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Does policy matter? The role of policy systems in forest bioenergy development in the United States

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ABSTRACT

Public policies play a key role in supporting systems of innovation in the woody biomass energy sector. Although hundreds of biomass promotion policies have been enacted at state and national levels in the United States, the effectiveness of these various policies—individually and as a policy system—remains unclear. Here we draw upon a survey of biomass producers and users at various supply-chain steps to explore whether and how individual policies and the larger policy system influence innovation and decision-making. We find that individual policies were considered influential in a small but substantial proportion of significant changes made to operations, with disbursement, tax, and regulatory policies seen as the most influential. A relatively small proportion of respondents were willing or able to describe policy effects across multiple supply-chain steps; those who did described variably effective biomass support policies, largely at the state level, conflicting with federal regulatory policies that were seen as creating additional costs and uncertainties. These results suggest that the biomass policy system in the United States may not be well designed to support innovation, particularly due to conflicts between biomass promotion policies and other forest, environmental, or energy policies.

1. Introduction

A "systems" approach to policy analysis has opened new possibilities for understanding processes of innovation, firm behavior, and policy implementation in forestry (Rametsteiner and Weiss, 2006; Weiss, 2011). The systems of innovation literature, for example, highlights the role of interacting entities and institutions in national, regional, and sectoral realms in encouraging and diffusing new modes of organization and operation. A systems approach has also been brought to bear on questions of policy design and implementation, drawing attention to the interaction among policies at multiple scales and the sometimes unexpected results as experienced by private actors (Chappin et al., 2009; Kemp and Pontoglio, 2011). In the field of wood-based bioenergy specifically, Becker et al. (2011b) have called for a shift from analyzing individual policies in isolation to analyzing interactive policy systems that affect private actors at multiple points along the supply chain. To date, relatively little research in the United States has attempted to investigate the complex system of forest biomass policies, a system that includes not only various state and federal biomass legislation but also a suite of energy, environmental, tax, and related policies affecting the fortunes and behaviors of biomass producers and consumers (Becker et al., 2011b; Rametsteiner and Weiss, 2006). This is true in spite of the large number of biomass-related laws, regulations, and programs promulgated at the state and national level in recent years.

Our objective here is to examine the degree to which prevailing policies in the United States affect innovation in the woody biomass sector. Understanding to what extent a coherent "policy mix" for forest biomass innovation exists, and to what extent policies are ineffective or mutually conflicting, can help inform policy design and implementation. Here we present an exploratory study of the interactive effects of policies on biomass innovation through an analysis of survey data collected from biomass producers and consumers along four steps of the biomass supply chain. Our focus on these four distinct steps allows us to probe the effects of individual policies as well as the interaction of policies "vertically" (by assessing the coherence of state and national policies) and "horizontally" (along multiple steps of the supply chain). We present this actor-oriented assessment as an initial step toward understanding the dynamics of the larger system within which private biomass actors in the United States operate and contributing to an understanding of the relationships between public policies and innovation in forestry.

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Table 1
Classification and examples of biomass policy instruments (Kudrna, 2015).

Policy instrument	Description	Example policies (policy scale)
Disbursement	Grant funding to purchase equipment; payment for biomass delivered to qualifying facilities	Biomass Crop Assistance Program (federal)
Government services	Technical and business planning assistance; installation or use of public infrastructure	Biomass District Energy Program (state – Vermont)
Market activity	Government procurement policies	Michigan Net Metering (state – Michigan)
Research and development	Funding for new technologies and processes; funding for pilot demonstration facilities	Public Interest Energy Research (PIER) Program (state – California)
Rules and regulations	Renewable energy portfolios; emissions regulations	Clean Air Act (federal) Next Generation Energy Act (state – Minnesota)
Tax policy	Income tax credits; exemption or reduction of taxes (e.g., income tax, sales tax, fuel tax)	Biomass Producer and Consumer Tax Credit (state – Oregon)

2. Background

2.1. Innovation and policy mixes

Numerous scholars have called for analytical approaches that go beyond assessing individual policies in isolation to encompass systemic and dynamic treatments of policy design and implementation (Kay, 2006; Rametsteiner and Weiss, 2006; Stewart and Ayres, 2001; Weiss, 2011). The system perspective is perhaps best developed in the context of innovation studies. The "systems of innovation" perspective explores the generation and diffusion of innovations as embedded processes influenced by networks of policies, institutions, actors, and both market and non-market relationships (Buttoud et al., 2011; Edquist, 2005). Under this perspective, "Innovating firms do not act on their own, but are embedded in a system of other actors and institutions that may be supportive or hindering" (Weiss, 2011, p. 18). Many treatments of the systems of innovation concept describe the particular functions performed by individual actors or institutions (Edquist, 2005; Orozco et al., 2013). For example, Kubeczko et al. (2006) detail ten functions across three broad categories (provision of resources, management of complexity of innovation processes, and promotion of innovation use) important to stimulating innovations in the forestry sector.

Public policies (e.g., regulatory legislation, government subsidies, support programs, and the like) have been found to play important roles in the outcomes of these systems of innovation (Borrás and Edquist, 2013; Chaminade and Edquist, 2010; Smith, 2000), though the complexity of innovation systems often makes it difficult to isolate the effects of individual policies (Kemp and Pontoglio, 2011). Chappin et al. (2009) highlight the importance of attending to "policy accumulation" in systems characterized by numerous policies. Dimensions of policy accumulation include the "growing variety of types of instruments, (in)consistencies between the policy mechanisms, and…the clustering of instruments into policy regimes" (Chappin et al., 2009, pp. 937–938). In the context of policy analysis, this suggests a need to consider the sometimes unpredictable interactions of multiple policy influences on the diverse set of actors operating within a sector. The term "policy mix" has been used to refer to the idealized set of coordinated policies designed to stimulate innovation (Borrás and Edquist, 2013; Flanagan et al., 2011). Borrás and Edquist (2013, p. 1513) argue that "innovation policy instruments must be designed carefully and on the basis of an innovation system perspective, so that they are combined into mixes in ways that address the complex problems of the innovation processes."

Designing an ideal policy mix is complicated by, among other factors, the policymaking and implementation processes themselves. Flanagan et al. (2011, p. 71) highlight the "messy and complex, multi-level, multi-actor reality" involved in policy instrument choice and implementation, a reality characterized both by a multitude of potential interactions and the lack of a unitary entity providing oversight and adaptation. Failing to effectively coordinate the kinds of functions described by Kubeczko et al. (2006) and Borrás and Edquist (2013), such policy systems may poorly align to achieve desired outcomes. Indeed, policymaking is often characterized by a multiplicity of decision-makers embedded in various interest coalitions, the weighty influence of pre-existing institutions, and "a far looser coupling between problems and policies" than imagined by a rational instrumental model of policymaking (Hertin et al., 2009, p. 1186). Given these complexities

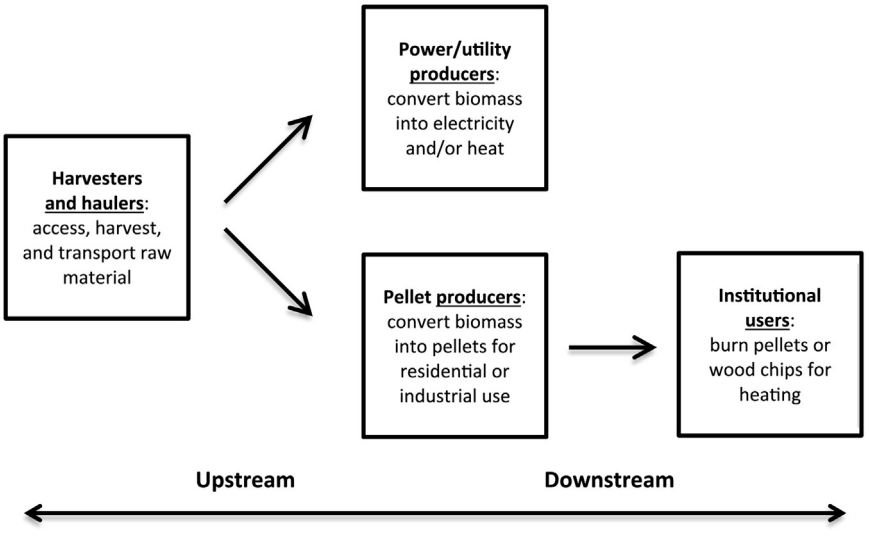

Fig. 1. Flow of material and operations in a US biomass thermal or electric supply chain, highlighting the four supply-chain steps surveyed in this study.