

Barriers to Utilization of Municipal Biomass Residues for Bioenergy

Abstract

Municipal biomass residues (MBR) are plentiful in the southeastern U.S. Despite favorable economic and policy contexts, few cities generate bioenergy from MBR. We hypothesized that the perspectives of the actors managing MBR have hindered implementation. We conducted interviews among stakeholders in Wake County, NC to investigate MBR use. Barriers that prevented stakeholders from adopting MBR to energy programs included lack of economic incentives for key practices, lack of credible enforcement for MBR use regulations, and poor communication. We discuss opportunities for Extension specialists to facilitate stakeholder interactions related to MBR utilization and bioenergy.

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Introduction

In 2000, wood wastes produced from urban forest maintenance constituted 12% of U.S. municipal solid waste (McKeever & Falk, 2004; McKeever & Skog, 2003). In 2002, half of the discarded wood in the U.S. was from urban forests (McKeever, 2002). Sprawling urban centers have mounting wood wastes because residential development patterns extend urban forest cover over formerly non-forested agricultural land (McKeever & Skog, 2003). In addition to regular urban forest maintenance, natural disasters (e.g., hurricanes) produce sporadic volumes of wood unfit for sawtimber but ideal for bioenergy use (Mayfield, Foster, Smith, Gan, & Fox, 2007).

Outside the U.S., projects converting municipal biomass residues (MBR) to bioenergy have proven economically feasible, attractive to investors, and valuable to residents for sustainability reasons (Madlener & Vögeli, 2008; Mahapatra & Gustavsson, 2009; Rakos, 2005; Vallios, Tsoutsos, & Papadakis, 2009). These residues are often constituted of diverse materials, including landscaping waste, trees cleared during development projects, and even wood pallets. In the U.S., Renewable Portfolio Standards, which have been adopted by 27 states and the District of Columbia (U.S. DOE, 2010), have created the political impetus to encourage bioenergy use.

Despite potential economic benefits and legislative motivation, a bioenergy industry has not emerged in the U.S. (Mayfield et al., 2007), and MBR is generally underutilized (MacFarlane, 2009). Although alternative uses, including firewood and mulch production, compete with wood waste to energy programs, the same competition exists in areas where wood waste to energy is far more common than in the U.S. (Heinen, Lawler, McHale, & Peterson, 2012). Understanding barriers to the development of an urban wood waste to energy industry could help jumpstart this nascent industry.

Although little research has been conducted on MBR utilization in urban areas, findings from studies of rural and industrial forest circumstances provide some insight on potential barriers to greater MBR utilization. In the Great Lakes Region, the utilization of biomass from private non-industrial land has been stalled by market prices and the need for specialized equipment (Campbell, 1988). The process of changing from food business perspectives to energy business perspectives also has prevented alternative utilization (Kelsey & Franke, 2009; McCormick & Käberger, 2007). In the southeastern U.S., barriers to rural and industrial biomass utilization have been generally categorized under six main themes: (1) marketing, (2) infrastructure, (3) community engagement, (4) incentive support, (5) collaboration, and (6) education (Mayfield et al., 2007).

Evidence suggests that awareness of renewable energy and bioenergy does not equate to an awareness of the potential of feedstocks for energy (Mayfield et al., 2007). In other words, stakeholders know that bioenergy is important, but they may not realize the biomass they produce or manage is marketable (Grebner, Perez-Verdin, Henderson, & Londo, 2009). Municipal biomass uses in the southeastern U.S. warrant research because the region produces significant MBR from urban forests and the urbanization process. We used a qualitative case study in Wake County, NC, where sprawling urban areas have plentiful MBR but do not generate electricity from MBR, to uncover factors that may contribute to the lack of adoption of MBR for bioenergy.

Methods

Data for the study were collected from 27 semi-structured interviews with stakeholders in Wake County NC. Interviews ranged in length from 30 minutes to 3 hours. Theoretical saturation, the point where additional interviews ceased to provide new insights, dictated sample size (Flick et al., 2007). In this approach informants provided information that identified their association with MBR, and that information was used to identify stakeholder groups for the purposes of our research. The number of informants to be interviewed was restricted by total membership in a particular stakeholder group. The initial exploratory approach occurred in the fall of 2009, when eight initial informants were selected to include groups we thought might work with MBR (e.g., city foresters and tree care companies). We pursued a snowball approach to select additional informants by asking each of the

initial interview participants and the Raleigh Chamber of Commerce to suggest people who might have a stake in MBR utilization. Questions used to prompt conversation during interviews are listed in Table 1.

Table 1.
Prompt Questions Used in Semi-Structured Interviews

1) Please describe your job. In what way does your position involve you with urban woody biomass and trees?
2) What are all the types of biomass do you deal with? Where does each type of biomass you deal with come from?
3) What specifically is done with each type of biomass you collect?
4) Why does your company choose that (those options?) Policy? Budgetary constraints?
5) What challenges are involved with each of these processes? How do you overcome those challenges?
6) What are the goals of your operations/processes? Is there a plan to reach these goals?
7) What other options are available to you for this biomass? Probe: What challenges are involved with these other options? Why are these not the preferred option?
8) With whom do you interact when dealing with this biomass? (to clarify if not expressed above). How often/when do you interact with these stakeholders?
9) Can we contact these partners? Who else could you recommend for us to contact for further information or input? Do you work closely/regularly with any other companies that deal with biomass? How can we contact them?

Transcripts from interview notes and audio recordings were entered in the research software tool QSR Nvivo 8 for coding and analysis. Nvivo is a qualitative research software tool that enables the researcher to manage complex, unstructured qualitative data during the analysis. Data were coded using the seven defined categories of the Social Process Framework: participants, perspectives, values, situation, strategies, effects, and outcomes (Clark, 2002; Lasswell, 1971). Additionally data were coded using two of the defined categories of the problem orientation framework: problems and goals (Clark, 2002; Lasswell, 1971). Use of the frameworks in this application allowed for a systematic analysis of the data, in such a way that stakeholder perspectives were systematically identified in terms of what they see as their problems and goals.

Findings

We identified four main stakeholder groups based on their association with MBR and categorized

them as: state regulators, city managers, land clearing and inert debris facility (LCID) owners/operators, and other producers/users of the wastes. The two state regulators interviewed held senior positions central to enforcing the management of municipal biomass residues. All managers at the city level were targeted for and agreed to interviews. All four LCID facilities in Wake County were targeted for interviews, and three of the four agreed to interviews. Through systematic analysis, we were able to identify stakeholder goals that influence decisions related to MBR generation, use, and management. State regulators and city managers held common goals of public health and safety (Table 2). LCID owners/operators and producers/users of the wastes all had goals centered around economic incentives (Table 2). We were also able to identify factors that hindered the stakeholders from achieving their goals. Money was reported by all four stakeholder groups to be in some way involved with the barriers to achieving their goals.

Table 2.

Overview of the Reported Goals and Barriers for Each Stakeholder Group
Interviewed

Stakeholder Group	Number of Interviews	Goals	Reported Barriers
State Regulators	2	enforcing the proper management of municipal biomass residues such that the human health risks associated with the wastes are reduced	greed and ignorance of producers/users of the wastes
City Managers	8	"mission is public safety and healthy sustainable urban forest"	lack of money and personnel
LCID* Owners/Operators	3	balancing economic feasibility with the requirements set out by their state-issued permits while managing municipal biomass residues	disconnect with state regulators, public indifference to waste management, lack of economic incentives
Producers/Users of Municipal Biomass Residues	14	generating profit through municipal biomass residue generation and use	other businesses not following the rules and lack of economic incentives to properly manage wastes

* LCID = Land Clearing and Inert Debris Facility

State Regulators

Both of the state regulators interviewed indicated that their goal was to enforce the proper management of wood wastes such that the human health risks associated with the wastes was reduced. Their goal was based entirely upon the legislation (NC Senate Bill 111) that defines terms associated with the wastes, along with the proper management practices:

The state interests are several. The material [biomass residue] is viewed as a resource. Regulatory, it's viewed as a potential liability.... It has a definite public health threat associated with it, an environmental threat associated with it when it's not managed properly. -*State interviewee B*

[We are]...responsible for insuring solid waste state laws are followed regarding facilities and so we, by definition, would be responsible for enforcement actions associated with non-permitted facilities or places where wastes are being managed inappropriately that are not on a permit. -*State interviewee A*

Additionally, both interviewees indicated that barriers keeping them from attaining their goals included greed and ignorance among some producers and managers of the wastes.

...the primary [goal] is to save money. Pure greed. And the second is ignorance to a much lesser degree. Some people are avoiding a tipping fee by not taking it to the proper place, or it's just inconvenient to take it to the proper place. So it's saving them time and money. Disposing of it or managing it correctly, sometimes it's ignorance that they didn't know that with a little bit of effort they could have mulch or compost. More often than not, it's my opinion that it's solely for money." -*State Interviewee B*

This quote is consistent with the regulatory framing of their role. The state stakeholders identified greed and ignorance as the main barriers to legal waste management that did not threaten human health.

City Managers

Most of the city managers reported that their umbrella "mission is public safety and healthy sustainable urban forest". -*City Interviewee A*

The achievement of these goals was limited by the lack of resources, explicitly in the form of money and personnel. All eight of the city employees agreed that limited resources limited their ability to maintain a sustainable forest. Inability to attain existing goals results in stakeholder frustration and is a potential explanation for why municipalities are not adopting new goals such as managing MBR

to produce bioenergy:

There are about 122 park sites in six districts with eight people per district crew. We maintain 1100 miles of street right of way, 880 acres of parks, 63 miles of greenway trails. We also handle cemeteries, complaints, and neighborhoods...too many acres, not enough people. We are expected to do more on less money. -*City Interviewee A*

Well, we can stretch our resources as far as our dollars...well money of course. I think that there are days I'm just like we could do so much more, but I need one more person. Or I need another truck. It's resources. Eventually that's how we max out. -*City Interviewee V*

...we're understaffed because we lost positions. We just try to work smarter. Try to use volunteers. This is how we get work done. We can barely keep our heads above water... Sometimes we get so stretched out that you feel you can't do one thing really well because you're trying to do five things mediocre. -*City Interviewee H*

LCID Owners and Operators

All three LCID owners and operators shared the goals of generating profit and balancing economic feasibility with the requirements set out by their state-issued permits. One LCID owner indicated that a factor keeping his operation from making money was a lack of awareness on the part of state agencies. As a manufacturer of mulch and hog fuel (a common term for wood chips that are burned to generate electricity), the LCID was exempt from paying sales tax on the nearly one million dollars worth of equipment. The owner was, unexpectedly, required to pay sales tax on the equipment. He felt forced to educate the state regulators about the regulation that applied to LCID owners/operators:

It took me a year and a half to get where I was tax exempt from sales tax on my equipment. I argued with them [the State] 'til I turned blue in the face. Well, the little guy that worked for the government didn't know what I was. All he knew was that I was a mad old man, that's all he knew. But see, I am a producer, I'm making hog fuel, and I'm making triple shredded mulch. I am a manufacturer like it or not. They said you're not manufacturing that wood! I said no, you knuckle head, but you take that stump and get out there and chew it up as fine as I'm doing and you'll see I'm manufacturing something!" -*LCID Operator C*

LCID Operator C indicated that this disconnect with the state agencies created a hurdle to attaining his goals. A further disconnect between what the state regulators think is happening and what the LCID owners/operators are experiencing limits the ability of all participants to manage wastes in a cost-effective manner. State regulators believed that there was a market for hog fuel, while LCID

actors reported otherwise:

The [LCID/T&P] facilities support a big boiler fuel market where those ground up stumps or ground up trees are used as a boiler fuel. -*State interviewee A*

This fuel [hog fuel] right here for me to sell it, I only get \$50. A whole tractor trailer load, that's it. What I do is I sell it to a company that hauls it to Plymouth for boiler fuel. So that's what I'm saying there's no money. I was losing my rear end trying to do it. I can bury it [yard wastes] for probably 1/8 the cost of recycling it. -*LCID Operator C*

The *LCID Operator C* also indicated in this statement that there was a lack of economic incentives for owners and operators to explore wood to energy strategies. All LCID owners/operators reported that economic considerations were central to their waste management strategies.

Producers/Users of Municipal Biomass Residues

The stakeholders involved with the production and utilization of the wood biomass residues included tree service companies, artisans, and urban sawyers. As business owners, generation of profit was a common goal for all three types of producers/users, and they perceived conflict between profit and wood to energy programs.

Because if it's not economical, private industry's just not going to do it. Not for long anyway. -*Producer of Residue L*

All tree services reported being limited by other producers and users of the MBR who were not following the rules. This complaint was specifically targeted toward perceived illegal immigrants and non-licensed businesses.

They're working cheap. They don't have the equipment to do it properly. A lot of the competition, and I'm seeing it with a lot of the 'illegals', a Bobcat® and a dump truck and that's it. I mean that's what I'm seeing. They're fast and furious and they don't care what it hits when it falls. They're not paying taxes, most of them aren't insured. There's big factors here. I'm insured, workman's comp, general liability, plus all my guys are on payroll, so they're paying taxes and we're withholding, we're matching. So I can't work as cheap as them, and I lose a lot of work because of them. -*Producer of Residue L*

Producer L believed following the rules put him at an economic disadvantage in the market place. Other Producers shared his complaint:

We're finding that the 'illegals' are causing a lot of harm to the businesses. I mean in the tree business, they come in and cut a tree, it falls on the power

lines, they pack up and leave and they're never heard of again. That has happened several times in Raleigh. In the tree business, I tell folks, you get what you pay for. I'm not the most expensive, but I'm not the cheapest. All my guys pay taxes and, I say to the customer: look, you hire us and your money stays in Wake County. It doesn't go to Mexico. -*Producer of Residue J*

...it irritates me to see them working there with no safety equipment, no hard hats, no glasses, no chaps and there's a climber up in the tree with no safety gear on. And if those people get hurt then, even though they're not on our [workers compensation] policy, it affects the state rates and that affects our workers comp policy. And we pay a fortune in that anyway. We have a phenomenal record but people doing stupid stuff like that are hurting us. -*Producer of Residue B*

These producers and users also indicated that the fees charged by the LCID owners/operators were a barrier to their ability to generate profit. Consequently, many producers and users indicated that they saved money by avoiding dumping MBR at LCIDs.

...it boils down to money and how we can do it cheaper...occasionally we have customers that flag us down and want the raw mulch, and we'll dump it with them, but ...I've been with the company for six years and I think we may have dumped at a [LCID] maybe once or twice during that entire time. So it is very rare for us to do that. -*Producer of Residue B*

The name of the game is to try to reduce the number of dump fees you have at the [LCID]. One thing is it gets very expensive dumping in the [LCID], not to mention the buildup of waste in there anyways. Not to mention that for us, with the volume that we do, it would be so much money bottom line going straight out it does not make sense. -*Producer of Residue L*

Discussion

Inadequate enforcement of existing MBR regulations may explain slow adoption of MBR to bioenergy in the southeastern U.S. Although state regulatory process had clearly defined purposes and rules, the producers/users' complaints about "illegal" competitors suggest that enforcement of those rules was limited. Without credible enforcement of MBR regulations, producers appeared unwilling to pay tipping fees and provide the MBR feedstock needed for bioenergy production from urban forests. The state regulators explained this phenomenon as "greed," when, from the producers perspective, it was a rational business practice given limited enforcement of regulations. Better enforcement of producers/users could result in more MBR available for wood to energy programs by reducing illegal dumping outside LCIDs. Credible enforcement, however, will be difficult and inequitable unless unlicensed and uninsured producers face enforcement.

Extension professionals could promote MBR to energy programs by helping state regulators determine what enforcement actions would be the most efficient means of preventing unlicensed

businesses from producing MBR and illegal MBR management practices. Second, Extension professionals could work in public outreach to reinforce the importance of appropriate management and legal businesses to the general public. In addition to supporting credible enforcement, Extension professionals can highlight benefits associated with patronizing insured and licensed businesses that adhere to MBR regulations. Such Extension efforts should introduce the public to bioenergy options that may be feasible in their communities. Plate, Monroe, and Oxarart, (2010) explored public perceptions of this topic and suggested the public would be interested in MBR to bioenergy projects.

Communication problems may slow adoption of MBR to bioenergy. We found LCID owners/operators and producers/users reported significant misunderstandings with one another and with state regulators. If good communication is lacking, stakeholders cannot have reliable perceptions of one another or the MBR to energy process (Buttoud, 2009). Each stakeholder group controls key information regarding viability of MBR to energy programs (e.g., costs, tax breaks, potential revenues, MBR sources, how MBR is diverted from the waste stream), but the groups are not sharing this information. By facilitating communication among key stakeholders (e.g., energy companies, city managers, policy makers), Extension professionals could highlight contexts where MBR to energy programs are viable alternatives to current MBR usage.

Our results suggest that creating an arena for the participants to work on goal sharing will be critical to increasing opportunities for MBR to bioenergy generation in the southeastern U.S. We suggest that an "open active debate about what to do" (Clark, 2002) would begin to address the key issue of sharing knowledge about wood to energy efforts among stakeholders. We expect that increasing an exchange of ideas would allow stakeholders to develop a common goal for MBR.

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