of measurable sustainability goals, and avoidance of catastrophic failures and disillusionment.

Imaginaries can mobilize action, but they can also themselves come apart or be influenced by events. The imaginary of a large bioenergy industry from woody biomass grown in Southern forests has, to a significant extent, unraveled over the past few years with lower fossil fuel prices due to abundant natural gas, environmental opposition, and the failure of any plant to produce economically competitive cellulosic fuels. Pellet plants have continued to operate, although long-term E.U. policy may change in response to concerns about forest sustainability and limited carbon reduction benefits. At the same time, there is an ongoing but slow-moving process by which bioenergy facilities, in association with pulp mills, saw mills, and other wood product industries, continue to find synergistic ways to grow using residual wood products. Simultaneously, interest remains for targeted biomass harvest, for example of small diameter trees on Forest Service lands, to meet forest

health and fuel reduction objectives. At the practical level, these lessons sound a cautionary note for other sustainability ventures driven by powerful imaginaries. At the theoretical level, our research reinforces Strauss's (2006) call for paying ethnographic attention to concrete actors and exploring conventional discourses when conducting research on imaginaries.

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