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Impacts of the Biomass Producer or Collector Tax Credit on Oregon's Wood Fuels Market and Economy

Update and alternate scenario consideration

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Executive summary

Although Oregon's active forest sector and extensive forests make wood a plentiful source of energy, the costs of handling and transporting woody biomass can be a significant obstacle to increased use of this energy source. Oregon's Biomass Producer or Collector (BPC) Tax Credit offsets costs for transporting and processing biomass used in the production of bioenergy. We quantified how the BPC Tax Credit has changed the amount of woody biomass used for bioenergy and the price of woody biomass in Oregon in 2011. Further, we estimated the amount of economic activity created within Oregon from additional work to collect and transport woody biomass supported under the BPC Tax Credit program. Finally, we described two potential alternate program formulations for consideration in reviewing and evaluating modifications.

Changes in woody biomass use and price

In 2011, an extra 182,000 dry tons of woody biomass was used for bioenergy production in Oregon

over and above what was expected based only on market conditions. The BPC Tax Credit program is believed to have promoted use of a sizable portion of that biomass. Other factors, such as increased availability of logging residues because of a rebound in demand for wood, likely also influenced increased use of woody biomass. Our findings for year 2011 are consistent with our previous analysis which found increased use of woody biomass for the BPC Tax Credit period 2007–10.

The BPC Tax Credit can reduce the cost of supplying woody biomass to bioenergy plants and because of that we expected the average price of woody biomass to be reduced when the tax credit was in place. We found the price of woody biomass in 2011 to be nearly \$11 per dry ton less than (a 21 percent reduction) what would otherwise be expected based on market conditions alone. That finding is consistent with what we previously found for the earlier BPC Tax Credit years, when prices were be-

tween about \$6 and \$17 per bone dry ton less than would otherwise be expected.

Economic activity from woody biomass production

Economic activity is created as companies collecting, producing, and transporting woody biomass pay workers and purchase supplies. In 2011, handling and transport of the extra biomass associated with the BPC Tax Credit supported between 30 and 71 full and part time jobs in Oregon. Wages and income to Oregon workers and business owners was between \$1.4 and \$3.3 million. In 2011, economic activity generated within Oregon, in association with the BPC Tax Credit program, was between 1.3 and 3.6 times greater than the total tax credits granted under the program.

Program considerations and alternate formulations

The BPC Tax Credit program is currently authorized through 2017 and was revised in 2011 with lower credit rates for woody biomass, removal of some urban biomass feedstocks from the program, and inclusion of electric-only bioenergy generators as qualifying program facilities beginning in 2012. Despite program changes, the amount of woody biomass certified under the program in 2012 was mostly unchanged from previous years. There has been discussion about changing the formulation of the BPC Tax Credit program and legislation has been considered in recent sessions. We developed and described two potential alternate formulations: 1) a tax credit for bioenergy production using targeted biomass feedstocks and 2) incentives for capital expenditures to expand bioenergy production capacity.

A program aimed at bioenergy producers who use woody biomass would directly benefit the bioenergy producers with a tax credit and indirectly benefit suppliers of woody biomass who could take advantage of increased demand for woody biomass. Those biomass suppliers located nearest bioenergy facilities (i.e., those on Oregon's westside) may be in the best position to benefit. Biomass suppliers located in eastern Oregon and those who currently receive a tax credit for biomass that is transported to out-of-state bioenergy facilities may receive less benefit under this program formulation. Program rules may have to be formulated to target desired outcomes and ensure accountability.

As with the previous alternate formulation, an incentive to support expanded bioenergy production capacity would directly benefit bioenergy producers and indirectly benefit Oregon suppliers of woody biomass. However, only those biomass suppliers selling material to new or expanded facilities may benefit from this program formulation. A capacity incentive program could be aimed at small-scale biothermal capacity, such as facilities commonly used at schools, hospitals, and government buildings, or at large co-generation or stand-alone facilities. At current program costs, perhaps 10 small-scale biothermal facilities might be supported per year; current program costs could likely support a limited number of large facility expansions in a given year. Program rules may be needed to ensure that targeted types of biomass are used and to ensure that expanded bioenergy capacity is achieved through the program—not simply replacement of existing capacity.

Alternate policy formulation scenarios

	Who benefits?	What is the potential magnitude and lasting effects?	Efficiency and administrative considerations.	Implementation options.
Continue current implementation	<ul style="list-style-type: none"> ▪ Biomass producers and collectors who receive the tax credits ▪ Accountants, brokers and others providing transfer services ▪ Bioenergy producers indirectly benefit from a lower biomass price 	<ul style="list-style-type: none"> ▪ Woody biomass likely remains the primary feedstock supported by the program ▪ Benefits last through the program sunset 	<ul style="list-style-type: none"> ▪ Current certification working effectively ▪ Natural cross-check between sellers and purchasers of biomass creates built-in accountability 	<ul style="list-style-type: none"> ▪ Differential tax credit rates based on cost of production or energy value of the feedstock ▪ Differential tax credit rates based on geography or economic or ecological program goals
Biomass production tax credit	<ul style="list-style-type: none"> ▪ Bioenergy producers who receive the tax credit ▪ Biomass suppliers receive an indirect benefit as demand for biomass increases 	<ul style="list-style-type: none"> ▪ Greater use of woody biomass and other feedstocks ▪ Benefits last through the program sunset 	<ul style="list-style-type: none"> ▪ Implementation may require identifying biomass feedstocks of interest ▪ Current tax recipients who transport biomass out of state may receive lower program benefit ▪ Additional monitoring and accountability would be required 	<ul style="list-style-type: none"> ▪ Differential tax credit rates based on geography or economic or ecological program goals
Incentives for capital expenditures to expand bioenergy production capacity	<ul style="list-style-type: none"> ▪ Institutions and businesses who can build or expand bioenergy production ▪ Biomass suppliers receive an indirect benefit as demand for biomass increases ▪ Local communities may benefit from bioenergy facility construction 	<ul style="list-style-type: none"> ▪ Construction of up to about 10 small-scale biothermal facilities per year at current program funding ▪ Limited support for large facility construction at current program funding level ▪ Increased biomass demand would last for operating life of the new facility 	<ul style="list-style-type: none"> ▪ Implementation requires establishment of an entirely new program ▪ Budget level for the incentive would need to be determined and would influence program scope and amount of new capacity supported 	<ul style="list-style-type: none"> ▪ Implementation could require specific biomass feedstocks be used ▪ Program could focus on specific Oregon regions of interest or projects that address the economic or ecological goals of the overall program



Introduction

Increased production of energy from renewable sources has received much attention as a way to reduce reliance on fossil fuels, encourage energy independence, and create new economic activity. Bioenergy (liquid fuels, heat, and electricity) is one in a suite of potential renewable energy approaches. Biomass material to support bioenergy production can be generated from products and wastes in the agriculture and forest sectors and from urban wastes (yard and construction debris, food wastes, etc.), among others. The use of woody biomass obtained from forests has the potential additional benefits of contributing to hazardous fuels reduction and other forest management goals. Rural forest communities also can benefit from economic activity created from biomass production and its use in energy generating facilities.

Economic conditions can be a challenge to significant expansion in the use of woody biomass for bioenergy despite the potential co-benefits to forests and communities. In particular, transportation and processing costs and the prices of alternate energy sources can serve as significant impediments.¹ Federal and state policy makers have developed

incentives to increase renewable energy production including bioenergy. These policy incentives have been aimed at improving bioenergy conversion technology, reducing the costs of producing and transporting biomass, and increasing demand for bioenergy. In Oregon, the Biomass Producer or Collector (BPC) Tax Credit acts to offset costs in transportation and processing. The BPC Tax Credit was first implemented in 2007 and is authorized through tax year 2017. Total tax credits issued in the initial years were low but annual credits have increased in recent years. Tax year 2011 saw the greatest annual tax expenditure to date, with about \$5.6 million in tax credits issued. There have been recent discussions in the legislature about revising the program formulation. For example, Oregon House Bill 3104, which was considered but not voted on by the 2013 Oregon legislature, would transfer the eligibility for the credit from the producers and collectors of biomass to the producers of bioenergy. Given the potential for changes to the law and a possible review of the BPC Tax Credit by the Oregon Legislature, we updated our analysis of the economic effects of the tax credit and analyzed the potential impacts of several alternatives to the current policy.

Previous research and present study purpose

This report serves to update and extend a previous report that examined the effect of the BPC Tax Credit in 2010.² That report found additional use in 2010 of woody biomass, over and above market expectations, with the BPC Tax Credit in place. Additionally, under the BPC Tax Credit, 2010 prices for woody biomass were about \$13 less per bone dry ton (BDT) than would otherwise be projected. Based on conservative estimates of the amount of new economic activity from woody biomass production, the original study estimated that in 2010 the BPC Tax Credit supported between 32 and 73 full and part-time jobs and between \$1.5 million and \$3.4 million in wages and benefits. Extra woody biomass collection and processing in 2010 generated economic activity equivalent to about 2.4 times the program's cost (the total tax credits certified for woody biomass). Even under the most conservative alternative considered, the program was found to have generated economic activity equal to at least the value of the tax credits provided under the program.

However, other programs were in place during the period of analysis that could also have contributed to increased biomass production. For example, the American Recovery and Reinvestment Act (ARRA) provided funding for woody biomass projects involving public and private forests throughout Oregon. Oregon's Business Energy Tax Credit (BETC) and the federal Woody Biomass Utilization Grant (BUG) program, which supported capital infrastructure for bioenergy and renewables, were also available. Many of the grinders, trucks, and other equipment used to collect and process biomass received BETC or Woody BUG funding when purchased. The presence of these other incentives made it difficult in the previous analysis to identify the specific influence of the BPC Tax Credit alone on Oregon woody biomass markets. With the end of ARRA and the expiration of BETC, 2011 offered the opportunity to more closely examine how the BPC Tax Credit uniquely influences Oregon's woody biomass markets.

This study extends our previous efforts to consider how the current implementation, and potential alternate future implementations, of the BPC Tax Credit influence Oregon's economy. Again, we focus on woody biomass, which accounts for the vast majority of material credited under the BPC Tax Credit. In this report, we first use newly-available data for 2011 to update our previous analysis of how the BPC Tax Credit likely influenced the woody fuels market in Oregon and the associated economic impact of that change. Second, we describe potential effects of maintaining the existing BPC Tax Credit policy versus two alternatives: 1) a bioenergy production tax credit and 2) incentives for capital expenditures to expand bioenergy production capacity in Oregon.



The Biomass Producer or Collector Tax Credit in 2011

Program implementation in 2011 remained mostly unchanged from 2010.³ Biomass eligible for the BPC Tax Credit included, among other materials, logging residues from timber harvesting, material from fuels reduction activities, crop residues from agriculture production, and agriculture wastes such as manure. Woody material used must have been sourced in Oregon. To be eligible to earn the tax credit, an individual or company must have been an Oregon taxpayer, held title to the biomass material when it was delivered, and have caused the delivery of the material for use in bioenergy production in Oregon or elsewhere.

If the biomass material was used to produce electricity in 2011, the biomass must have been used by facilities that generate both electricity and useful thermal energy or co-generation facilities as defined by the Public Utility Regulatory Policies Act found at 18 CFR 292.205. Biomass delivered to stand-alone electric generation facilities was not eligible. Facilities that produced only heat from burning biomass (thermal-only facilities) were qualifying facilities in 2011. Beginning in 2012, biomass material used in a stand-alone electric generation facility became eligible. Most woody biomass credited under the current program was utilized at facilities producing both electricity and heat and located on-site at wood processing facilities. In 2011, the credit for eligible woody biomass was \$10 per green ton. When measuring on a “green weight” basis, the weight of woody biomass is reported with existing material moisture. In 2010, the average moisture content of the woody material receiving a BPC Tax Credit was 44 percent.

Tax credits issued under the program can be transferred between parties. When a transfer occurs, the minimum transferred tax credit value has to be at least 90 percent of the original credit value. This arrangement allows the producer or collector to receive cash from a third party in exchange for transfer of the tax credit. Receiving cash, rather than a tax credit, can be desirable for a producer or collector who may not have the tax liability to fully utilize the value of the credit.

Although a tax credit is intended to provide an incentive, it also can create a cash flow management challenge. We earlier found that one impact of the tax credit was to reduce the price paid to a woody biomass collector; this price was approximately the value of the transferred tax credit. If a producer or collector receives a lower payment from the energy facility and does not have the tax liability to use the tax credit, they must wait to apply for a tax credit certification and for the application to be processed, and then must market the tax credit to a transferee before they can realize the value of the tax credit that was contributing to a lower payment from the energy facility. This creates a lag time before the producer or collector can realize the value of the credit. In addition, there are often fees charged by consultants or brokers and other transaction costs associated with transferring the credit, further diluting the value. These fees and other transaction costs can be up to 5 percent or more of the total value of the tax credits. Producers and collectors of other types of biomass, such as agriculture wastes, may have a level of tax liability that allows those operators to directly use the tax credit rather than transferring it to a third party. This ability to use the tax credit directly, rather than transfer it and incur transaction costs, allows producers of other types of biomass to use the full value of the tax credit. However, in previous program years, nearly all of the tax credits derived from forest biomass were transferred from the entity initially receiving the credit.

Table 1 Biomass Producer and Collector Tax Credit rates and 2010 and 2011 utilization

Biomass type	Credit rate	Units	2010 volume	2011 volume	2010 tax credits	2011 tax credits
Woody biomass	\$10.00	Wet tons	480,423	413,691	\$4,726,764	\$3,909,205
Manure	5.00	Tons	92,048	141,505	457,843	708,357
Oil seed	0.05	Pounds	314,260	829,160	15,713	41,458
Used oil and grease	0.10	Gallons	1,614,462	2,856,969	152,676	285,697
Vegetative biomass	10.00	Tons	13,790	24,887	137,903	277,257
Yard debris	5.00	Tons	12,557	28,357	55,875	379,618
Wastewater biosolids	10.00	Tons	405	0	4,051	0
All types					\$5,550,825	\$5,601,592

In 2011, more than \$5.6 million in tax credits were certified under the BPC Tax Credit program for a variety of biomass types (see Table 1, page 6). Nearly 70 percent of the credited value (\$3.9 million) was provided for woody biomass. Manure and yard debris accounted for the next highest credited values, although they were a distant second and third. In total, 113 applications for the BPC Tax Credit were certified. Tax credit applications for wastewater biosolids and bedding material were also received but determined to be ineligible.

The total value of BPC tax credits provided in 2011 (\$5.6 million) was very similar to that in 2010 (\$5.5 million). However, the volume of woody biomass credited under the program declined between 2010 and 2011 by upwards of 70,000 tons. In 2010, woody biomass accounted for nearly 85 percent of total credited value. For each of the other types of biomass, the share of the total credited amount increased between 2010 and 2011. Of those other types, manure biomass, an important agriculture biomass feedstock, had the greatest increase in credited share during the period—from 8 percent to 13 percent.

Approach

The goals of the original report⁴ were to identify how the BPC Tax Credit influenced the consumption of and prices for woody biomass and to examine the economic activity associated with increased woody biomass production resulting from the tax credit. We replicate that analysis here, focusing on year 2011. We address three specific questions:

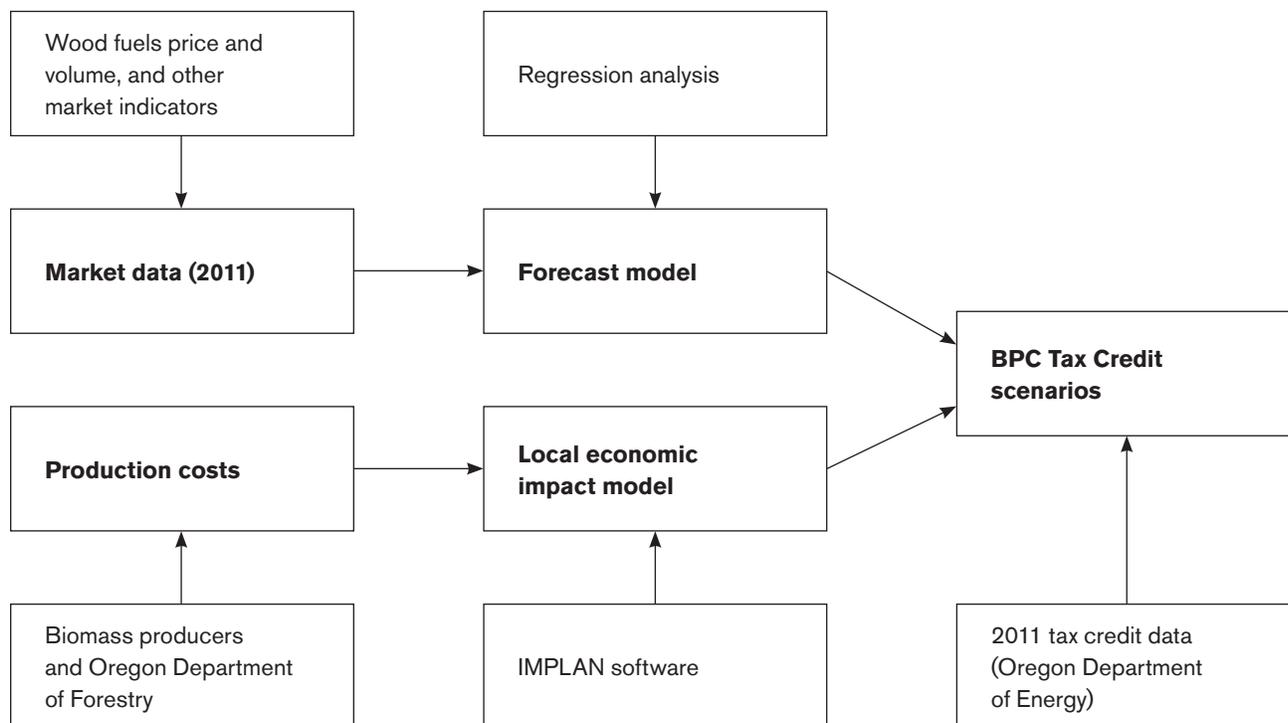
1. How much did the credit influence the volume of woody biomass collected and the prices paid for woody biomass?
2. How many jobs were created and how much economic activity was generated in Oregon from woody biomass collection activities and delivery to energy facilities?
3. What are other possible policy scenarios for spending the same amount of money to foster biomass energy development?

To answer the first question, we compared actual market conditions observed in 2011 with output from regression models built to forecast market conditions if the BPC Tax Credit did not exist (see Appendix 1, page 26). We assumed that the differences between the forecast and what actually occurred were mostly related to the presence of the BPC Tax Credit. We then estimated the amount of economic activity generated in Oregon because of the production of extra woody biomass (question two). To do this we applied our measurement of how much extra woody biomass was produced in 2011 to an economic input/output model constructed for Oregon (see Appendix 1, page 26). That model measured how changes in demand for woody biomass traced through Oregon's economy to create broader changes in employment, income, and economic output (see Figure 1, page 8).

Finally, we identified several policy formulations for the credit and we described the potential effects of those policies on biomass production and use in Oregon (question three). Three potential policy formulations were considered:

- A continuation of the current 2012 implementation of the BPC Tax Credit
- A revised program where bioenergy producers receive a tax credit for use of eligible biomass
- A different program that supports creation of new bioenergy facilities or expansion of existing bioenergy production capacity

The potential effects of these alternate policy formulations are based on our understanding of how the current program is functioning and knowledge of bioenergy markets and similar programs. We identified a variety of program considerations specific to Oregon.

Figure 1 Research approach to evaluating the economic effects of the BPC Tax Credit

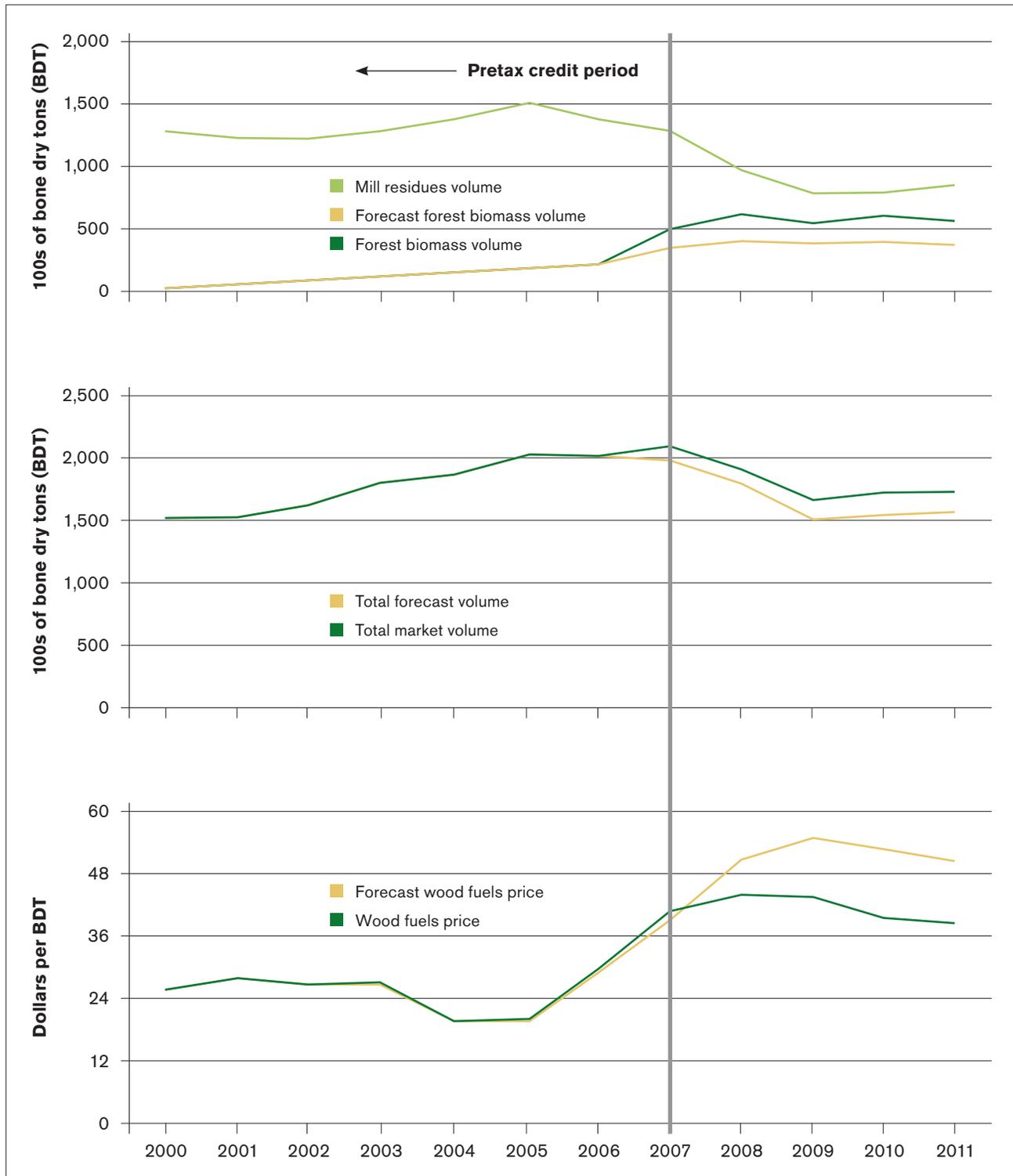
Market influence and economic activity from the BPC Tax Credit

Woody biomass usage and prices

Our expectation was that the BPC Tax Credit would lead to increased use of woody biomass for bioenergy. We compared actual levels of woody biomass use during the BPC Tax Credit period (2007–11) with what would be forecast in the absence of the tax credit. During the BPC tax period studied, annual use of woody biomass for bioenergy was about 167,000 BDT per year greater than market-only expectations (see Figure 2, page 9). For 2011, the volume of woody biomass used for bioenergy was about 182,000 BDT greater than the market-only forecasted amount.

Because the tax credit reduces the costs for collection and transport of biomass, we expected the BPC Tax Credit to result in lower woody biomass prices. We compared the actual prices for woody biomass in the BPC Tax Credit period with what would otherwise be forecast in the absence of the tax credit. The actual prices for woody biomass in the BPC Tax Credit years have consistently been lower than the forecast based only on market behavior (see Figure 2, page 9). For 2008–10, actual prices for woody biomass were \$6.87/BDT to \$17.47/BDT less than expected based on market conditions alone (a price decline of between 12 percent and 24

Figure 2 Wood fuel market observed and forecast annual volume and price trends



percent). In 2011, actual prices for woody biomass were \$10.68/BDT less than the forecast without the BPC Tax Credit (a price reduction of 21 percent).

From our comparisons between actual observations and forecast market conditions, the BPC Tax Credit likely increased the amount of woody biomass used for bioenergy and lowered prices. In 2011, up to 32 percent less woody biomass would have been used for bioenergy if the BPC Tax Credit was not in place. Similarly, in 2011, the price for woody biomass was 21 percent less than what was expected if the BPC Tax Credit was not in place. Both of these results are consistent with our previous findings for 2010.

Economic impact from woody biomass production

Collecting, producing, and transporting woody biomass for use in bioenergy facilities spurs economic activity. Demand for woody biomass instigates direct economic activity as businesses and individuals purchase goods and services from other companies and hire employees in the course of collecting and transporting biomass. That direct economic injection causes a chain reaction of indirect economic activity as supporting companies also make new purchases of supplies and services. Finally, employees and proprietors induce economic activity in local communities as they spend their earnings from employment associated with supplying biomass. Combined, those direct, indirect, and induced effects form the economic impact associated with increased biomass production as a result of the BPC Tax Credit. Although some woody biomass material credited under the program is transported to and used at energy facilities located in neighboring states, we assume that the Oregon producers and collectors receiving the credits are hiring employees and purchasing equipment and fuel within Oregon. Therefore, for the purposes of this analysis we make a simplifying assumption that all of the economic activity caused by the presence of the BPC Tax Credit accrues to Oregon.

The additional woody biomass collected and transported because of the BPC Tax Credit creates new economic activity over and above what would have otherwise occurred. In 2011, the volume of woody

biomass consumed in Oregon was about 182,000 BDT greater than the regression model forecasted based on market conditions alone. Some portion of that additional woody biomass consumed was in response to the incentive created through the BPC Tax Credit. Although the tax credit certainly had some role, other factors likely also contributed to the consumption of more woody biomass. To account for the presence of those other factors, the previous report, analyzed three scenarios wherein the BPC Tax Credit was assumed responsible for 75, 50, and 32 percent of the increased woody biomass volume occurring in the year. Adopting those same scenarios, in 2011, the BPC Tax Credit could have been responsible for between 136,500 BDT (75 percent of increased volume) and 58,240 BDT (32 percent of increased volume) of additional woody biomass consumption (see Table 2, page 11).

The economic model used in this analysis, IMPLAN, operates by tracing how a change in demand for some good or service—demand for more woody biomass in this case—creates responses in demands for other associated goods and services and changes employment. Within the economic model, the sectors of the economy are linked and changes in one sector influence other sectors. The “ripple” of economic activity that is created as linked sectors activate results in what is commonly referred to as the “multiplier effect.” Accounting for all of those “ripples” of economic activity, additional woody biomass collection and transport associated with the BPC Tax Credit supported between 30 and 71 full- and part-time jobs within Oregon in 2011. Those jobs corresponded to wages and income of between \$1.4 million and \$3.3 million. In total, collecting and transporting the additional woody biomass associated with the BPC Tax Credit created new economic activity in Oregon worth between \$5.1 million and \$11.8 million.

We can put the economic effects of the program into perspective by comparing that economic activity with the cost of the program. In 2011, the State of Oregon provided about \$3.9 million in tax credits for the woody biomass certified under the program. Under the most conservative alternative (58,240 BDT of woody biomass directly resulting

Table 2 BPC Tax Credit program 2011 characteristics and economic impact alternatives for Oregon's economy**A. Actual 2011 BPC forest biomass program characteristics**

BPC tax expenditures on forest biomass (\$)	\$3,909,205
Percent of total BPC Tax Credit program	70%
BPC forest biomass volume (BDT)	413,691
Extra biomass over market projection (BDT)	182,000

B. Scenario-based economic impacts of the forest biomass component of the BPC Tax Credit

	Alternative 1 (75%)	Alternative 2 (50%)	Alternative 3 (32%)
Forest-based biomass generated by the tax credit (BDT)	136,500	91,000	58,240
Percent of forest biomass unexplained by market	75%	50%	32%
Percent of total 2010 certified tax credits	33%	22%	14%
Jobs supported by the tax credit	70.8	47.2	30.2
Wages and benefits (\$1,000s)	\$3,290	\$2,193	\$1,401
Total economic activity attributed to the credit (\$1,000s)	\$11,848	\$7,899	\$5,055
Net tax expenditure (\$1,000s)	\$3,270	\$3,430	\$3,590
Tax credit multiplier	3.6	2.2	1.4

from the program), the value of all economic output was 1.3 times the value of the provided tax credits. Economic output under the largest production alternative (136,500 BDT) was 3.6 times the value of the provided tax credits. Consistent with our previous findings, the BPC Tax Credit program in 2011 generated at least as much, and likely much more, economic activity as foregone tax revenue.

Current and expected implementation to 2017

The BPC Tax Credit was established in 2007 as part of House Bill 2210. This bill was a legislative proposal from the Governor's Office to grow the biofuels market in Oregon with a combination of a liquid fuel blending standard and property tax incentives for processing facilities, tax incentives for growers of feedstock (BPC credit), and tax incentives for consumers of high blend biofuels. During testimony on this bill the issue identified for the BPC Tax Credit was the high cost of producing feedstock compared to other commodities.⁵ The BPC Tax Credit is cur-

rently authorized through tax year 2017. Between 2007 and 2011, the implementation of the BPC Tax Credit remained largely unchanged, although certification of these tax credits was required, by House Bill 2078, beginning in 2010. The legislative and program implementation history was discussed in our previous report.⁶

There were significant alterations in implementation of the BPC Tax Credit program between 2011 (the focus of our analysis) and 2012. The changes to BPC Tax Credit implementation in 2012 involve the program credit rates, the types of biomass eligible for credit, and where eligible biomass can be used. Most pertinent to woody biomass, the \$10 tax credit provided for collection and transport of woody biomass was changed from a per-green-ton to a per-bone-dry-ton basis. Converse to a "green ton," a BDT is the material weight if the moisture content was driven to zero. Before 2012, one ton of green woody material would receive a \$10 credit. Beginning in 2012, and assuming 44 percent moisture content, it would take about 1.8 tons of green

woody biomass to receive the same \$10 tax credit. In addition to the change in weight basis, beginning in 2012, yard debris and municipal food wastes were no longer eligible biomass feedstocks. Further, requirements that biomass must be used in a cogeneration or thermal-only facility have been removed. This change allows biomass used in electric-only bioenergy facilities to receive a BPC Tax Credit. Few such facilities currently exist in Oregon but others, that may purchase eligible material, exist in neighboring states.

Alternate policy formulation scenarios

Under the current formulation, the BPC Tax Credit program offers an incentive to those producing, collecting, and transporting biomass for use in bioenergy facilities. The tax credit does serve to offset a portion of the production costs faced by suppliers. A wide variety of biomass types are recognized under the program. Those biomass types differ in their energy contents, the costs of production, the types of facilities using the biomass, and the conversion technologies used for bioenergy generation.

Under the program, there is an incentive to use particular types of recognized biomass (e.g., woody biomass or manure) in the generation of bioenergy. In the current program formulation, the tax credit rates for recognized types of biomass are set, and changed, in statute. Credit rates are not necessarily reflective of market conditions for differing types of biomass nor do they explicitly reflect the differing costs of production or energy contents of the different biomass types. Finally, there are no differential tax credit rates in the current program for different types (i.e., biofuel, biothermal, bioelectric, or combined heat and power) of bioenergy production.

Expanded production of bioenergy and biomass feedstock faces a number of challenges. Although bioenergy can be used on-site by producers (e.g., at wood processing facilities), bioelectricity is often supplied to meet general consumer demand. Electricity demand has been slowly growing over the recent short term. In the Northwest, electricity demand is met with a variety of resources. Hydro-

electric comprises approximately 39 percent, coal about 35 percent, natural gas is about 16 percent, with the remainder comprised of nuclear and renewable sources. Biomass power provides about $\frac{3}{4}$ of 1 percent of Oregon's electricity.⁷ Although renewable portfolio standards adopted in many states promote the use of renewable energy, and biomass is a qualifying resource under Oregon's RPS, wind-generated electricity has proven attractive to electricity purchasers in the Northwest.

Aside from energy markets, there are other challenges to expansion of bioenergy use and biomass production.^{8,9} Producing biomass through either collection of waste products or dedicated energy crops often requires changes in practices in forest or agriculture sectors. For example, rather than piling and burning logging residues at a harvest site, those residues must now be collected, handled at a log landing, and transported off site. In some cases, the skills or knowledge to produce or collect biomass may be lacking in the local workforce. Additionally, existing federal or state forest policies and practices may make it difficult to take full advantage of potentially available biomass. Finally, negative perceptions by the public regarding the use of biomass or production of bioenergy may make it difficult or undesirable to expand production of biomass or bioenergy.

Between 2007 and 2011, the BPC Tax Credit has supported increased use of woody biomass created from forest restoration treatments, logging residues, and other in-woods sources for the production of bioenergy in Oregon. Although the share of in-woods biomass being used for energy production has increased over the period, there was a decline in the total volume of all types of biomass (logging residues, mill residuals, etc.) used to produce bioenergy. This suggests that the BPC Tax Credit has not necessarily led to increases in overall production of bioenergy from all types of woody biomass (logging residues, mill residuals, etc.). Regardless, observed patterns of the amount of in-woods woody biomass consumed and the price for delivered woody biomass both changed from what would be expected based solely on market conditions. Further, the collection of the additional in-woods woody biomass

Table 3 Biomass Producer or Collector Tax Credit rates and 2012 utilization

Biomass type	Credit rate	Units	Volume	Tax credits
Woody biomass	\$10.00	wet tons ¹	500,094	\$2,200,414
Manure	5.00	tons	145,043	725,215
Used oil and grease	0.10	gallons	3,107,763	310,776
Vegetative biomass	10.00	tons	6,302	63,016
Yard debris	5.00	tons	337	1,683
Wastewater biosolids	10.00	tons	261	2,606
Total				\$3,303,710

¹In 2012, the credit rate was \$10 per bone dry ton. Here we report woody biomass weight in wet tons, assuming 44% moisture, to be consistent with Table 1, page 6

produced because of the program generated economic activity that was at least as great as the tax credits offered under the program.

The amount of woody biomass certified under the BPC Tax Credit was about the same in 2012 as in previous program years (see Table 3, above). The reduction in the tax credit rate did not appear to have affected the amount of woody biomass material certified under the program. However, other program changes, including allowing bioelectric-only facilities to be eligible biomass users, and an increase in logging activity in 2012 may have also influenced the amount of material in the program. We do not have data to complete a full analysis for year 2012. However, given that woody biomass volumes remained about the same, the program likely continued to generate economic activity at levels similar to previous program years. To the extent that job creation is a goal of the BPC Tax Credit, the 2012 implementation is proving consistent with that goal.

To aid in policy discussions for the remaining BPC Tax Credit program years, we consider a continuation of the current program and two alternate program scenarios:

- A revised program where bioenergy producers in Oregon receive a tax credit for use of eligible biomass, and
- A program that supports creation of new bioenergy facilities or expansion of existing bioenergy production capacity in Oregon.

For each scenario, we address several considerations:

- Which parties benefit from the program?
- What are the potential magnitude and lasting effects?
- What are some efficiency and administrative considerations?
- What alternative formulations might be considered?

Continuation of current implementation approach

Which parties benefit from the program? Biomass producers and collectors receive direct benefits from the current implementation of the BPC Tax Credit program. Those tax credits serve to offset costs to collect and transport biomass to bioenergy facilities. In 2011, about 35 different entities received a tax credit for collection and transportation of woody biomass. In 2012, BPC tax credits were received for woody biomass collection and transport by about 23 different entities. The majority of those operators were located in western Oregon. Because many of the tax credits are transferred between parties, accountants, brokers, and others offering services necessary for trading credits also benefit from increased requests for services under the program.

The producers of bioenergy appear to receive an indirect benefit from the BPC Tax Credit program. The results of our analyses indicate that bioenergy

producers used more woody biomass when the BPC Tax Credit was in place than would be expected based solely on market conditions. This suggests that bioenergy producers are taking advantage of an increased amount of available woody biomass with the BPC Tax Credit in place. Additionally, the prices for woody biomass, with the BPC Tax Credit in place, were lower—a benefit to bioenergy producers—than what would be expected based on market conditions alone.

Rural communities with operating biomass collection and transport businesses receive an indirect benefit from the increased economic activity associated with the production of extra biomass. The magnitudes of those indirect benefits differ across regions. In our previous analysis, we showed that woody biomass collection and transport in western Oregon created greater economic activity than the same activity in eastern Oregon. That is because there are greater economic linkages in western Oregon than in eastern Oregon. Regardless, most operators receiving BPC tax credits are located in western Oregon. Because there are more biomass collectors and producers, the indirect benefit of economic activity from the BPC Tax Credit program is likely greater in western Oregon.

What are the potential magnitude and lasting effects? Based on patterns observed in 2012, continuation of the credit under current implementation will likely yield, between now and the program sunset, credited biomass volumes similar to previous program years. The relative shares of different biomass feedstocks may change. For example, patterns in recent years suggest an increase in the relative share of manure credited under the program. From 2010–12, the amount of manure in the program increased from 92,000 tons to 145,000 tons. Manure's share of program tax credits rose from 8 percent to 22 percent. However, the magnitude of that increase was influenced by the steep reduction in the credit rate for woody biomass in 2012. Used grease has experienced similar share increases, although not as large in magnitude. Looking forward to the remaining program years, indications

are that manure and other biomass feedstocks will increase in relative importance and forest sector biomass will decline in relative importance. At the same time, the amount of woody biomass credited has remained fairly stable. Woody biomass still accounts for the majority of the biomass certified under the program and the program costs. However, with the new tax credit rate for woody biomass, program expenditures have declined from highs in 2010 and 2011. In 2012, the BPC Tax Credit program offered about \$3.3 million in tax credits.

It is possible the program in 2012 is responding to other factors in the wood products market and may not be reflective of outcomes in future years under the current implementation rules. The stability in the amount of woody biomass certified under the program in 2012 could reflect increasing activity in wood products markets or creation of more logging residues. For example, the current rebound in the wood products market may be creating increased need for lumber drying. Additionally, greater timber harvesting may be generating increased amounts of in-woods biomass available at low prices. However, increased lumber production also produces mill residuals which can be used as feedstock for bioenergy production; potentially offsetting the need for logging residues in future years. The relative amounts of feedstock types involved in the program have changed and will likely continue to do so. Woody biomass is the primary biomass feedstock within the BPC Tax Credit program; other forms of biomass (manure, waste grease, yard debris, etc.) have historically made up relatively small components of the program. However, the amounts of manure and waste grease certified under the program have been increasing.

What are some efficiency and administrative considerations? Based on year 2012 results, the reduced BPC Tax Credit for woody biomass appears to provide enough of an incentive for woody biomass production and at lower program cost. Because woody biomass currently accounts for the majority of biomass involved in the program, reducing the tax credit rate resulted in significant reductions in program costs.

The 2012 implementation appears to result in a slightly more even distribution of program funds across forest sector, agriculture sector, and urban-generated bioenergy feedstocks. A more even distribution of program funds across sectors may be desirable for a number of reasons. For example, supporting a range of feedstock types may promote use of a variety of bioenergy technologies and facility types. Further, having a bioenergy portfolio that depends on a variety of feedstocks reduces dependency on any one source, potentially improving resilience of bioenergy production to unexpected system shocks. Conversely, because it is more costly to produce some types of biomass, a relatively even distribution of program funds across biomass types may not be desirable. Our previous research found significant economic inputs were required to produce and transport woody biomass (see Appendix 1, page 26) while the costs of collecting and transporting manure, once the infrastructure is put in place, can be minimal.

In addition to differing production costs, energy content differs across biomass types and an equal distribution of program credits may not reflect that. Adopting standard assumptions on the energy content of biomass, woody biomass was responsible for the greatest amount of energy credited (11.3 million BTUs) under the BPC Tax Credit in 2011 (see Table 4, below). However, on a per unit energy basis,

woody biomass received the second smallest tax credit (less than \$1 per million BTUs). Conversely, manure and oil seed biomass received tax credits worth about \$9 per million BTUs produced; vegetative biomass was credited at nearly \$7 per million BTU. Manure, oil seed, and vegetative biomass created just a fraction of the total energy produced from woody biomass.

For woody biomass, the tax credit, as currently implemented, is received by the entity collecting and transporting the biomass material. In recent implementation years, nearly all of the program tax credits have been transferred from the original applicant to a third party. Transferring the tax credits allows those entities with cash flow needs and low tax liabilities to increase cash flow now rather than waiting for tax filing. If the program continued to be implemented as is, this pattern of extensive transfer of credits would likely continue. Allowing the transfer of received tax credits is clearly an attractive quality of the current program formulation, but not unique to this design.

Although the tax credit is clearly desirable, adopting a different structure for how the incentive is provided might increase the value that goes to the producer. Inefficiencies enter the program as additional time and costs are required as state agencies must track and account for transferred credits.

Table 4 Energy produced and tax credits issued per unit energy produced

Biomass type	Total energy (MMBTU)	Total credits issued (\$)	Tax credit per MMBTU (\$)
Manure	216,845	\$1,807,042	\$8.33
Oil seed	6,142	57,171	9.31
Used oil and grease	835,528	717,227	0.86
Vegetative biomass	65,044	433,628	6.67
Wastewater biosolid	12,400	44,284	3.57
Woody biomass	11,308,147	10,727,585	0.95
Yard debris	323,156	335,543	1.04

MMBTU = million British thermal units



More significant, perhaps, the entity receiving the tax credit incurs additional transaction costs for participating in the program. Those transaction costs accrue as the original recipient of the tax credit has to find and enter into agreements with tax credit purchasers. It is unclear whether the current inefficiency and additional transaction costs from credit transfers are great enough to warrant program modifications on their own.

The current program formulation contains a natural cross-check between the biomass suppliers and the biomass buyers that likely benefits the program. Under current BPC Tax Credit implementation, there is a general incentive for woody biomass producers and collectors to overreport the amount of biomass delivered and underreport the biomass moisture content. However, under the certification process, both the weight and moisture content are reported via forms completed by the biomass buyer. Because the biomass buyer is typically paying based on weight and moisture content, they have the opposite incentive of the biomass supplier. The opposing incentives for each party likely promote accuracy in the figures provided to the Oregon Department of Energy during the certification process.

What alternate formulations might be considered?

Transportation costs are one of the significant economic barriers to widespread expansion in woody biomass use. The current formulation of the BPC Tax Credit offsets the costs associated with collecting and transporting woody biomass. However, applying the tax credit to the transportation component of the supply chain can serve to incentivize long transportation of biomass instead of development of new facilities close to the biomass supply. In 2010, the average transportation distance for woody biomass certified under the program was about 100 miles. In some cases that year, biomass was hauled 200 miles to a bioenergy facility. Generally, assumed maximum reasonable haul distances for woody biomass are between 50 and 90 miles. The long transportation distances associated with the program can lead to increased fossil fuel use and carbon emissions over what would have otherwise occurred. Differential incentives that promote shorter haul distances, or establish a maxi-

mum haul distance, could be adopted if a program goal is overall reductions in emissions from fossil fuel energy. However, adopting a maximum haul distance for material certified under the program could significantly alter program participation as facilities that are further away from sources of biomass may not purchase the feedstock at a price high enough to justify the transportation cost.

A tailored approach to developing the tax credit rate for biomass could be established if a specific program goal is to promote the use of woody biomass as a specific biomass feedstock. A targeted, flexible approach to setting the tax credit amount for woody biomass could help to ensure that the tax credit incentive is great enough to promote extra woody biomass collection and transport. Under the current implementation, the tax credit rate is set within the statute. Rather than the current approach, the tax credit rate could be established by the implementing agency and vary from year to year, as necessary, based on production and transportation costs. The specific amount of the credit could be set using information from the previous year's costs of collection and transport. Alternately, the credit rate could be set based on the expected tax credit needed to promote a specific amount of woody biomass used in bioenergy.

The BPC Tax Credit amount serves as a signal to influence the production of woody biomass by producers and collectors. Currently, the signal is clearly established in the enabling legislation. If the credit amount were instead set by the implementing agency, a process would need to be established so the amount of the credit is relayed, in a timely fashion, to potential program participants. If that signal is not relayed in a timely or clear fashion, it may not be appropriately incorporated into the production decisions of producers and collectors. Delayed or inconvenient signaling of the credit amount could result in a reduced amount of woody material involved in the program or a reduction in overall bioenergy production. A process that engaged affected stakeholders early and provided timely and predictable information would be a critical component.

The mix of biomass types that receive an incentive under the BPC Tax Credit program will influence the total economic activity generated by the program. If a goal of the program is to generate economic activity, then the production requirements of the various biomass types may be an important factor in program formulation. The amount of economic activity reflects the variety of economic sectors spurred on in the process of collecting and transporting biomass. The goods and services required to collect and transport differs across different types of biomass. The economic activity generated from collection and transport of manure or urban waste grease will likely be less than that of woody biomass production. The implementing agency for the BPC Tax Credit program could influence the relative amounts of biomass involved in the program with the adopted tax credit rates.

Bioenergy producers receive a tax credit for using woody biomass

The existing BPC tax program acts to increase supply of biomass feedstock by providing a tax credit to those who collect and transport eligible biomass feedstocks. An alternate policy scenario is to provide the tax credit to the bioenergy producers who purchase delivered biomass. Under that scenario, producers of bioenergy would be provided with an economic incentive to use more biomass. In this case, the tax credit would offset some of the purchase price of biomass. The expectation is that the incentive to offset the cost of purchasing biomass would lead to new, expanded demand for targeted biomass feedstocks.

What parties benefit from the program? Bioenergy producers would directly receive the program benefits under this scenario. Assuming facility eligibility remains similar to the current program, cogeneration facilities at wood processing facilities and at agriculture operations, heat-only sites, and stand-alone electricity generators operating within Oregon would receive the tax credits. Within Oregon, there are about 50 bioenergy facilities. Those facilities range in size from small thermal-only facilities heating schools or hospitals to large electricity generating facilities selling bioelectricity to energy markets. The majority of bioenergy facilities

in Oregon are located west of the Cascade Range. Under this scenario, the program would be intended to increase demand for targeted types of biomass. The expectation is that biomass producers and collectors would increase the amount of biomass they supply to meet new demand. Under this alternate formulation, biomass producers and collectors who previously responded to an incentive signal that offsets their production costs, would respond to a signal of increased demand for biomass. Those who are able to supply additional biomass to meet new demand would indirectly benefit from the tax credit program. Transparency in how the tax credit rates were established would give participants confidence in the program and their understanding of the process.

Although biomass producers and collectors would still benefit under this formulation, the number of producers and collectors that benefit may change. Because there are fewer energy facilities located in eastern Oregon, producers and collectors on the eastside of the state may have great challenge benefiting under this program formulation. In the current program, participating producers and collectors of woody biomass in eastern Oregon have transported their certified biomass to 1) the few operating bioenergy facilities on the eastside, 2) out of state, or 3) to western Oregon. Under this formulation, those producers and collectors who had been receiving tax credits for delivery to out-of-state bioenergy facilities would have to instead find an in-state producer to use that material. Barring significant expansion of eastside bioenergy capacity, to benefit from the program, eastside producers and collectors would likely have to transport a greater relative amount of biomass to western Oregon facilities.

What are the potential magnitude and lasting effects? In 2010 and 2011, about 1.8 million tons of a variety of woody feedstocks were used to produce bioenergy in wood processing facilities. About half of that material was from mill residuals generated on-site or purchased from other operations. In-woods biomass comprised another third—about 600,000 tons—of the used biomass. The remaining feedstock needs were primarily met with urban

wood waste. If the feedstock eligibility of this alternate program mirrored that of the current program, the 600,000 tons of in-woods biomass used by these bioenergy producers would be eligible for tax credit. For comparison, in 2011, about 414,000 BDT of woody biomass received a tax credit under the existing BPC Tax Credit program. If all of the in-woods biomass used by forest sector facilities was credited, total program costs for woody biomass would be about \$6 million.

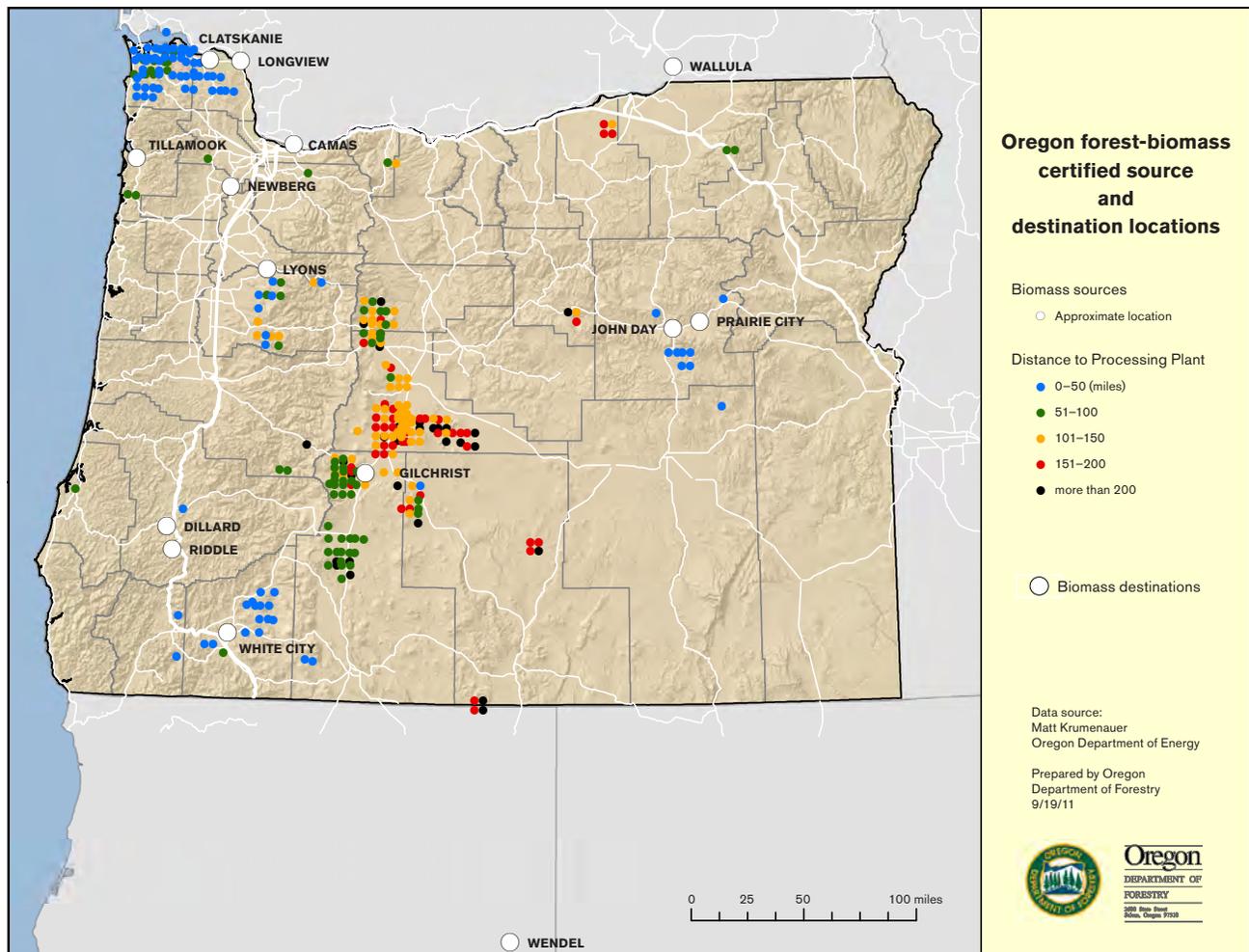
How much additional use of woody biomass this alternate program might promote is not fully known. Forest sector bioenergy producers will use some woody biomass in production of bioenergy regardless of any policy incentive. The period between 2000 and 2007, prior to the BPC Tax Credit and other incentives, gives us some insight into the level of baseline woody biomass usage. During that period, on average, about 6 percent of the feedstock used by wood processing facilities was in-woods biomass. However, between 2007 and 2011, with the BPC Tax Credit and other incentives in place, the reliance on in-woods biomass increased to about 25 to 33 percent of feedstock. Given that the underlying incentive concept is similar to the current BPC Tax Credit, this alternate scenario—where bioenergy producers receive a tax credit—might reasonably be expected to also support an increase in woody biomass consumption. However, the comparison is difficult because the observed increase in use of in-woods biomass from 2007 to 2011 with the BPC Tax Credit in place corresponded to a period of very low lumber production (and assumed correspondingly low levels of creation of mill residuals) within Oregon.¹⁰ If abundant mill residuals were available, that material may be used at co-generation facilities located at wood processing facilities before any in-woods biomass is purchased.

A biomass tax credit aimed at bioenergy producers would likely most influence the mix of biomass feedstocks used to produce energy while in effect. For example, a tax credit aimed at in-woods biomass might increase the share of that biomass used to generate energy at a given facility. However, without promoting significant expansion or some change in firing technology that promotes

reliance on woody biomass, bioenergy producers could return to their historic, low level usage of logging residues and fuels reduction material after the incentive program ends. Short of the tax credit promoting new contractual relationships between energy producers and biomass suppliers, there may be little residual effect of the program.

What are some efficiency and administrative considerations? If a goal of the program is to increase the production of biomass feedstocks, then the incentive program must spark additional demand for biomass. Such a program would need to be developed with targeted incentives that promote the consumption by bioenergy producers of biomass feedstock types of particular interest. Because many bioenergy producers can use multiple feedstock types, if a revised program considered bioenergy produced from any biomass feedstock (including those not covered under the current BPC Tax Credit program), bioenergy producers could simply scale up production using their current mix of feedstocks. In that case, the increase in demand for targeted feedstocks might be minimal. Further, if targeted feedstocks were not identified for the program, the bioenergy producers could choose to increase reliance on mill residuals or other feedstocks not of program focus.

Monitoring a program aimed at bioenergy producers could present several challenges. First, the current implementation of the program incorporates a natural cross-check on reported biomass amounts and moisture contents between biomass suppliers and bioenergy producers. If bioenergy producers were to receive the tax credit directly, that natural cross-check would disappear as both biomass suppliers and bioenergy producers would have an incentive to overstate actual deliveries. Some monitoring system likely would be required to ensure the amounts of woody biomass and the moisture contents of that biomass are properly reported. Second, the current formulation provides tax credits only for biomass produced in Oregon and conceivably that characteristic would remain in a revised program. To the extent that Oregon bioenergy producers use material sourced from outside the state, the certification system would need to ensure that

Figure 3 Forest-biomass certified source and destination locations, year 2010

only Oregon-sourced biomass was certified, similar to how this is currently managed. Third, if a program goal were to increase woody biomass usage above some level that would occur anyway, a system would need to be developed to provide incentives to only the material used to produce additional bioenergy. Such a system would likely have to rely on previous levels of woody biomass feedstock use. However, as noted, it is difficult to pick a timeframe to form that baseline level of use because behavior in the last several years has been influenced by a variety of incentives, policies requiring increased renewable energy production, and changing market conditions.

What alternate formulations might be considered?

Existing bioenergy facilities that historically have used woody biomass for bioenergy primarily are located at wood processing facilities west of the Cascades (see Figure 3, above). Many of those facilities are in relatively urbanized areas. Unless specified otherwise in the implementation, the majority of program benefits would likely accrue to western Oregon and to the feedstock source areas of those existing bioenergy producers. However, if consistent with the program goals, implementation might influence whether rural or urban communities receive benefits. Additionally, specific implementation rules could be developed that promote

expansion of feedstock source areas of participating western Oregon bioenergy producers. Expanded feedstock source areas may spread out the positive economic activity from the program.

The program might also be formulated with a specific regional focus, depending on program goals. Differential incentives for specific types of woody biomass or regional targets could be incorporated into the program to influence benefits in particular regions. For example, if incentivizing fuels reduction was deemed a program goal, bioenergy facilities could receive a greater credit for use of biomass generated from hazardous fuels reduction rather than logging slash. Such a formulation would incentivize production in central and eastern Oregon where fuels reduction activities are more common. Similarly, implementation rules could set differential tax credit rates for bioenergy facilities operating within particular regions of the state where biomass production costs are greater. For example, a greater tax credit might be offered in eastern Oregon, where the supply of logging slash is less than in western Oregon.

An incentive program to support additional bioenergy capacity

Similar to the scenario above, an alternate scenario might convert the program to an incentive program that promotes more bioenergy production capacity within the state. The incentive program might be implemented as a grant or a tax credit program. Under a grant program, entities might receive funding up front to provide cash flow for capacity construction. Under a tax credit program, entities could apply tax credits to current or future tax liabilities. Greater bioenergy capacity could lead to greater demand for biomass feedstock and economic activity that are similar to those of the current program.

A capacity expansion grant program could promote establishment of new bioenergy facilities or expansion of existing facilities. New bioenergy facilities could promote new sources of, and locations for, demand for biomass within Oregon. Incentivizing substantive expansion of existing facilities could increase the demand for woody biomass within

existing biomass market areas. In either case, policymakers might choose to focus the program on either small-scale facilities, like those used to provide heat in institutional settings, or larger electric-only and co-generation facilities. In the remaining sections, we will consider both approaches.

Which parties benefit from the program? Previous bioenergy capacity grant programs can provide some insight into what parties benefit. There have been several state (such as the energy incentives) and federal programs (such as ARRA, Fuels for Schools) to support the establishment of bioenergy facilities at public buildings like schools, government offices, and hospitals. In most cases, the new systems were biothermal systems that replaced existing heating systems relying exclusively on fossil fuels. A revised BPC Tax Credit program incentivizing new small-scale thermal facilities would directly benefit those operating institutional buildings, and other settings, where existing heating facilities rely on fossil fuels. Those facilities that rely on heating oil or propane to fire boilers are probably the most likely to participate in the program. Upon conversion to bioenergy, municipalities, school districts, and other entities could apply long-run cost savings associated with bioenergy usage to other local budgetary needs.

Current bioenergy operators who expand, and those who develop in the state, would be the direct beneficiaries of a program supporting construction of stand-alone facilities or expansion of existing facilities. In the context of woody biomass, existing bioenergy producers are generally wood processing facilities. There are a limited number of entities in the state that are operating stand-alone facilities using woody biomass.

Biomass feedstock suppliers and local communities would receive indirect benefits from the establishment of small-scale biothermal facilities. For a biomass supplier, new heating facilities provide new customers with relatively consistent levels of annual demand for a biomass product. Annual feedstock consumption at a small-scale biothermal facility can range from a few hundred to thousands of tons.

For local communities, these facilities can serve as a source of pride and make use of readily-available local forest resources. In some cases, small-scale biothermal facilities, district heating operations, or small combined heat and power facilities may achieve joint local objectives of reducing institution operating costs and energy expenditures leaving the community, supporting achievement of forest management goals, and increasing employing local forest contractors.

New facility demand for biomass feedstock has the potential to create economic activity as the feedstock is produced and transported to the bioenergy facility. Again, the type of feedstock used at the facility can influence the amount of economic activity generated. Mill residuals and manure feedstocks produced and used on-site likely would create relatively little additional economic activity. Conversely, the collection and transport of logging slash or materials from fuels reduction projects can generate substantive economic activity. Pellets or other engineered woody biomass would generate economic activity when those materials are produced and transported. If generating economic activity were a program goal, it would likely be useful to specify eligible feedstock materials in the program formulation.

Unlike other program formulations, promoting the creation of new facilities and expansion of existing facilities has the potential to create economic activity from facility construction as it would directly promote new facility development. This activity should be accounted for when determining program effects. Small biothermal facilities for institutions can be put in place on site in under several days.¹¹ Further, the boiler and associated components can be constructed at facilities either inside or outside Oregon and containerized, requiring little on-site assembly and reducing initial costs. With short on-site time and the potential for the boiler itself to be constructed outside the state, the economic activity in Oregon from construction of small-scale systems may be relatively small. However, the economic activity associated with creation and operation of these facilities could be meaningful to local com-

munities and suppliers such as biofuels producers. Additionally, those facilities may serve as important clients to bioenergy companies within Oregon.

Indirect benefits would also accrue to the state economy from the creation of stand-alone facilities or expansion of existing facilities. The indirect economic benefits from stand-alone large facilities would almost certainly be greater in magnitude than that created by establishment of small-scale biothermal facilities. Like with construction of small-scale facilities, the use of materials or contractors from within the state would increase local economic impact. Construction to expand existing facilities would likely have economic activity benefits that are somewhere between that of construction of small-scale biothermal facilities and large stand-alone facilities.

What are the potential magnitude and lasting effects? Other programs have been successful in supporting expanded capacity at facilities already producing bioenergy. In recent years, State of Oregon and federal funds have been used to support expansions in bioenergy capacity at several wood processing facilities using woody biomass. Facilities generating bioenergy are typically producing both heat and electricity. The production of additional heat energy may allow for expansion or increased efficiency of facility operations. New electricity production, above any used on-site, could be sold to the electric grid.

The existing BPC Tax Credit program costs the state about \$5.5 million per year in foregone tax revenue. A grant program with the same amount of funding could support establishment of a number of small biothermal facilities in institutional settings. With a typical small-scale installation cost of about \$500,000 per unit, the full costs of up to 10 projects might be supported by the program in a given year.

With the same funding level, a grant program would offset only a portion of the construction costs for perhaps just one new large bioenergy facility. For example, recent construction costs for new



bioenergy facilities in the state have been between \$20 million and \$75 million. Expansion of existing facilities would likely be less costly than constructing a new facility. Depending on the scope of expansion, at current levels of program costs, perhaps several facility expansions might be supported by the program in a given year. Given current energy markets, it is unknown if any new facilities might be constructed in Oregon without additional incentives.

A program that results in new bioenergy capacity differs from the other programs in that the outcomes may remain in place for a number of years. Capacity that is built with program grants will remain in place after the program sunsets and will result in increased biomass demand, if in operation. Whether the capacity is used over the long term depends on a number of factors, including energy markets and the availability of biomass feedstock. Low prices for, and ready availability of, energy produced from non-biomass sources could reduce the demand for bioenergy from any new capacity. Likewise, unforeseen biomass supply limitations in the future could further reduce the competitiveness of bioenergy production. Long-term use of small-scale biothermal facilities, once installed, likely depends more on the boiler lifespan and less on energy markets.

What alternate formulations might be considered?

If consistent with the program goals, the implementation rules can promote the use of specific feedstock types at new or expanded facilities. For example, if use of woody biomass is of particular interest the program could specify that capacity must rely on woody biomass. That specification could remain in place or sunset over some period of time

or under some conditions. However, if the program goal is to increase bioenergy production generally, the specific types of biomass feedstocks used are not of concern. In that case, facilities would make feedstock selections that are best for their operation and their own interests. Currently ineligible feedstocks, such as mill residuals, wood pellets, yard debris, and waste grease, might be used at new or expanded facilities.

Rather than focusing on specific biomass types, the program might be developed to support the use of biomass from specific Oregon regions or from specific processes, if either is a program goal. For example, the program might require new capacity to utilize material created from fuels reduction activities, promote specific biomass source regions (e.g., southern Oregon), or require material to be sourced from within a specified distance of the facility. Confirming that eligible feedstocks are being used in new installations or at small biothermal facilities would be fairly straightforward.

If a program goal is to increase overall use of biomass or to increase the provision of bioenergy, the formulation might include restrictions to help ensure that program funds build additional capacity. Such a control would reduce the chance that an entity uses grant program funds to simply replace functioning, existing capacity. For example, a facility might use funds to install a new biomass boiler that only replaces an existing, operating, biomass boiler. That action would likely lead to little or no increase in overall bioenergy production or biomass consumption. If desirable, the program might specify that funds be used only for expansion of capacity. However, monitoring compliance with such a provision could prove challenging.

Conclusions

Woody biomass used for energy production, with the BPC Tax Credit in place, continues to be greater than what would otherwise be expected based on market conditions alone. For 2011, we found woody biomass collection and transport supported by the BPC Tax Credit program generated economic activity within the state that was greater than the program cost. Based on an initial examination, the reduced tax credit rate for woody biomass in 2012 appeared to still support a substantial amount of woody biomass use, but at lower program cost.

In this analysis, we updated our previous research examining the BPC Tax Credit program in year 2010. In 2010, a variety of other programs to incentivize bioenergy and biomass production (including ARRA and BETC) were also in place. It was difficult to isolate how much of the increased woody biomass production was uniquely associated with the BPC Tax Credit. Our analysis post-ARRA and BETC supports the notion the BPC Tax Credit program provides a stand-alone incentive to woody biomass production. Further analysis in the coming years of the program will better determine the unique influence of the BPC Tax Credit program.

We also considered potential alternative program scenarios. The programs differ in a variety of ways, including who receives the direct program benefit. Those direct beneficiaries range from biomass suppliers, to the current purchasers of biomass, to those desiring to install bioenergy capacity. However, the indirect beneficiaries largely remain the same regardless of the program scenario. Local economies and the state economy, rural communities, and forest managers trying to achieve management goals likely would indirectly benefit under each program scenario. However, the magnitude of those indirect benefits and how they are distributed across parties and within the state would differ depending on what program is adopted.

Each program scenario might be implemented using a variety of different formulations. The formulation that is selected to implement the program would influence what outcomes are achieved. More clearly defining the goals to be achieved might help inform selection of which program scenario and alternate formulation, if any, is most appropriate. Better articulating the goals of the program also will aid in evaluating the outcomes of the program.

The use of woody biomass to create energy can yield a number of co-benefits. Increased use of woody biomass can be promoted via a number of policy instruments that operate in coordination. Here, we have considered the effects and alternate scenarios of one incentive program on Oregon's woody biomass use. Taken in context of an overall biomass strategy for Oregon, the BPC Tax Credit appears to be making it easier for bioenergy facilities to use biomass from logging slash and stewardship projects. However, it will be useful to continue to monitor the effects of the BPC Tax Credit in the coming years as energy and wood products markets, and the general economy, continue to experience changes and the credit program is revised.



Appendix 1

We created regression models to forecast the amount of woody biomass consumed and the price per ton of woody biomass and compared the output to observed Oregon consumption and prices.¹² The regression models were constructed using data from the years 2000 to 2006, prior to the establishment of the BPC Tax Credit. Because the models were constructed from data for the period when there was no BPC Tax Credit, differences between the model forecasts and market observations in the years after BPC Tax Credit establishment (2007–11) were attributed, in part, to the presence of the BPC Tax Credit.

The regression models use information on year-by-year forest sector market conditions to forecast the annual volumes of woody biomass used for bioenergy and the average delivered prices for woody biomass. To update the previous analysis to year 2011, we combined the existing regression models from the previous report with new forest sector data from year 2011. We have applied the same regression model used in the previous report to forecast 2011 prices. However, we have slightly revised the model to forecast the volume of woody biomass used for energy production. That revision does not significantly change the results reported previously, but does result in a better model fit when incorporating the 2011 data (see Table 5, page 27).

The economic activity within Oregon generated because of the production of additional woody biomass under the BPC Tax Credit was estimated using

a model of Oregon's economy. The inputs, such as labor, fuel, and supplies, required to collect and transport woody biomass were identified from a survey of Oregon operators. A "production function" reflecting those required inputs, developed specifically for woody biomass producers and collectors, was created in the economic input-output model IMPLAN¹³ (see Table 6, page 27).

We report the projected economic activity from IMPLAN caused by simulated increased demand for collection and transport of woody biomass. The economic model IMPLAN reports economic activity in terms of changes in value added, jobs, wages and benefits, and taxes. Economic impact models are linear in the estimated economic activity generated by changes in final demand; economies of scale do not influence results. For a given project, the first \$1,000 of new demand for a good or service generates the same amount of economic activity as the last \$1,000 of new demand for a good or service. Because the projected economic effects are linear and economies of scale are not accounted for, we can use "response coefficients" drawn from IMPLAN to model how extra woody biomass production influences Oregon's economy. However, this linear assumption is also a limitation insofar as the production of woody biomass does experience returns to scale. Here, we report the economic activity from woody biomass production using the same response coefficients as used in our previous analysis.

Table 5 Regression models of Oregon forest biomass market volume and wood fuel market prices

	Wood fuels price model	Forest biomass volume model
Intercept	69.23***	4.26
Total wood fuels volume	0.05**	0.52***
Mills residuals volume	-0.16***	-0.51***
U.S. lumber export volume	-0.05**	-
Softwood lumber prices	-0.06**	-
Wood pulp price	0.19*	-
Natural gas price	-0.04	-
n	28	27
Model F	14.79***	69.23***
R ²	0.81	0.98

*p<0.05 **p<0.01 ***p<0.001

Table 6 Line item production costs as a percentage of total production costs for forest biomass collection and transportation

Production costs	Labor	Nonlabor	Total costs
Logging	0.11	0.56	0.66
Slash collection	0.07	0.2	0.27
Grinding	0.03	0.36	0.4
Transportation	0.11	0.17	0.28
Truck and haul	0.11	0.15	0.26
Mobilization	0	0.02	0.02
Overhead	0.01	0.04	0.05
Administration and fees	0.01	0.04	0.05
Total	0.23	0.77	1

Endotes

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- 3 There were significant changes to how the BPC Tax Credit was implemented in tax year 2012. We do not yet have data to complete analysis for the year 2012 implementation.
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