Sustaining Bioenergy

Incentives to ensure woody biomass reforestation

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Baker Center Policy Challenge, 2018

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Executive Summary

Bioelectric power is a reliable, renewable energy source where biomass is burned to generate electricity in a process similar to coal.

Biomass: plant materials; e.g., crop resides, yard waste, switchgrass, corn

Woody biomass: sourced from trees, or parts of trees (branches)

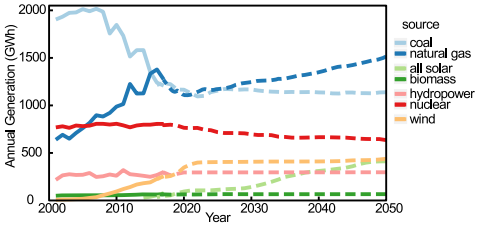
Photo from: Oregon Dept. of Forest (2007)

Problem: Biomass cannot be considered renewable if there is no requirement to reforest lands

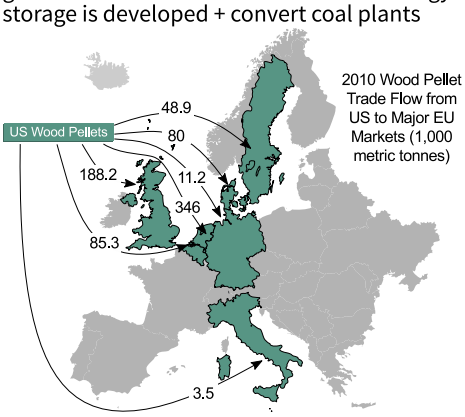
- Biomass consumes CO_2 during the plant's life cycle
- CO_2 is released into the atmosphere when biomass is burned to generate electricity
- Best practices exist to ensure biomass is a carbon-friendly renewable energy source

Wood pellets are a common form of woody biomass and:

- Can use any part of the tree
- Made from waste products
- Offer increased energy density
- Easy to package, easy to transport



While biomass currently is a small part of the energy picture, it could supplement future growth in other renewables as energy storage is developed + convert coal plants



2010 Wood Pellet Trade Flow from US to Major EU Markets (1,000 metric tonnes)

Europe sources most of its wood pellets from the U.S. Since 2010, demand has further ↑

American People

- Trees are an important resource and don't want to risk deforestation
- Clean air: reduce pollutants when biomass is burned instead of coal
- Aesthetic integrity of the wild, maintain connection to nature

Forestry Industry

- Industry depends on longevity of forests
- Many companies are already involved in sustainable sourcing
- Sustainable Forestry Initiative: largest certification program in North America
- Waste streams → wood pellets → ↑ wood pellet facilities → ↑ revenue

Utilities

- Cheaper natural gas makes coal less attractive; coal plants retiring due to cost + emissions
- Coal plants can be easily converted to co-fire with coal or become bioelectric only plants
- Utilities must meet demand → biomass is renewable + reliable

Southeast US

- 4.6 m MT of wood pellets exported in 2015; 98% to EU
- Desire to conserve forests for clean air, recreation, aesthetics
- Sprawl is the biggest threat to forests, while wood pellet manufacturing provides returning value to forested land

Solution: Incentivize bioelectric power plants and wood pellet facilities to source woody biomass obtained from sustainably certified forests

- US forests are protected + bioelectric power is responsibly realized
- Certification of forests is conducted by SFI
- Incentive plan will be overseen by USDA
- Funded from a 0.5% corporate tax on land developers
- Tax credits will be awarded to plants that source SFI certified biomass
- Southeast retains a vital economic partner

Time to Implement

- **Y0:** Apply tax to land developers
- **Y1:** SFI + USDA partnership
- **Y2:** tax refunds based on % SFI certified biomass
- **Y3:** USDA will award states, grants based on SFI certified electricity
- **Y4:** Mid-plan review; evaluate + readjust
- **Y6:** initiate 4% corporate tax on plants that do not source 80% SFI certified woody biomass
- **Y6:** States receive funds from USDA
- **Y9:** States receive funds from USDA
- **Y10:** Up for renewal

I. Problem Statement

Biomass was not recommended in the Clean Power Plan (CPP) as a "Building Block 3" zero-emitting renewable energy source (Inwood et al. 2018). This was primarily due to the challenges in calculating biomass specifications, i.e. energy density, carbon dioxide output, etc. Without these calculations, it is difficult to determine the reduction of carbon dioxide, which conflicted with the purpose of the CPP to reduce carbon emissions by 30% from 2012 levels. Although the CPP did not come to fruition, the controversy surrounding bioelectric power was brought to the national level yet remains unaddressed.

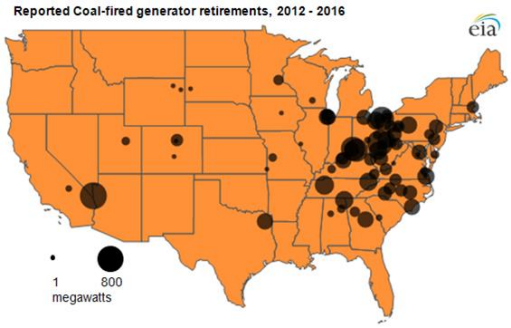


Figure 1: Coal-fired generator retirements (EIA).

Bioelectric power is a controversial renewable energy source as carbon dioxide is released into the atmosphere when biomass is converted into electrical energy. Just as with coal, biomass is burned to create steam in a turbine-based power plant (Rankine cycle), that also produces carbon dioxide. As plants (biomass) grow, they remove carbon dioxide from the atmosphere which has led many to argue that biomass should be regarded as "near-carbon neutral". This view was recognized by the European Union (EU), which initiated the process of converting former coal plants into cofired plants (coal & biomass) or biomass (bioelectric power) plants (Dale et al. 2017). Critics argue that biomass should not be considered carbon neutral as it still releases carbon dioxide as it is burned, irrespective of whether the carbon dioxide output is equal to that absorbed in the lifetime of the biomass source.

There are various sources of biomass, from switchgrass to oak trees, each with their own energy density and carbon dioxide consumption rates. "Woody" biomass, or biomass sourced from trees, faces the most scrutiny owing to the fear that it may lead to deforestation. Specifically, the use of wood pellets in bioelectric power plants is on the rise, as their condensed form expedites combustion, produces less ash (a waste product of combustion), has reduced water weight, and is easy to transport. In 2015, the US exported 4.6 million metric tonnes of wood pellets, and 98% of which was delivered to Europe (Dale et al. 2017). Remarkably, just a decade before, there were effectively no wood pellet exports (Dale et al. 2017). The U.S. Department of Energy expects woody biomass to source 9% of U.S. energy consumption by the year 2030, as compared with 2% in 2015 (Law, 2017).

Figure 2: Wood Pellets (Bruton, 2003).

Woody biomass will source 9% of US Energy by

Yet, provided that the biomass source is replanted, biomass is a reliable, renewable energy source. Other renewable energy sources may be limited by the local climate and environmental resources – that is some energy sources have a spatial distribution that favors generation in certain regions. Even in favorable regions, daily weather may affect generation. Energy storage technologies can mitigate the intermittency of generation to meet consistent demand, but this technology has yet to be fully realized, because of cost and or technical limitations. The lack of consistent generation challenges grid operators, whom are expected to consistently meet customer demand. The nonrenewable status quo is relatively easy to control, as the energy source is readily deployed when needed at power plants. Bioelectric power, however, is also reliable. Just as with coal, the amount burned can be changed to meet electric demand.

Wood pellets are not 'near-carbon neutral' if trees are not replanted

There are no federal regulations to ensure that biomass is sustainably harvested, which is of great concern to U.S. forests as the demand for wood pellets continues to increase, while the supply of forests remains nearly the same. Wood pellets cannot be regarded as near-carbon neutral if the feedstock forests are not properly managed and replanted. Negligence may result in deforestation of the southeastern United States, the primary region of wood pellet production, which could prove disastrous for a variety of socioeconomic and environmental reasons. Failure to supply the European Union with wood pellets will prolong not only the EU's dependence on coal-fired plants, but the U.S.'s reliance on fossil fuels as well.

II. Policy Options

Our proposition: to incentivize bioelectric power plants and wood pellet facilities to source woody biomass obtained from sustainably certified forests. Additionally, we recommend that states update their Renewable Energy Portfolios (REPs), or analogous documents, to require all woody biomass to be sustainably certified. In doing so, the integrity of U.S. forests will be maintained, while bioelectric power can be realized as a sustainable, renewable resource. We recommend that the certification be conducted by a third-party organization, specifically the Sustainable Forestry Initiative (SFI), and these incentives will be awarded by the United States Department of Agriculture (USDA).

Without regulation, woody biomass may cause deforestation

This policy aims to protect U.S. forests as the demand for wood pellets rises. Indirectly, the policy will increase awareness that woody biomass is not inherently sustainable. Without regulation, sourcing woody biomass may lead to deforestation, particularly in the southeastern region of the U.S. (Southeast). Moreover, forested land will gain protection from sustainable wood pellet markets by adding value forested lands, preventing deforestation through urban expansion and land development (Dale et al., 2017) (Wear et al., 2013).

Over the past ten years, consumption of coal has been declining (Figure 3). This decline has led to the retirement of coal plants, and job loss in the southeast and Appalachian regions of the U.S.

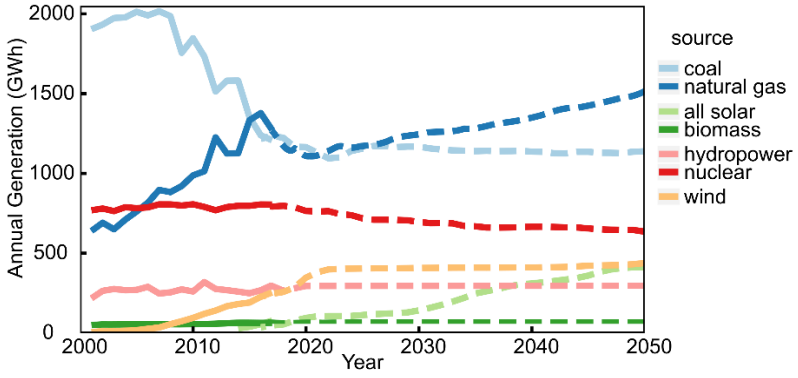


Figure 3: EIA Annual Report of U.S. net electrical generation in GWh (solid) and Annual Energy Outlook 2018 (dotted) Own work; data from EIA (Comstock, 2018).

The pulp and paper industry has also been declining; 25% of mills have closed since 2005 (USIPA, 2018). An increased growth in the wood pellet manufacturing industry can offset job losses in both industries. The southeastern region of the U.S. is of specific interest to this policy as it is responsible for producing over 75% of U.S. wood pellets (Aspinall and Worthy, 2015) (Figure 4). This parallels the region's history of being home to the pulp and paper industry (Figure 5).

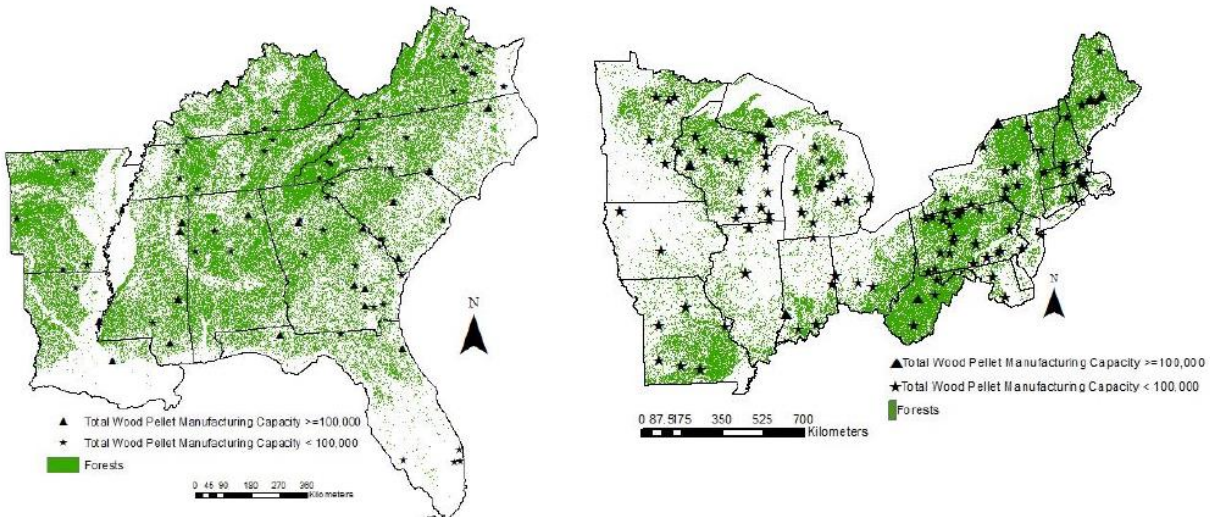


Figure 4: Map of forests and wood pellet manufacturing facilities in the eastern U.S. (Olesen et al., 2016). The triangle represents more than 100,000 metric tons; the star represents less than 100,000 metric tons.

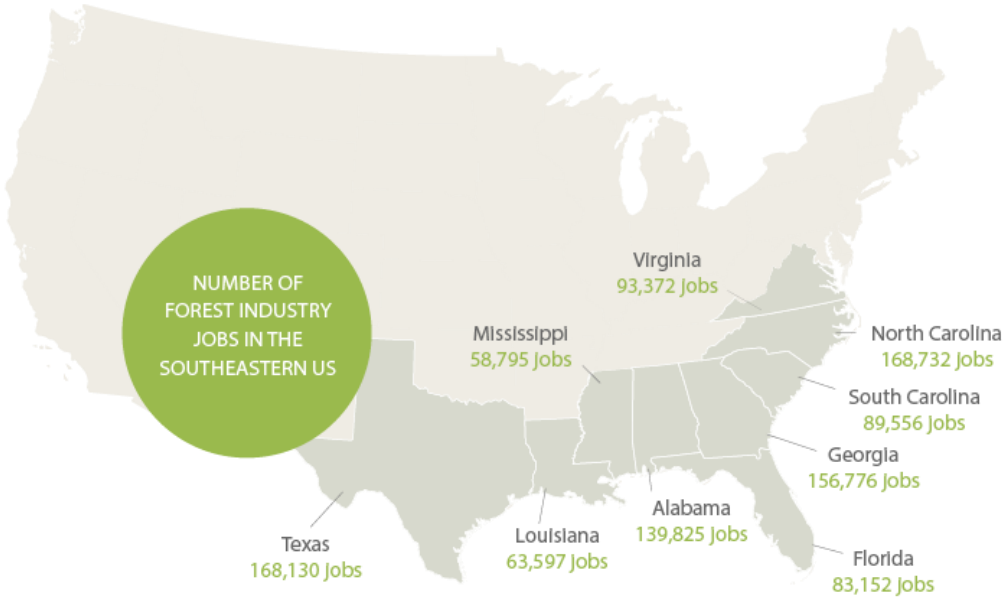


Figure 5: Map of U.S. southeast with reported number in the forestry jobs.

The EU's consumption of wood pellets is an excellent source of revenue to the largely rural – and forested – Southeast. Yet as the EU becomes more concerned with the sourcing of wood pellets, as indicated in the Olesen et al. report "Environmental Implications of Increased Reliance of the EU on

Biomass from the South East US", there is the risk of losing the EU market if standards for sustainability are not met. *The southeast must meet the demands of their supplier and source sustainably harvested wood pellets.*

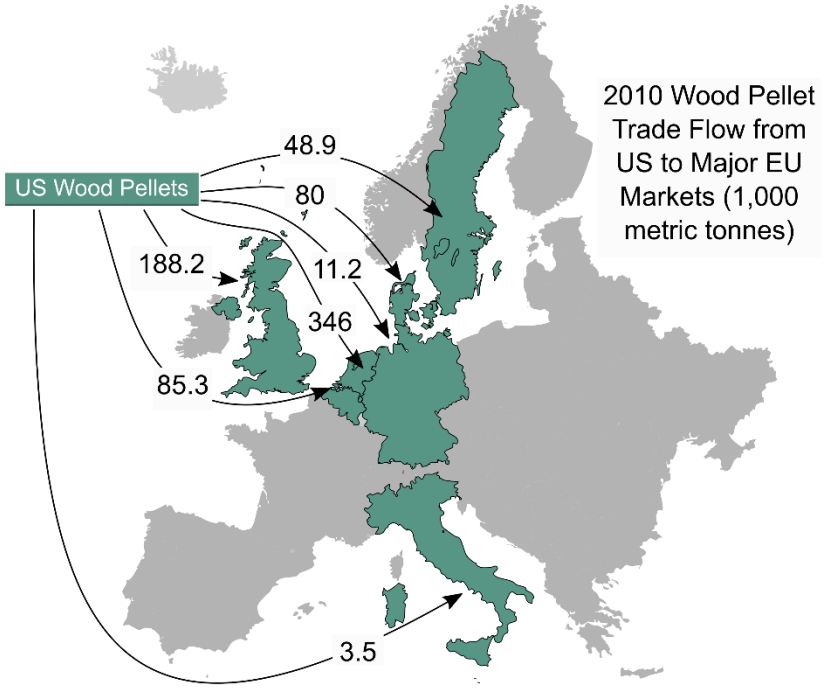


Figure 6: Map of U.S. wood pellet distribution in Europe (Own work, reproduced from Qian and McDow, 2013).

SFI Principles
1. Sustainable Forestry
2. Forest Productivity & Health
3. Protection of Water Resources
4. Protection of Biological Diversity
5. Aesthetics and Recreation
6. Protection of Special Sites

The SFI is an independent non-profit organization with the aim to further sustainable forest management. (SFI, 2015). Not only has this organization been well recognized by the pulp and paper industry, but it has been internationally recognized and endorsed by the Programme for the Endorsement of Forest Certification (PEFC), an international certification system (Olesen et al., 2016). SFI promotes the management, growth, and harvest for products and ecosystem services alike. Ecosystem services are identified as "conservation of soil, air, and water quality, carbon, biological diversity, wildlife, aquatic habits, recreation, and aesthetics" (SFI, 2015). In addition to the forest management certification program, SFI has a fiber-sourcing, and a chain-of-custody program. These additional programs can be adapted to evaluate the sustainable sourcing of bioelectric power plants and wood pellet manufacturing plants.

Alternatively, individual forests can be certified by SFI, and the bioelectric plant or pellet plant may receive financial incentives based on a system of percent certified biomass. This is may be an appealing alternative for large facilities which must source from a multitude of forests to meet demand. Forest landowners will be responsible for certification fees, which may raise the feedstock price. The government's financial incentive, in the form of a tax credit, intends to offset the cost of a feedstock from a sustainable forest so that plant owners are not discouraged from these potentially more expensive purchases. In 2011, The Southern Group of State Foresters reported an annual cost of $6.14 per 10,000 acres for SFI

Annual cost of SFI certification: ~$6/ 10,000 acres

certification (Lowe et al., 2011) (Olesen et al., 2016).

The "Environmental Implications of Increased Reliance of the EU on Biomass from the South East US" was published in 2016 and demonstrates the relevance of our proposed policy. This review coincided with The European Commission's 2030 target to reduce the 1990 greenhouse gas emission levels by 40% (2030 Energy Strategy). If woody biomass is not sustainably sourced, The European Commission will likely be pressured to discount bioelectric power from its target calculations. As of 2016, only 17% of forests in the Southeast were sustainably certified, and there are no guarantees that wood pellets are sourced from certified forests (Olesen et al., 2016). There is a need to incentivize private land owners to certify their forests as roughly 60% of forests in the Southeast are privately owned, and they are the predominate supplier of wood feedstock. (Olesen et al., 2016).

~60% Southeast forests are privately owned

A forestry economist, Bob Abt, reports that policymakers are largely responsible for the explosion of the wood pellet industry (Cornwall, 2017). During the Obama administration, there was a push for Congress to recognize wood pellets as carbon neutral, but the policy never came to light (Cornwall, 2017). Our policy does not evaluate the carbon balance of biomass; rather, it focuses on the need for biomass to be sustainably sourced. Several organizations have considered moving away from the term "carbon neutral" altogether, instead using the term "carbon friendly" when referring to bioenergy (Law, 2017).

There are several other policies and government programs related to this proposal, notably including the US Fish and Wildlife Service (USFWS), and the Environmental Protection Agency (EPA). These federal agencies have the authority to enforce environmental laws regarding forestry practices, but much of this authority has been delegated to respective state agencies (Olesen et al., 2016) (Ellefson et al., 2002). States are responsible for regulating forests, but there is a high degree of variation in what those regulations are and whether they are enforced. This federal policy will provide financial incentive for states to encourage sustainable sourcing of woody biomass, instead of enacting a new federal directive. A summary of related policies can be found in Table 1.

Table 1: Summary of policies related to Sustainable Energy.

Policy	Key Information
Forest Resource Assessment Strategies (FRAS), state governments	• Oversee forest management (developed by all southern states)
Renewable Energy Portfolios (REP) or Renewable Portfolio Standards (RPS), state government	• Standards to increase renewable electricity • Vary across states • 8 states have set renewable energy goals (Durkay, 2017)
Federal renewable electricity Production Tax Credit (PTC), USDT	• Per kWh tax credit for renewable electricity generation (Cunningham, 2016) • (biomass sources were terminated in 2016)
Forest Inventory and Analysis (FIA), USDA	• Collections information and consists of a forest monitoring program • FIA field site located every 6,000 acres of forest to provide measurements on forested ecosystems (Olesen et al. 2016)
Forest Vegetation Simulator (FVS), USDA	• Complex analytical tool used to simulate forests • help landowners manage their forest (Vilsack, 2016)
Biomass Crop Assistance Program (BCAP), USDA	• Provide funding for eligible biomass (Cunningham, 2016) • Forest landowners and farmers
Community Wood Energy Program, USDA	• Grants for small bioelectric plants (< 2 MW) (Cunningham, 2016) • State and local governments are eligible for funds

There have been numerous federal programs to incentivize renewable energy. The Department of Treasury (USDT) has awarded tax credits to renewable energy sources. However, under the 1603 Grant Program, biomass only received an estimate of 2% of the 2012 renewable technology grants (Energy Tax Reform). The 2015 tax reform bill primarily awarded tax credits to wind and solar energy (Siegel, 2017). One biomass specific program is the Biomass Crop Assistance Program (BCAP), reauthorized in the 2014 Farm Bill. The program is overseen by Farm Service Agency (FSA), within the USDA, and provides funding to biomass from forester landowners and farmers alike (Cunningham, 2016). The 2017 BCAP specifically calls out woody forest residues and agriculture crop residues (Cunningham, 2016). This policy does not extend to the harvest of forest trees, which is unique to our proposed policy.

Example Calculation

Total state SFI certified electricity:

- 5 plants, each with 1 MW capacity
  → 5 MW total
- Each plant uses 80% sustainably certified biomass
- **Total: 4 MW of SFI certified electricity**

In addition to providing tax credits to individual plants, funding will be awarded to the states based on total of SFI certified electricity (MW) produced in their state. Distribution of the funding will be overseen by the USDA, and states will be encouraged to use this funding to promote the use of sustainable bioelectricity. This is not limited to woody biomass, and states may use the funding to promote other biomass programs, such as methane production from landfills, or collection of yard waste residues to be burned in power plants (Note: up to 5% of biomass can be burned in a coal-fired power plant without any change in infrastructure). States could also use this funding towards new bioelectric plants, the conversion of coal fired plants to become cofired plants (up to 5% biomass or, with modification, greater), or the conversion of coal fired plants to bioelectric plants.

We recommend that this policy be enacted with a 10-year life span, with the opportunity for renewal. The objective of the policy is to ensure woody biomass is sustainable sourced (meeting the SFI certification criteria). This will require plant owners, and private land owners to pay certification fees, which will be compensated with tax incentives. In year one, we look to establish a partnership between SFI and USDA, and initiate a 0.5% corporate tax on land development companies to fund the sustainable woody biomass program. It is our intention that a third-party organization will instill the longevity of sustainable certification, continuing after the program has come to an end. SFI will not be awarded federal funding as the certification fees will provide financing. This will further ensure the longevity of the program, independent of shifts in federal priorities. A small percentage of funding will be used to create departments within the USDA & USDT to oversee the program.

Sustainably certified woody biomass for either bioelectric power or wood pellet manufacturing plants has not been tracked by a government agency. We recommend that interested plants submit an application to the USDA at the beginning of fiscal year 1 to provide information on the current status of sustainably certified biomass. Note, this policy strictly recognizes the SFI certification, and this data can be used to assist SFI in staffing decisions.

In year two, we will initiate tax credits to bioelectric power plants, and wood pellet manufacturing plants based on the percentage of biomass that is SFI certified. The tax credits will be carried out by the USDT, and individual plants can apply in the yearly tax return, providing relevant documents of certification. In year three, the USDA will award state grants based on total SFI certified electricity. In year six, we will initiate a 4% corporate tax on plants that do not source 80% of their woody biomass from SFI certified forests. The program will be eligible for renewal at the end of the 10th year (Figure 7).

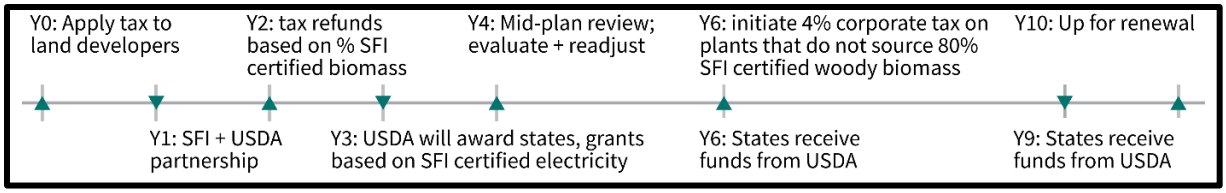


Figure 7: Timeline of Sustainable Bioenergy policy implementation.

III. Action Plan

This policy aims to protect U.S. forests from deforestation as wood pellet manufacturing is on the rise. The four primary stake holders are identified as the American people, the Forestry Industry, Utilities, and the Southeastern region of the United States. The figure below summarizes the policy stakeholders and their perspectives.

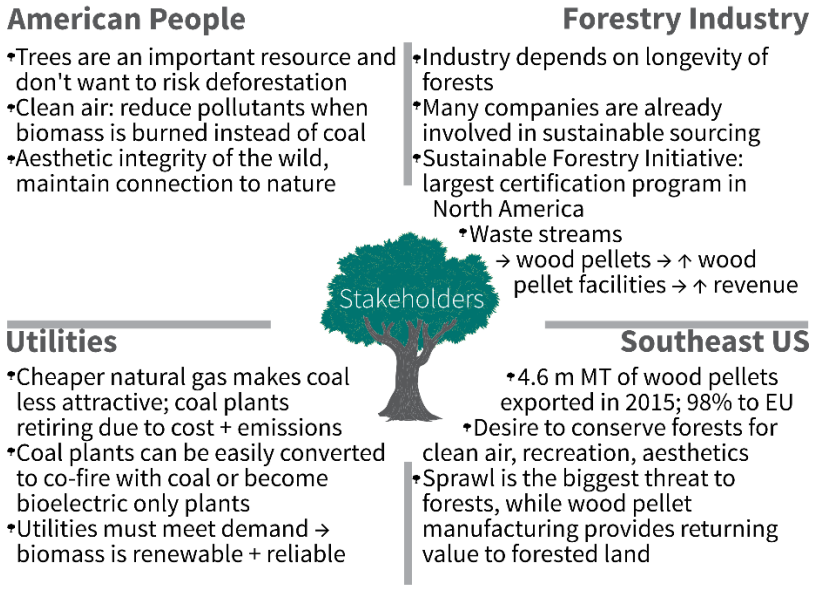


Figure 8: Sustainable Bioenergy policy stakeholders.

Coal is losing economic favor in U.S. markets, in part due to domestic expansion of hydraulic fracturing to produce inexpensive natural gas. Bioelectric power offers a solution to coal dependent communities as coal plants can be easily converted to accept biomass as a fuel source, with little change to existing job functions. The remaining mining regions of the U.S. are forested and can be transitioned to forestry and wood pellet manufacturing regions. With bioelectric power offsetting coal fired power, the American people will benefit from significantly reduced levels of pollutants, such as sulfur and mercury, which are released during the combustion of coal.

The EU will also benefit from this policy, as their demand for *sustainable* wood pellets will be met. This will ensure that the U.S. will continue to earn revenue on wood pellet exports, specifically within the Southeast. The Southeast will continue to enjoy the benefits of economic growth from the jobs supported and created by the wood pellet industry.

Bioelectric power is a cost effective, reliable, renewable energy source, and when source sustainably, has the potential to be "carbon-friendly", if not carbon neutral. However, a lot of controversy surrounds the carbon balance of bioelectric power. Certain parties will only support renewable energy that does not emit any carbon dioxide. This policy leaves the carbon accounting to the states, or other governing bodies, such as the EU. It is our intention for parties who deem SFI certified biomass insufficient to lobby individual states for carbon accounting regulations.

Land development lobbying groups may pose a potential roadblock for this policy. This is due to the 0.5% corporate tax on their industry. Land development groups are targeted as a source of revenue for because it is land development – through sprawl, not the forestry industry, that poses the largest threat to U.S. forests (Dale et al., 2017) (Wear et al., 2013). The forestry industry is expected to show support for this policy as sustainability is highly emphasized, and widely practiced in the industry to date. Sustainable sourcing has become a competitive advantage in a marketplace that shows willingness to pay a premium for sustainable sourcing and – critically – has disincentives to purchase non-sustainably sourced products. The wood harvested for timber, and other wood products do not directly compete with sourcing for wood pellets. In fact, wood waste streams from these industries can be rerouted to manufacture wood pellets.

The effectiveness of our policy will be evaluated by the states, via their application for federal incentives based on total SFI certified electricity. This will be reported to the USDA for verification. The amount of funding states receive from this program will be determined on a yearly basis once a benchmark has been established from the collective data of state applicants.

IV. Budget and Funding Sources

The land development companies have been targeted as a funding source because land development and urban expansion (sprawl) has been identified as the biggest threat to American forests. It is our collective responsibility to properly manage our nation's forests and ensure this resource is available to future generations. Between 2009-2014 land development companies generated average revenue of $19.5 billion (Statista, 2018). Therefore this tax will create an estimated annual budget of $100 million.

The 4% corporate tax on plants that do not source 80% will penalize bioelectric plants that do not comply. This tax will also provide the program some funding, but the true intention is to provide a disincentive to nudge plants to source sustainable biomass. According to Pirragilia et al., wood pellet plants generate revenue of $25.3/ metric tonne (2010). Dale et al. reported that 4.6 million metric tonnes were exported in 2015. From this data we can extrapolate an estimated annual revenue of $116 million from the wood pellet industry. The upper limit of potential tax revenue from this source is $4.6 million. In 2015, Biomass comprised a total of 11% electric generation (2016). Statista reported $391 billion revenue from the U.S. electric power industry in 2016 (2018), which could roughly equate to $43 billion revenue from biomass power. With a 4% tax rate for non-compliance, the upper limit of potential tax revenue from this source is $1.7 billion.

V. Conclusion

Our policy proposes an incentive plan to encourage states to require sustainable sourcing of woody biomass in both bioelectric power plants, and wood pellet manufacturing plants. Woody biomass is regarded as a renewable resource, but there are currently no legal assurances that the trees will be replanted. Not only does this risk deforestation, it may result in carbon accounting errors in state REPs. Specifically, we recommend that woody biomass receive certification from a non-profit, third-party organization, the Sustainable Forestry Initiative (SFI). This enforces reforestation, and management of forests in a manner that recognizes the sensitivity of the local ecosystem. This proposal is independent of state REPs; however, we recommend that states with existing REPs require sustainably certified woody biomass in an update. This will enable states to more accurately pursue the goals outlined in their REPs, specifically with carbon accounting. It is imperative to our nation's future that active oversight is in place to source woody biomass with proper environmental stewardship in mind.

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Appendix

A.1 Acronyms

ARIES	America's Renewable Incentives for Energy Sustainability
BCAP	Biomass Crop Assistance Program
CPP	Clean Power Plan
EPA	the Environmental Protection Agency
EU	European Union
FRAS	Forest Resource Assessment Strategies
FSA	Farm Service Agency
PEFC	Programme for the Endorsement of Forest Certification
FIA	Forest Inventory and Analysis program
REP	Renewable Energy Portfolios
SFI	Sustainable Forestry Initiative
USDA	United States Department of Agriculture
USDT	United States Department of Treasury
USFWS	US Fish and Wildlife Service