

Inventory and Classification of United States Federal and State Forest Biomass Electricity and Heat Policies

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December 2015

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Funding support for this project was provided by the Northeastern States Research Cooperative (NSRC), a partnership of Northern Forest states (New Hampshire, Vermont, Maine, and New York), in coordination with the USDA Forest Service.

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Project Summary

This research used a four-tier classification structure to categorize forest electricity and heat policy instruments used in forest biomass electricity and heat policies based on: approach (incentive, regulation, information), type (e.g. tax incentive), subcategory (e.g. tax exemption), and specification (e.g. sales tax exemption).

More (113) of these policies were enacted in 2007 and 2008, more than in any other two-year period, and there was a significant increase in the number of forest bioenergy (46) and biomass specific (36) policies by 2013. Cluster analysis provided evidence that neighboring states adopted similar numbers and types of policies. Oregon (in cluster by itself) had the highest number of tax incentives and biomass-specific policies, while most Southern, Southeast, Southern Appalachia and Midwestern states (the most dissimilar cluster to Oregon) had a limited number of policies. Most states in remaining clusters offered a mix of integrated policies, rather than policies focused on regulations and technology improvement.

Our findings provide guidance and information for the development of forest biomass policies in the Northern Forest by enabling the transfer of policy approaches to Northern Forest states.

Background and Justification

A variation of an 'infant industry' argument is often used to justify government intervention into the renewable energy sector. An infant industry, such as the forest biomass energy industry, often incurs high entry costs, including research and development, negotiation, contracting, and contract enforcement costs. In this initial stage, policymakers often enact legislation that protects the infant industry and reduces these costs. As the industry continues to grow, the production costs are expected to decline through learning-by-doing and economies of scale. In theory, at some point the infant industry should no longer require governmental support and become independent.

Governments adopt policy instruments with different characteristics to stimulate growth in the bioenergy industry, and several attempts have been made to classify policy approaches. Generally these, studies have identified numerous policies promoting renewable energy, but have found few policies specifically targeting forest bioenergy.

Background and Justification

One approach used seven policy categories, three of which were aimed at lowering project capital costs (tax credits, renewable energy grant programs, and loan guarantees; tax credit for residential biomass energy; and government bonds), three others represented government mandates (renewable energy mandates; voluntary or mandatory renewable portfolio standards (RPS); and federal green power purchasing goal); and one category addressed rural energy grants and feasibility studies.

Another survey of wood-to-energy policy instruments classified policies into three mutually exclusive categories: rules and regulations (e.g. RPS, green building requirements), public service programs (e.g. technical assistance, research, and education), and financial incentives (including a variety of policies that promote sustained feedstocks, reduce capital and start-up costs, and offer production subsidies). The study identified 272 state policies in effect as of September 2008 applicable to the forest bioenergy sector. Only four states had policies specifically aimed at promoting the use of forest biomass for energy. These included Alabama's wood-burning heating system deduction, Arizona's qualifying wood stove deduction, Maryland's wood heating fuel exemption, and Missouri's wood energy production credit.

Background and Justification

In another review of state bioenergy policies, the policies were analyzed based on their effects at different stages of the supply chain (harvesting, transportation, manufacturing, and consumer markets) and included building codes and biofuel policies. The policies were divided into six categories: tax incentives, cost-share programs and grants, rules and regulations, financing, procurement, and technical assistance. The majority of biomass policies were aimed at manufacturing and consumer markets, and only a few policies addressed transportation.

This research builds on these efforts by developing a four-tier classification structure to categorize forest electricity and heat policy instruments used in forest biomass electricity and heat policies based on: approach (incentive, regulation, information), type (e.g. tax incentive), subcategory (e.g. tax exemption), and specification (e.g. sales tax exemption). It also used cluster analysis to detect evidence that neighboring states adopted similar numbers and types of policies.

Methods

We compiled a list of federal and state forest bioenergy policies affecting the generation of electricity and heat in effect as of September 2013 using three primary sources: online data-mining, cross-checking and updating the 2008 database, and searching the North Carolina Solar Center's DSIRE database. In accordance with previous studies, the number of policies in our database reflected the federal and state statutes and programs managed by administrative agencies.

We searched for policies specifically targeted towards forest bioenergy, as well as energy policies that apply to multiple renewable energy technologies, one of which included forest biomass. Since our focus was on electricity and heat, we excluded biofuel policies, harvesting regulations, policies focused on wood waste, and building codes. Since we were interested in state and federal legislation, we excluded executive orders, private incentives, and local and regional government legislation. After reading each policy, we coded and classified policies by their approach, type, sub-category, and for some incentive based policies by their specification (see Table 1 – next slide).

Table 1

Classification of policy approaches for forest bioenergy production.

Approach (# policies)	Type (# policies)	Subcategory (# policies)	Specification (# policies)	State implemented (* indicates states with a policy specifically targeting forest bioenergy)	
Incentive (279)	Tax incentive (94)	Tax exemption (46)	Sales/Use tax exemption (18)	CA, CO, CT, GA*, IN, KY, MD*, MS, ND, NE, NV, NY*, OH, SD, UT, VT, WA*, WI	
			Property tax incentive (25)	AK, AZ(2), CO(2), CT, KS, MI, MO, MT(4), NH, NJ, NV (2), NY(2), OH(2), RI, SD, TX, VT	
			Tax exemption zones (3)	MI, OR, UT	
			Tax credit (41)	Investment tax credit (4)	Fed, AL, MT, VT
				Production tax credit (7)	Fed, AZ, FL, IA, MD, MO*, NM
				Corporate tax credit (22)	AZ, GA, KY(2), MI(2), NE, NC(2), ND, NM, OR*(4), SC*, TN, UT(3), VA, WI*
				Personal tax credit (9)	Fed*, MT*(2), NC, OR*(3), SC*, WI*
			Tax deduction (5)	Personal tax deduction (3)	AL*, AZ*, ID*
				Corporate deduction (2)	MA, NM
				Depreciation (1)	Fed
Project finance (97)	Loan (56)	Loan Program (27)	AK, AL(3), CA, CT, IA(3), KY, MI(2), MO, MS, MT, NC, NE, NV, NY(2), OH(2), OK, OR, PA, SC, VA		
			PACE Loan (8)	ME, MI, MO, NH, NV, NY, OH, VT	
			Loan guarantee (1)	Fed	
		Grant (26)	Fed(3), IA, IL(3), IN, KY, MA*(2), MI, NH, OR(3), PA(2), RI, VA, WI		
		Rebate (9)	IL, MA*, MD*, ME*, NH*, NV, NY(2), VT		
Production incentive (88)	Net metering (42)	AK, AR, AZ, CA, CO, CT, DE, DC, FL, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, NC, ND, NE, NJ, NH, NM, NV, NY, OH, OK, OR, PA, RI, SC, UT, VA, VT, WI, WV, WY			
		Renewable energy credit (37)	AR, AZ, CA, CO, CT, DC, DE, FL, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MT, NC, ND, NH, NJ, NM, NV, OH, OR, PA, RI, SD, TX, UT, VA, WA, WV, WI		
		Production payment (9)	CA*(3), HI, ME, MN, RI, SC*, VT		
Regulation (115)	Consumption/production standard (73)	Renewable portfolio standard (38)	AZ, CA, CO, CT, DE, DC, HI, IA, IL, IN, KS, MA, MD, ME, MI, MN, MO, MT, NC, ND, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SD, TX, UT, VA, VT*, WA, WV, WI		
		Public benefits fund (16)	CA, CT, DC, HI, IL, MA, ME, MN, NJ, NY, OH, OR, PA, RI, VT, WI		
		Green power mandate (8)	CO, IA, ME, MT, NM, OR, VA, WA		
		Green power purchasing (7)	Fed, IL, MA, MD, ME, NY, WI		
		Siting and permit regulation (3)	CT, OR, VA		
		Reverse auction (1)	CA		
		Connectivity standard (42)	Interconnection standard (42)	Fed, AK, AR, CA, CO, CT, DE, DC, FL, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, NC, NE, NH, NJ, NM, NV, NY, OH, OR, PA, RI, SC, SD, TX, UT, VA, VT, WA, WI, WV, WY	
		Information (100)	Dissemination (85)	Coordination and Action Plans (25)	AL, CA, CT, DE, HI(2), ID(2), LA, MD, ME(2), NH(2), NC, ND, NJ, NY, OR*, PA(2), RI, VT*(2), WV
				Reporting and disclosure (25)	CA, CO, CT, DE, DC, FL, HI, IA, IL, MA, MD, ME, MI, MN, NJ, NH, NV, NY, OH, OR, PA, RI, TX, VA, WA
				Education and outreach (22)	Fed*(3), AL*(2), CA, CO*, DC(2), MA*, MN*, MT, NC, OH, OR*, PA, TN, TX(2), VT, WA, WI
Technical assistance (13)	Fed, CT*, ID(2)*, MO*, MT*, ND*, NV*, UT*, VT*(2), WI*, WY*				
	Research and feasibility (15)	R & D Grant (9)	Fed*(2), CA, FL, IA, NY*(2), ND, UT		
		Audit & feasibility study grant (6)	AK*(2), ID, NJ*, OR, SD*		

* indicates states with a policy specifically targeting forest bioenergy.

Methods

In addition to the framework of the three policy approaches (incentive, regulation, information), we classified each policy based on how strongly it specifically targeted forest bioenergy production. Indirect policies, such as those that apply to numerous renewable energy technologies, may have a lower impact on forest biomass sector than more direct policies. By including other renewable energy technologies, forest biomass enters into direct competition with more established technologies, which also may be less expensive (or more heavily subsidized). Indirect policies might also have lower impacts on development of forest bioenergy sector if the policy is not tailored to the specifics of bioenergy, is incompatible with forest operations, or ignores feedstock constraints.

We identified three categories of policies, from indirect to more direct, based on their focus on forest biomass energy: (1) general renewable energy policies that are applicable to wind, solar, geothermal, hydro, biomass, fuel cell and other alternative energy technologies; (2) biomass energy policies that target both agricultural and forest biomass bioenergy, including woody and perennial herbaceous crops like switchgrass or willow; and (3) forest biomass energy policies that are focused on logging residues, thinning material, wood manufacturing residuals, wood chips, cordwood, and wood pellets.

Methods

We also used hierarchical cluster analysis, an explorative technique that uses average linkage between clusters to group states with similar policies. The policies were coded and counted according to their focus (forest biomass- and bioenergy-specific vs. general renewable energy policies) and approach (information, regulation, tax incentive, project finance, and production incentive). This allowed us to group states so as to minimize policy differences among states in the same cluster, but maximize policy differences between clusters.

Results/Project Outcomes

We identified 494 state and federal policies in effect as of September 2013 that affect the use of forest biomass for energy: 279 of these were based on incentives, 115 were regulations, and 100 were information policies (Tables 1 and 2). The most widely used incentive policies were project finance (97 policies), tax incentives (94 policies), and production incentives (88 policies). The majority (83%) of policies applied broadly to all renewable energy; 38 policies (8%) addressed biomass energy and 46 policies (9%) targeted forest bioenergy specifically.

The federal government had more policies than any state except Oregon, and used incentives (11 policies) much more often than information (6 policies) or regulatory approaches (2 policies). Oregon had the most policies (22), followed by New York (18 policies), and Vermont and California (16 policies each).

In addition to variation in the number of policies, states' policies used different approaches. While 13 states had three or less incentive policies, some states had significantly more. For example, Oregon had 13 incentive policies, while Michigan and New York each had ten. Every state, however, had at least one incentive policy that qualified forest biomass for governmental support, but few states had legislation specifically promoting forest bioenergy.

Table 2
State and federal bioenergy policy counts by policy approach and focus.

Jurisdiction (as in Ref. [22])	Policy approach			Policy focus			Total# policies
	Regulation	Incentive	Information	Renewable energy policy	Bioenergy policy	Forest bioenergy policy	
Federal Government	2	11	6	11	6	2	19
Northwest							
Alaska	1	4	2	6	0	1	7
Idaho	0	3	5	5	0	3	8
Montana	2	9	2	7	4	2	13
Oregon	5	13	4	16	3	3	22
Washington	3	2	2	5	1	1	7
Wyoming	1	1	1	2	0	1	3
West Coast							
California	4	8	4	14	1	1	16
Hawaii	3	4	3	8	2	0	10
Southwest							
Arizona	1	7	0	7	0	1	8
Colorado	3	7	2	10	0	2	12
Nevada	2	8	2	11	0	1	12
New Mexico	3	6	0	8	1	0	9
Utah	2	7	2	10	0	1	11
Midwest							
Illinois	4	6	1	10	1	0	11
Indiana	2	4	0	6	0	0	6
Iowa	3	7	2	12	0	0	12
Kansas	2	3	0	5	0	0	5
Missouri	1	6	1	6	0	2	8
Nebraska	1	4	0	5	0	0	5
North Dakota	1	5	3	7	1	1	9
Oklahoma	1	4	0	5	0	0	5
South Dakota	2	4	1	6	0	1	7
Great Lake States							
Michigan	2	10	1	12	1	0	13
Minnesota	3	4	2	8	0	1	9
Ohio	3	9	2	12	2	0	14
Wisconsin	4	7	2	8	1	4	13
Northeast							
Connecticut	4	8	3	11	4	0	15
DC	3	3	3	9	0	0	9
Delaware	2	3	2	7	0	0	7
Maine	5	5	3	12	0	1	13
Maryland	3	6	2	9	0	2	11
Massachusetts	4	6	2	9	0	3	12
New Hampshire	2	7	3	9	2	1	12
New Jersey	3	4	3	9	0	1	10
New York	4	10	4	15	2	1	18
Pennsylvania	3	5	4	12	0	0	12
Rhode Island	3	5	2	10	0	0	10
Vermont	3	8	5	10	3	3	16
Southern Appalachia							
Kentucky	1	6	0	7	0	0	7
North Carolina	2	6	2	10	0	0	10
Tennessee	0	1	1	2	0	0	2
Virginia	4	5	1	10	0	0	10
West Virginia	2	2	1	5	0	0	5
Southeast							
Alabama	0	4	3	5	0	2	7
Arkansas	1	2	0	3	0	0	3
Florida	1	4	2	6	1	0	7
Georgia	0	2	0	0	1	1	2
Louisiana	1	2	1	4	0	0	4
Mississippi	0	2	0	2	0	0	2
South Carolina	1	7	0	5	0	3	8
Texas	2	3	3	7	1	0	8
Total	115	279	100	410	38	46	494

Results/Project Outcomes

The diffusion of policy literature demonstrates that policy transfers can occur between policymakers from different states. Similarly our cluster analysis found regional clusters of state bioenergy policies (Fig. 1 – next slide). For example, Oregon's policies were very different from other states, and it was singled out into its own cluster because it had the highest number of tax incentives and biomass-specific policies. New York and Vermont (Cluster 6) enacted the most project finance and information policies and their policies were focused on biomass (Table 3 – next slide).

States in clusters 3 to 7 had higher average numbers of policies and mixed policy approaches, which some suggests is one of the key factors for the success of forest bioenergy industry. California, Maine, and Pennsylvania (Cluster 4) preferred a mix of regulation, information, and production incentives to tax incentives, while the 14 states in Cluster 5 had a mix of policy types, but did not have many biomass specific policies. Arizona, Montana, and Utah (Cluster 3) enacted many tax incentives, but only one, Montana, had a project finance incentive. Alabama and Idaho (Cluster 2) favored information policies, but had no production incentives or regulations. In sum, most states offered a mix of integrated policies, rather than policies focused on regulations and technology improvement, which is regarded as important for development of forest biomass industry.

Most Southern, Southeast, Southern Appalachia and Midwestern states were grouped into Clusters 1 and 2. These states had limited biomass and forest biomass-specific policies (see Table 3), indicating that biomass was not a focus of energy policy in these states.

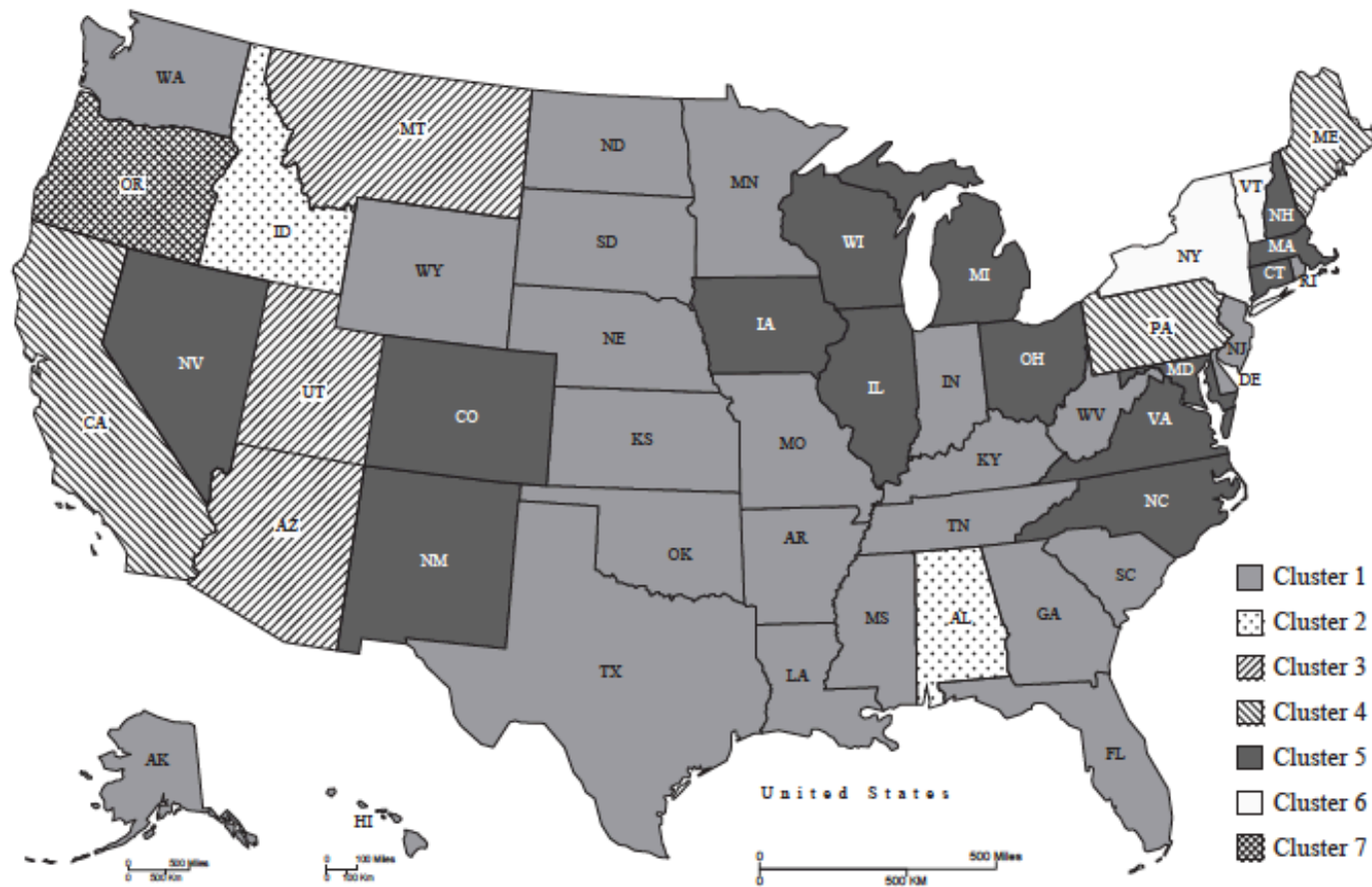


Fig. 1. Hierarchical cluster analysis: grouping states in seven clusters by policy approach and focus.

Table 3
Average number of state policies by focus and type, by cluster.

Cluster number	Policies focused on forest biomass and bioenergy	Information policies	Production incentive	Project finance	Regulation	Tax incentive	Number of states in cluster
1	0.7	1.2	1.5	1.0	1.5	1.0	26
2	2.5	4.0	0.0	2.0	0.0	1.5	2
3	2.7	1.3	1.6	0.3	1.7	5.7	3
4	1.0	3.7	3.3	2.3	4.0	0.3	3
5	1.7	1.7	2.0	2.9	3.1	2.1	14
6	4.5	4.5	1.5	4.5	3.5	3.0	2
7	6.0	4.0	2.0	3.0	3.0	9.0	1
Average	2.7	2.9	1.7	2.3	2.4	3.2	

Implications and Applications in the Northern Forest region

In contrast to previous studies that included policies aimed at biomass feedstock producers, our research specifically focuses on policies targeting electricity and heat producers who utilize forest biomass as a feedstock and range in scale from large-scale (utilities, independent power producers) to commercial and residential (businesses and homeowners). In this manner, our study investigates the incentives that are available to Northern Forest energy producers to utilize forest biomass from the time the feedstock reaches the generating facility to the time the electricity/heat is used up on site or fed into the distribution network.

If policy information was more transparent or compiled in a single depository, it might reduce complexity for Northern Forest states and business owners with respect to available support and compliance, and also provide the public information on public spending on different programs. At the moment, Northern Forest states interested in evaluating forest bioenergy policies must use multiple sources, including time-consuming personal communications with program managers, to gather information about the programs, since information on spending and policy impacts is rarely tracked and largely unavailable to policymakers, administrators, or the public. Northern Forest states should consider addressing this issue by developing a depository for their states' forest biomass energy policies. Doing so would increase policy transfer among Northern Forest states.

Future Directions

While increasing numbers of federal and state forest biomass electricity and heat policies indicate governments' increased acceptance of forest biomass as a renewable energy feedstock, an important next step in forest bioenergy research is to evaluate the effectiveness of state forest biomass energy policy. A four-tier policy classification system for policy categorization developed in this research can be more readily used for policy effectiveness evaluation than working with more general policy categories.

In addition, our study illustrated that policies addressing forest biomass have three foci, which depend on how specifically policies target forest biomass energy. While forest bioenergy-specific approaches are more likely to be tailored to the specifics of bioenergy, general renewable energy policies may be easier for governments to enact, because they are supported by more advocacy groups and often have less impact on existing infrastructure. Evaluation whether forest bioenergy-specific policies or more general policies are better suited for meeting renewable energy targets is recommended for future research.

Finally, our analysis revealed that neighboring states (e.g. Northern Forest states, the Lake States) adopted similar number and type of policies, providing evidence to policy diffusion across state lines. The cluster analysis also shows which states had the most dissimilar policies, with Oregon being the most different from the Southern, Southeast, Southern Appalachia and Midwestern states. This method added a quantitative analysis component to what are usually descriptive or qualitative policy diffusion studies. Future research should focus on clustering states depending on the amount of spending dedicated to forest biomass energy, as well as analyzing the timing of policy transfer.

List of products

Peer-reviewed Publications

Ebers, A., and R.W. Malmshemer, D. Newman, and T.A. Volk. 2016. Inventory and Classification of United States Federal and State Forest Biomass Electricity and Heat Policies. *Biomass and Bioenergy* 84:67-75.

Presentations

Ebers, A., R.W. Malmshemer, D. Newman, and T.A. Volk. 2013. Inventory of National Forest Biomass Policies. Society of American Foresters' National Meeting, Charleston, SC, October 23-27.