

THE POLITICS OF BIOMASS ENERGY IN CALIFORNIA:  
HOW EXTERNAL BENEFITS ARE USED TO SUPPORT AN  
ECONOMICALLY MARGINAL SECTOR

By

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## ABSTRACT

### THE POLITICS OF BIOMASS ENERGY IN CALIFORNIA: HOW EXTERNAL BENEFITS ARE USED TO SUPPORT AN ECONOMICALLY MARGINAL SECTOR

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Since the 1990s, there has been a decline in biomass energy generation in California. In order to promote state governmental policies aiming to increase biomass energy generation in California, the sector has been linked to a series of external benefits that biomass energy purportedly brings. Through document analysis, semi-structured interviews, and participant observation, five distinct external benefits were identified that have been used to promote the biomass energy sector. These external benefits are: renewable energy generation, air quality improvements, promotion of forest restoration and fuel removal projects, disposal of wood waste from agricultural and forestry sectors, and rural economic development. This study finds that the external benefits that are found in stakeholder discussions and legislative language reflect current events and politics that impact California, particularly as they relate to wildfire and forest management. There were three notable complications to creating policies that support biomass energy: disagreements about where along the supply chain biomass energy should be subsidized; questions centered on whether external benefits justify policy initiatives; and doubts about whether the external benefits claimed by biomass energy proponents were the best way to meet policy objectives.

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## INTRODUCTION

Biomass energy, or the energy derived from non-fossilized organic material, is known as the oldest source of energy for human use. Although the term *biomass energy* encompasses a range of energy, from the burning of wood for heat to the use of biofuels for energy, in this paper I will be using it to describe the energy which is generated in biomass energy facilities which contribute to an electrical grid, also known as *bioelectricity*. In the 1990s the biomass energy sector in California hit its peak, with 66 facilities and a total capacity of 800 MW. By 2015, California was down to 23 operating facilities with a total capacity of 410 MW (The Beck Group, 2015). In 2020, that number had increased slightly to a total of 25 operating facilities in California with a capacity of around 630 MW. Research suggests that the success of biomass power plants depends on policies that promote bioenergy utilization to maintain financial viability (Bildirici, 2014). This thesis explores the reasons behind the changing capacity of the biomass energy sector in California, and the ongoing disputes surrounding policies intended to support the sector. Policies supporting biomass energy are contingent on arguments about *external benefits*, which are benefits received by someone who is not directly involved in the production or consumption of a product or service, in this case biomass energy. Examples of external benefits that are linked to the bioelectrical sector in California include biomass energy as a source of renewable energy generation, a way to reduce negative air quality impacts from burning activities, a way to offset costs associated with forest restoration and fuel reduction work that could lower wildfire risk, diverting wood

waste from the agricultural and forestry sectors away from landfills, and as a source of economic development in rural California communities. The arguments that promote biomass energy using external benefits have changed throughout time and are often connected to resonant political issues and current events that impact Californians.

Following the dramatic fire that destroyed 12,000 structures in a community in Northern California, one biomass advocate stated during a policy advocacy conference that policymakers “could not afford to let a tragedy go to waste”, implying the use of this current event to influence legislation in the state.

The biomass energy sector, as a state-subsidized sector, can help us to understand the role of policies in supporting and undermining energy sources. Considering the overall decline of the bioelectricity sector and the potential for the sector to contribute to both energy needs in and forest management throughout the state, my research aims to answer the following questions:

- 1) What is the political context of biomass energy in California, and how have state and national policies impacted the biomass energy sector?
- 2) What are the discussions surrounding stakeholder support and/or opposition of stakeholders of the biomass energy sector in California, in other words, what are the external benefits of the sector in the eyes of stakeholders, and what are the areas of agreement, disagreement, and possible resolution?

I answer these questions through a combination of 1. Document analysis, using texts from political processes (both legislative and administrative), and policy advocacy



groups within the industry; and 2. Interviews with key stakeholders involved in the biomass energy sector in the state.

In this thesis, I first focus on the history of biomass energy in California, specifically the political and economic influences on the biomass energy market. I discuss the way external benefits are used to promote the biomass energy sector, and how the conversations around different external benefit changes in response to current events occurring in California. I analyzed legislation that has been introduced to the California State Assembly and the California State Senate since 1999 that supported or opposed the biomass energy sector, looking at external benefits that are referenced within legislation and comparing how they have adapted to current events and California's political climate. Semi-structured interviews with stakeholders provided support and context for the policy changes in the biomass energy market. I served as an intern at the California Forestry Association (CalForests), a professional organization that supports biomass energy, in order to gain access to interviewees and gain exposure to insiders' views of biomass energy politics.

I then describe the current state of biomass energy in California by presenting a breadth of perspectives from stakeholders involved in the sector. These are based on semi-structured interviews with 20 interviewees. I focused on the way stakeholders use external benefits to shape support for biomass energy, and how these external benefits have helped to inform policy. In addition, I demonstrate the ways in which external benefits have been used in proposed legislation to justify the need to promote biomass energy, and I explain how the language surrounding external benefits changes with

current events in California. In particular, I examine how recent wildfire disasters have fueled the discussions around forest management and ties to biomass energy programs, and how biomass energy has used wildfires and other current events to promote legislation.

Finally, I conclude with a discussion about the critiques surrounding the use of external benefits to promote biomass energy policy. This section looks at the debates surrounding what parts of the biomass fuel supply chain can have offset costs, whether the external benefits are valid arguments for policy promotion, and the sector's strategy of creating a framework of multiple external benefits that impact a variety of other sectors in the state. I conclude by explaining how not all external benefits are achieved with each policy initiative, and how there can be conflicting goals between the different external benefits.

#### Literature Review: The connection between biomass energy utilization and policy

Researchers have found that the success of the biomass energy sector is dependent on governmental policies that financially support or promote the sector (Bilgili et al., 2017; Siddiqui & Christensen, 2016), and introducing policies that promote biomass energy can increase the total capacity of biomass facilities (Ebers Broughel, 2019). These policies may lead to a reduction in emissions from fossil fuels (Suttles et al., 2014). In the United States, biomass energy policies have included tax credits and incentives; production incentives; financial offset programs such as grant, rebate, and loan programs; direct regulations, including renewable portfolio standards and interconnection rules; and

information policies including education and outreach and disclosure and reporting rules (Ebers Broughel, 2019). Since the sector is dependent on government interventions, proposed policies need a reason to promote biomass energy and are often linked to external benefits that the sector provides. In different countries throughout the world, the articulated external benefits have been a central part of the way biomass energy is promoted. A few examples of the external benefits that are used to promote biomass energy include: rural development and use of excess heat from combined heat and power facilities in rural communities (Ebers Broughel, 2019; Rahman, 2014; Steubing et al., 2020; Zhang & Kang, 2017); greenhouse gas reduction to meet climate goals in the European Union (Domac et al., 2005; Njakou Djomo et al., 2015; Paiano & Lagioia, 2016), and rural energy access and development in rural parts of developing countries (Bhutto et al., 2019; A. H. Demirbas & Demirbas, 2007; Kaoma & Gheewala, 2020).

In rural communities, especially in colder climates, biomass energy generation in combined heat and power facilities are commonly used to provide heat to neighboring buildings. These facilities can generate electric power for the grid and utilize the excess heat in nearby buildings. In Canada, rural communities use the generation of biomass energy as a source of heat for the surrounding buildings. A look into the ways biomass energy could provide electrical and heat benefits to off-grid communities in Canada demonstrated how barriers to the development of combined heat and power facilities can be minimized with governmental policies and grants (Mabee et al., 2011; Rahman, 2014). A study in Germany demonstrated the ability for biomass energy to provide more than 10% of the total heat consumed in the country, as long as it is coupled with policies that

reduce the competitive advantage of fossil fuels (Steubing et al., 2020). Research points to biomass energy as the most efficient way source of energy generation in rural communities that could benefit from both electrical and heat energy that the facilities provide (Rahman et al., 2014).

Another way biomass energy has been linked to external benefits is as a form of renewable energy to combat climate change. The European Union has steadily increased its climate goals which has shifted their focus onto renewable energy. The European Commission considers biomass energy to be carbon neutral and can potentially be combined with carbon capture and storage technology to reduce climate impacts (Delbeke & Vis, 2015). Because of this, biomass energy is seen as a tool that can be used to meet the aggressive climate goals in the EU. Development of biomass facilities throughout European countries have been linked to their classification as a renewable source of energy that will meet climate goals. A study done in Belgium demonstrated that having biomass energy generation replace energy generation from fossil fuels could create greenhouse gas sinks and finds that biomass energy is underutilized from a climate target perspective (Njakou Djomo et al., 2015). In Italy, researchers found that although there is sufficient residual biomass from the forestry and agricultural sectors in the country to sustain development of biomass energy facilities to promote renewable energy generation, obstacles with fuel transportation would require new policy that would promote biomass energy (Paiano & Lagioia, 2016). Proponents of the bioelectricity sector in the EU make the case that biomass energy is a renewable energy source that could displace fossil fuels and has been found to be a realistic goal to reduce greenhouse

gas emissions associated with energy generation. However, researchers point to the need for policy changes to encourage the growth of the sector.

Biomass energy as a way to develop rural communities is another way in which biomass energy has been linked to external benefits. In developing countries, especially within remote communities, access to fossil fuels is often limited, and many remote areas lack the infrastructure for the transmission and distribution of energy generated from fossil fuels offsite. In places so remote that they don't have transmission lines that can bring in outside power, research suggests that these areas would benefit from biomass energy generation, creating a way for rural communities to generate power with resources that are available to them without creating a dependence on fossil fuels (A. H. Demirbas & Demirbas, 2007). A case study in Zambia found that with proper policy development, biomass energy can be used to provide sustainable energy to rural populations that do not have access to electricity, and would be associated with further external benefits such as minimizing indoor air pollution and local deforestation (Kaoma & Gheewala, 2020). Although these studies demonstrate the practicality of utilizing biomass energy to generate sustainable energy to rural populations that do not currently have access to electricity, they again all affirm that development of the sector is dependent on governmental policies.

Bioelectricity is generally not economically viable on its own, and so in order to pass supportive governmental policies, advocates need to rely on arguments for external benefits of biomass energy (Bilgili et al., 2017) and there is a significant positive correlation between policy intervention and biomass energy generation (Cross et al., 2021; Ebers Broughel, 2019). Research has found that if the external benefits could be considered in the market price of biomass energy, the sector may be more economically competitive than fossil fuel energy (Sáez et al., 1998). The relationship between arguments about external benefits and policies that support the biomass energy sector is displayed in Figure 1. If proponents of bioelectricity strive to make biomass energy an economically viable sector, they will need to advocate for policies to be put in place to support the sector. Supporting stakeholders of the bioelectrical sector promote policies by justifying them through the use of external benefits, which are ways in which proponents link biomass energy to positive results outside of the direct energy generation and procurement, such as reducing emissions associated with open pile burning, increasing forest restoration and fuel reduction projects, and increasing rural economic development (Figure 1).

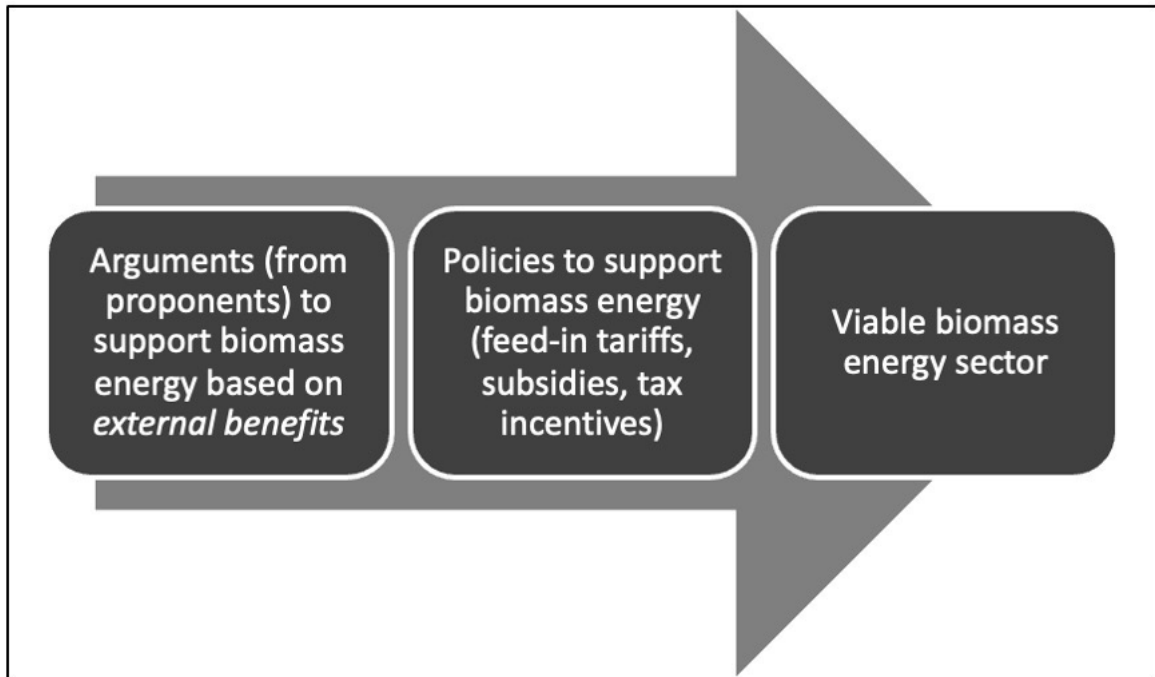


Figure 1: The relationship between arguments about external benefits and policies that support the biomass energy sector, where a viable biomass energy sector is dependent on policies which support it, which in turn are dependent on arguments in support based on external benefits.

The arguments in support of the sector based on external benefits are not unproblematic. Stakeholders within California and outside the state have long debated the environmental, social, and economic benefits and drawbacks to biomass energy. These debates have centered on whether biomass energy should be classified as carbon-neutral considering the CO<sub>2</sub> emissions associated with biomass energy generation (Harvey & Heikkinen, 2018; Willis, 2018) and whether it can be an effective way toward energy independence (Bartuska, 2006; Cho, 2011). Even when the benefits are not debated, research shows that policies that promote biomass energy can experience conflict between separate external benefits, for example maximizing job creation may conflict with maximizing reduction of greenhouse gas emissions (Berndes & Hansson, 2007).

I contribute to this literature by examining the external benefits that are purported to exist in generating biomass energy in California and determining which of these external benefits are used in the language of proposed state policy. The diverse geography and influence of the forestry and agriculture sectors in California have created an unusual political context for biomass energy, in which arguments centered on land management, environmental justice and pollution, and renewable energy all contribute. In particular, wildfire risk reduction has become a predominant narrative that appears in biomass energy policies amidst the growing impact wildfires have had on California and the attention it has brought to California politics.



## METHODS

I answered my research questions through a mixed-method approach, utilizing document analysis, semi-structured interviews with stakeholder participants, and participant observation.

### Participant Observation

In the summer of 2018, I was a policy intern at CalForests in Sacramento, California. CalForests is a policy advocacy group that represents the forestry sector in California. Because CalForests is located in the state's capitol, this internship allowed me to interact with a variety of people invested in policies affecting both the forestry and energy sectors.

The ten weeks I spent as an intern with CalForests allowed me to attend a variety of meetings and committee hearings surrounding biomass energy in California (Table 1). These meetings, hearings, conferences, and workshops provided exposure to policy makers, advocates, and opponents involved in the biomass energy sector, and introduced me to conversations surrounding biomass energy. I took notes during these meetings, and the notes were used to reference important people and documents relevant to the biomass energy sector, including proposed legislation, passed legislation, biomass energy projects, executive documents, and other research documents. During these meetings, I experienced firsthand the way biomass energy is talked about among stakeholders, and the levels of investment and influence that different stakeholders have on the sector. In

addition, I attended workshops and conferences outside of my internship, as shown in Table 1.

Table 1: Participant observation activities attended throughout my project, including dates and meeting types.

DATES	MEETING OR CONFERENCE NAME	ROLE
Nov 14-16, 2017	Western Statewide Wood Energy Team Forum	Student
June 12, 2018	Board of Forestry: Forest Practice Committee Meeting	Internship
June 13, 2018	Board of Forestry: Regular Session	Internship
June 13, 2018	California Low Carbon Fuel and Energy Coalition Meeting	Internship
	CalForests Board of Directors Meeting	Internship
July 9, 2018	Tree Mortality Task Force Meeting	Internship
June 21, 2018	California Biomass Energy Alliance Board of Directors Meeting	Internship
July 6, 2018	CalForests Meeting	Internship
July 10, 2018	Low Carbon Fuel and Energy Coalition Meeting	Internship
July 25, 2018	CEC- Wildfires	Internship
March 6-7, 2019	CalForests Annual Meeting	Internship
October 18, 2019	CAPE Meeting (RCEA) Biomass/Forestry (online)	Student

### Semi-Structured Interviews

I conducted semi-structured interviews with 20 participants who were selected to represent a range of stakeholder positions regarding biomass energy. These interviews were conducted with approval from the Institutional Review Board for the Protection of Human Subjects (IRB 17-107). I began sampling through my internship with CalForests, speaking with stakeholders recommended by advocates within CalForests. I asked interviewees at the end of every interview for additional names,

using a snowball sampling method (Patton, 2014) in order to gain a breadth of perspectives on the biomass energy sector. Interviewees included experts from government agencies, private companies, advocacy groups, and research institutions (Table 2). I reached out to potential interviewees through phone and email, and I found contact information through their organization's website or where their contact information was publicly listed on LinkedIn. I conducted interviews at a location chosen by each interviewee either at their own office, over the phone, or in a public place such as a coffee shop. Nearly all of the interviews took place between March and August of 2018, with two more occurring in 2019, and were typically between 45 and 90 minutes in length. I developed the following interview questions based on my research questions (see Appendix).

With permission from each interviewee, interviews were recorded using my personal recording device and transcribed verbatim. I then coded interviews using the software Nvivo. I began free coding (Patton, 2014) by reading through each document and creating codes for all lines of transcription that were relevant to the biomass energy sector. Once I finished the initial open coding, I read through all the codes I created and looked for more narrow themes within the codes. These themes were *Efficiency of Utilization*, *Forest Management*, *Air Quality*, *Rural Economic Development*, and *Renewable Energy*. I then revisited each transcribed interview and coded information based on the five themes I created. I created Word documents for each theme with quotes from each interview. Some coded content fit into more than one of the five themes, so I included that content in multiple documents.

Once themes were organized separately, I coded within the themes, creating codes based on the points the interviewee was making. I had two other social science colleagues independently code my interviews, discussing both agreement and disagreement among our codes in order to generate further discussion and reflection.

Table 2: List of interviewees and their positions, referenced by number to maintain anonymity.

#	Interviewee position
1	County Agency
2	Government Agency
3	Private Timber
4	Environmental Advocate
5	State Agency
6	Federal Agency
7	Environmental Group
8	Policy Advocate
9	Policy Advocate
10	Academia
11	Government Agency
12	Policy Advocate
13	State Agency
14	State Agency
15	Private Consultant
16	Environmental Advocate
17	County Agency
18	Environmental Advocate
19	Community Choice Aggregation
20	Biomass Facility

### Document Analysis

Document analysis was conducted on a variety of types of documents, including legislation, administrative orders, and advocacy documents.

Legislative documents were found using the search tool on the California Legislative Information website<sup>1</sup>. I used the key word searches “biomass”, “biomass energy”, and “bioenergy”. Once I found legislation that contained these words, I read through the legislative text to determine whether the language in the bill was impactful for the biomass energy sector. I included bills from 1999 through 2021. Additional legislation, administrative orders, and advocacy documents were gathered as a result of my internship with the CalForests and through stakeholder interviews. In both cases, I asked stakeholders involved in biomass energy for recommendations about biomass energy policies and created a list of relevant documents.

I then coded the bills and documents in Microsoft Word by coding the language that linked external benefits to biomass energy generation. After the initial coding, I coded a second time to narrow down themes. The themes that were established within the legislation were *Forest Management*, *Wildfire*, *Rural Development*, *Renewable Energy*, *Air Quality*, and *Waste Disposal*.

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<sup>1</sup> <https://leginfo.legislature.ca.gov/faces/billSearchClient.xhtml>

## RESULTS

First, I am going to demonstrate that biomass energy as a source of grid electricity itself is not economically viable due to the nature of the fuel, thus it is more dependent on outside market influences than competing forms of power generation. Therefore, if policymakers value biomass energy as part of the future of energy generation in California, there need to be policies in place to maintain financial sustainability of the bioelectrical sector. I present the policy context in California, including a brief history of state and national energy policies that have impacted the state of California's energy sector. Policies promoting the biomass energy sector have been justified and encouraged through the external benefits that biomass energy provides to California, and I will discuss how biomass energy industry has utilized these external benefits as a way to push their policy initiatives to maintain the sector. From interviews conducted across a range of stakeholders in biomass energy policy, I was able to recognize five distinct ways biomass energy has linked with external benefits to promote their sector: as a form of renewable energy, through air quality benefits, assisting with forest management objectives, creating efficiency of utilization of waste products, and by its impact on rural economies. Throughout the discussion of external benefits, I include the counterarguments that often work against the creation of supportive biomass energy policies.

## The Lack of Economic Viability for Biomass Energy

One obstacle to creating policies promoting economic success for the biomass energy sector is that the costs that accrue for the biomass energy sector occur throughout the supply chain (Figure 2). The biomass energy fuel supply chain begins at the source, such as a forest or an orchard, and must be harvested, treated, and transported to a biomass energy facility. In addition to the supply chain costs, interviewees discussed the benefits associated with biomass energy that are not directly related to the energy produced at the facilities, but instead provide non-energy benefits to the surrounding communities.

California has enough fuel to support the generation of biomass energy, however the nature of the fuel itself poses the greatest setback to the sector. Figure 2 shows that there are associated costs along the supply chain of biomass energy fuel, including the initial harvest of the fuel, the costs of processing the fuel in a way that allows transportation, transportation costs, and final processing and storage costs. Each step along the supply chain is associated with a cost: the cost of harvesting might include paying for fellers, logging equipment, the cost of a timber harvest plan or other document ensuring compliance with local and federal regulations, as well as the cost of labor and costs associated with the land ownership. In California, regulation requires intensive harvest documents to be submitted to the state before timber is harvested with the intention to sell, barter, or trade the material. A licensed forester is required for the submittal of these documents, which means for even smaller scale operations the cost of

the project may be increased by the need for professional oversight. After harvest, the cost of transportation includes the cost of equipment to load the trucks, the cost of the trucks and the fuel, the cost of road and equipment maintenance, and again the cost of the labor. Fuel that is taken directly to a biomass energy facility is often treated through chipping for ease of transportation, which has costs associated with both labor and machinery. In speaking with interviewees, the consensus was that the overwhelming financial setback for the biomass energy sector was transportation costs. Both the lower energy density of the fuel and how the origin of the fuel expands across much of California's land contribute to a high cost of transportation of the fuel.

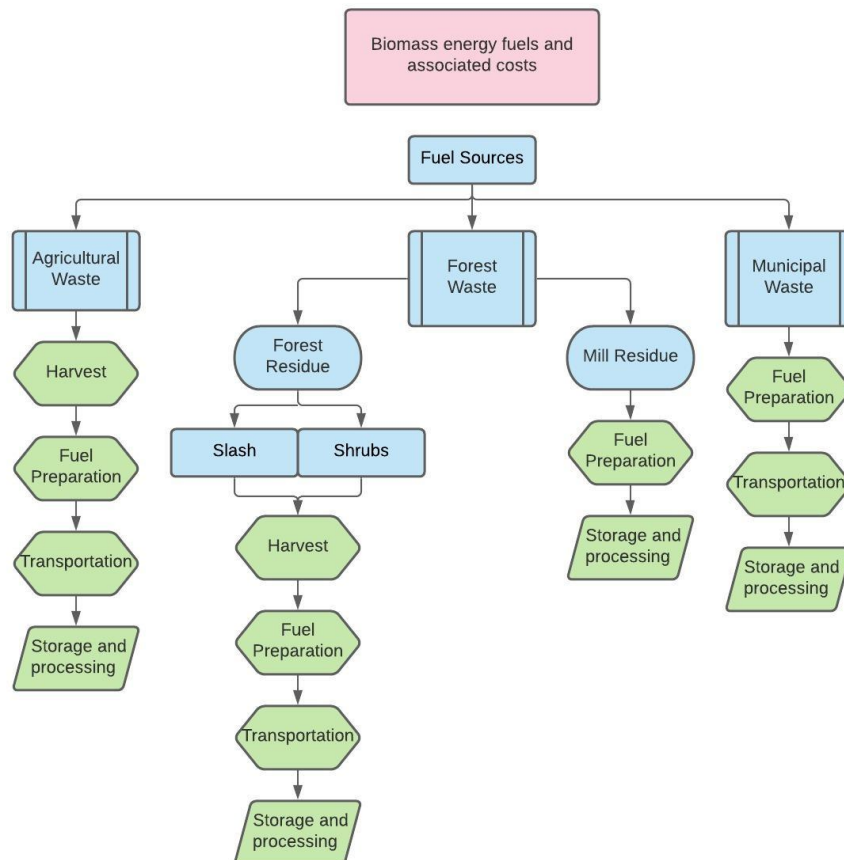




Figure 2: Flow chart representing the associated costs with the procurement of biomass energy fuel, beginning at the origin location of the fuel and ending at the biomass energy facility. Blue rectangles show types and origins of fuel, where green hexagons show associated costs along the supply chain for each type of fuel, and the final green parallelogram shows the final cost associated with the fuel.

While one desirable component of biomass energy fuel is that it can be transported and stored, the energy density by weight and size of the fuel is lower than that of other forms of transportable and storable energy, namely fossil fuels. For example, when comparing the energy density of biomass fuels to coal, biomass has a much lower energy content at approximately  $500 \text{ kg/m}^3$  than coal, which is approximately  $1300 \text{ kg/m}^3$  (Demirbas, 2004). Because of the low energy density in the fuels in combination with the widespread area in which fuels originate, the transportation of fuel from the source to the biomass facility is what sets apart biomass as a more expensive source of energy. In addition to the fuel's relatively low energy density, the origin of the fuel takes up much more space than that of fossil fuels. The origin of biomass energy fuel in California expands across much of the state's land, encompassing municipal, agricultural, and forested land. When considering the transportation from the origin to the facility, one obstacle is that each type of fuel origin spans across a large area, which makes planning for transportation and even the location of generation facilities more complicated because the location of fuels is decentralized. Biomass energy is generally dependent on trucks to transport the fuel. These forms of energy transportation are not only labor intensive, but the cost is dependent on the market price of diesel fuel. The market price of diesel fuel and the distance biomass fuel can be transported have a direct relationship when trying to maintain the associated costs. Because the price of diesel has increased over the last

several decades, diesel has put a financial burden on biomass facilities which depend on forest and agriculture fuel, which was a point made by one interviewee:

Just about all biomass plants—when they came into fruition in the mid-80s, the rule of thumb was you would site a facility within a 100-mile radius of your fuel sources. That was economically driven. The price of transportation back in the 80s was just a fraction of what it is now. Think of your diesel fuel costs, price per gallon, for example, back in the 80s versus what it is now. From an economic standpoint, that 100-mile radius may now be down to 50 miles or less. (Interviewee 20: Biomass Facility)

Highlighting the dramatic impact that the cost of diesel fuel may have on the procurement of biomass energy fuel, Interviewee 20 gives a visual for the physical limitations that can result from a change in market cost of diesel fuel. In this way, biomass energy is more heavily dependent on this outside market than other forms of energy generation. On top of the declining cost of other forms of energy, especially renewable energy, the increasing cost of transportation not only makes biomass energy less economically viable, it decreases the area in which it is financially feasible to transport biomass energy from for power plants that are not driven by sawmill residue. Throughout the history of biomass energy, the sector has had to repeatedly adapt to external changes that impact the way they collect their fuel, demonstrating the dependency on a variety of factors associated with fuel procurement, including price of diesel and location and abundance of wood waste. As the cost of diesel increases and the radius that the fuel can be transported from decreases, biomass energy facilities have utilized existing transportation methods to decrease the cost of transportation from areas which had already been utilizing trucks. One way of increasing the radius of available fuels is to utilize trucks which were transporting in one direction. In this scenario, one

community choice aggregation organization representative explained how the community used trucks which were transporting municipal waste to landfills out of the area to transport biomass fuel on the return trip:

Rather than have those trucks come back empty, they could be like, “Oh, well, we’re already driving this empty truck back.” It made it cost effective to transport from more distant mills because, otherwise, it would just be an empty truck driving back regardless. (Interviewee 19: Community Choice Aggregation)

Even with the adaptations the biomass energy sector has made to accommodate for the change in the diesel fuel market, studies show that the success of the biomass energy sector is dependent on policies to support financial sustainability (Bilgili et al., 2017; Siddiqui & Christensen, 2016). The associated costs of biomass energy, and thus the final cost in energy generation from a biomass facility, do not allow biomass energy to financially compete with other forms of grid energy that is generated in California. Without being financially competitive in California’s deregulated energy market, biomass energy is not financially sustainable without the assistance of policy initiatives. Biomass energy as a form of energy provides the California grid system with dispatchable, renewable energy, but this in itself is not always enough to encourage policy initiatives that promote biomass energy. Beyond conversations about the limiting factor of biomass energy is the cost and the sector’s struggle to compete with other forms of energy, especially renewable energy, the conversations both in support of and opposition to biomass energy in California often center around the external benefits that the sector provides. Biomass energy advocates have attached the sector to other key current issues throughout the state in order to gain momentum for policies that promote biomass energy.

In attaching biomass energy to these issues, they have identified external benefits (also known as positive externalities) biomass energy provides that can benefit other areas of concern in California. The externalities associated with biomass energy expand across multiple sectors and spark the conversation about whether bioelectricity should be financially supported by policy, and in turn where that support should come from.

### The Cost of Biomass and How it Relates to the External Benefits

While the cost of bioelectricity is currently a major concern in the biomass energy sector, this was not always the case. The early developmental stages of biomass energy utilized this form of energy production as a form of waste management, which kept the cost of fuel low, as facilities were utilizing fuel that they already had. Early facilities in California were cogeneration facilities, or facilities that are adjacent to sawmills and provide the sawmill with a close location to dispose of the sawmill's wood waste and deliver energy in the form of electric energy to power the sawmill and thermal energy to heat the kilns in return. Eventually, standalone facilities began opening in California, and as the sector branched out away from a solely cogeneration model, the way biomass energy was discussed changed from a waste facility with an external benefit of energy to a power generation facility with an external benefit of waste disposal. With this shift in discussion about the purpose of biomass energy facilities, the costs associated with generation also changed. Where biomass energy was once considered a low-cost alternative to open pile burning and landfill disposal with an added benefit of energy

production, it became an expensive form of energy production with an additional benefit of wood waste disposal.

Between the cost of transportation for biomass energy and the fact that biomass is less energy dense than other forms of combustible fuel, biomass energy is more expensive than other forms of energy on the market.

There are also questions on the overall economics of it. There are arguments that if you're looking at it from the business perspective, and especially from the utility side, why will you purchase power from the very expensive source when you can get a much lower cost from other systems. (Interviewee 13: State Agency)

Many arguments against biomass energy tend to come back to this point: that from a purely economic standpoint, utility companies and those that purchase the energy (often called "rate payers") do not directly receive the external benefits associated with the procurement of biomass energy, and for the amount of energy they receive there is no economic reason to purchase biomass energy over other, less expensive forms of energy.

[Biomass energy] is more expensive than solar and wind at this point. That is another argument that environmental groups and utilities make. Why should we pay for this more expensive power when we have less expensive alternatives? (Interviewee 12: Policy Advocate)

Because bioelectricity is not a financially sustainable source of energy generation on its own, this paper looks at the arguments that people make for and against utilizing and subsidizing biomass energy in California despite its economic limitations, why biomass energy might be worth investing in, and the discussions around where the money should come from. The life cycle of the fuel, the transportation to a facility, and the generation and distribution of the energy are all associated with external benefits that

provide important advantages to different communities throughout the state of California, and the discussion surrounding how to offset the costs of biomass energy are largely centered around which of these benefits are important enough for the state to prioritize subsidizing the sector.

#### Policy Context: Renewables and the Fate of the Biomass Energy Sector in California

Legislative tools have been used within California to either sustain or promote the biomass energy sector because the sector lacks the ability to be economically competitive in an open energy market. Legislation to promote certain types of energy generation is not uncommon, and in the United States there has been significant movement toward renewable energy in the last several decades. Between 2006 and 2016, the U.S. reduced its energy-related CO<sub>2</sub> emissions in all but four years (U.S. Energy Information Agency, 2017). This movement has been the result of policy initiatives through different levels of government that encourage the reduction of fossil fuel use. This background is important for understanding how biomass energy has both succeeded and failed, as it has moved from being included as one of many sustainable energy sources (alongside wind and solar) to a contentious sector that does not clearly fall into the sustainable energy mix.

#### Public Utility Regulatory Policies Act of 1978

One early policy that set the stage for the promotion of renewable energy was the Public Utility Regulatory Policies Act, which was a federal policy that encouraged independent renewable energy generation and was particularly successful in establishing contracts for independent generation facilities in California. In 1978, H.R. 4018, known

as the Public Utility Regulatory Policies Act (or PURPA), was enacted as part of the National Energy Act in the United States and became one of the first policies to promote independent energy development in the country and reduce the monopoly power that electrical utilities held at the time, managing both generation and distribution of electrical energy. PURPA was created following the 1973 Oil Crisis, in which an oil embargo was proclaimed by the Organization of Arab Petroleum Exporting Countries on nations who were believed to be supporting Israel during the Yom Kippur War. The United States was aiming to reduce their dependency on oil for energy, and PURPA created a market for non-utility power producers to generate power to sell back to power companies and opportunities for new forms of energy generation to develop (Czuffin & McCaffrey, 2020). In California, PURPA assisted in the development of a renewable energy market by enabling renewable energy providers to create 30-year contracts with investor-owned utility companies, called Power Purchase Agreements (PPAs).

Through PURPA, biomass energy facilities were securing 30-year PPAs at a profitable rate, and the biomass energy market began to grow in California. The biomass energy market continued to grow until its peak in the 1990s when 66 biomass energy facilities with a total capacity of 80 MW were converting 10 million bone dry tons of biomass into energy (The Beck Group, 2015).

#### Deregulation of California's Energy Market

PURPA contracts accelerated the biomass energy sector, and in 1984 and 1985 favorable contracts were created that gave biomass energy facilities 5 years to get online and secured contracts based on the forecasted cost of energy (Morris, 2000). These

contracts protected the biomass energy sector from the decline in cost of world oil prices in the years following an oil price collapse in 1986, where the cost of a gallon of oil dropped significantly and challenged the value of other energy sources (Gately et al., 1986). As more biomass energy facilities secured contracts with utility companies, the biomass energy sector became an important part of both the power sector and the waste disposal sector in California. In 1990, 11 more facilities secured contracts and the total generating capacity grew by 232 MW to more than 770 MW of generating capacity. The quick growth of the sector created problems in procuring fuel to supply the requirements of the contracts, and facilities were struggling to maintain generation to meet these contracts (Morris, 2000).

In 1994, proposals for a restructuring plan were introduced, which incentivized utility companies to buy out contracts from biomass energy facilities. Several facilities were receptive, especially as the growth of the sector was creating a higher demand for fuels that was difficult to fulfill, and in the years following the introduction of the restructuring plan, more than 215 MW of generation capacity was lost due to the buyout of contracts (Morris, 2000).

In 1996, a second restructuring plan was introduced to the California State Assembly in the form of AB 1890, which aimed to build off PURPA to create a more competitive market for wholesale energy producers and lower the cost of energy for consumers. It is estimated that when AB 1890 was introduced, California had an excess generation capacity of approximately 20%, which was seen by policymakers as a sign



that deregulation of the energy market would theoretically drive wholesale costs of energy down through a competitive market (Congressional Budget Office, 2001).

According to Interviewee 15, who was involved in the early stages of biomass energy advocacy in California, during this time each biomass facility was independently owned, creating a complex market that did not promote a culture of organized advocacy. Soon after the 1996 deregulation, the California Biomass Energy Alliance was created as a political advocate for the biomass energy industry, bringing representation into California's legislative process. Today, the California Biomass Energy Alliance is still among the prominent policy advocate groups for bioelectricity, serving 20 biomass energy facilities according to their website<sup>2</sup>.

### Renewable Portfolio Standards

One tool that California has used to promote the procurement of energy from renewable resources and reduce their energy-related emissions is through their Renewable Portfolio Standards (RPS) program. RPS are designed to set a goal for renewable energy generation within a designated government. In the United States, many individual states have taken initiative to set up RPS in a way that mandates the utility companies to procure a set percentage of their energy from renewable resources. This system creates a market for renewable energy through the development of renewable energy credits, which represent a unit of renewable energy that is input to the grid. These

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<sup>2</sup> [calbiomass.org/membership-directory/](http://calbiomass.org/membership-directory/)

credits can then be sold to energy retailers, or utility companies, to verify that they are meeting the renewable portfolio standards designated by the state. The renewable energy credits can also be purchased by businesses to demonstrate their dedication to reducing emissions. California has set some of the most aggressive RPS goals in the United States, starting with SB 1078 in 2002, which established RPS in the state. Since that time, California has continued to create more legislation, setting stronger goals as the state surpasses the path for the previous goals. The RPS goals in California are currently set for the state to procure 100% of its energy from renewable sources by 2045, with a benchmark goals of 44% by 2024, 52% by 2027, and 60% by 2030.

#### Policy Arguments About Biomass Energy: The Case for External Benefits

In this section, I explain the policy mechanisms that are introduced in legislation that promotes biomass energy, and I review the claimed external benefits of biomass energy production, which have been used to support the sector. I also present specific bills that have been passed that are commonly referenced by stakeholders in the biomass energy sector and give historical context for the language linking the biomass energy sector to external benefits in these bills.

In an attempt to make biomass energy more competitive with other forms of energy generation, California legislators have introduced policies that would attempt to minimize the financial differences between biomass energy and other forms of energy generation. The policy mechanisms that have been introduced by California legislators have included a range of tools, though most commonly these bills are in the form of tax

incentives and grant programs that would lessen the financial burdens of biomass energy generation. However, the policy tool that was most commonly discussed by interviewees was the feed-in tariff program, which supports forms of renewable energy generation by guaranteeing generation facilities a set price for energy, often in the form of long-term contracts with utility companies.

The language in state-level legislation contains both policy mechanisms and links biomass energy to external benefits (Figure 3). As Figure 3 demonstrates, the external benefits that are linked to biomass energy legislation adapt over time, often correlating with current events and the political climate of California at the time of the introduction of the bills.

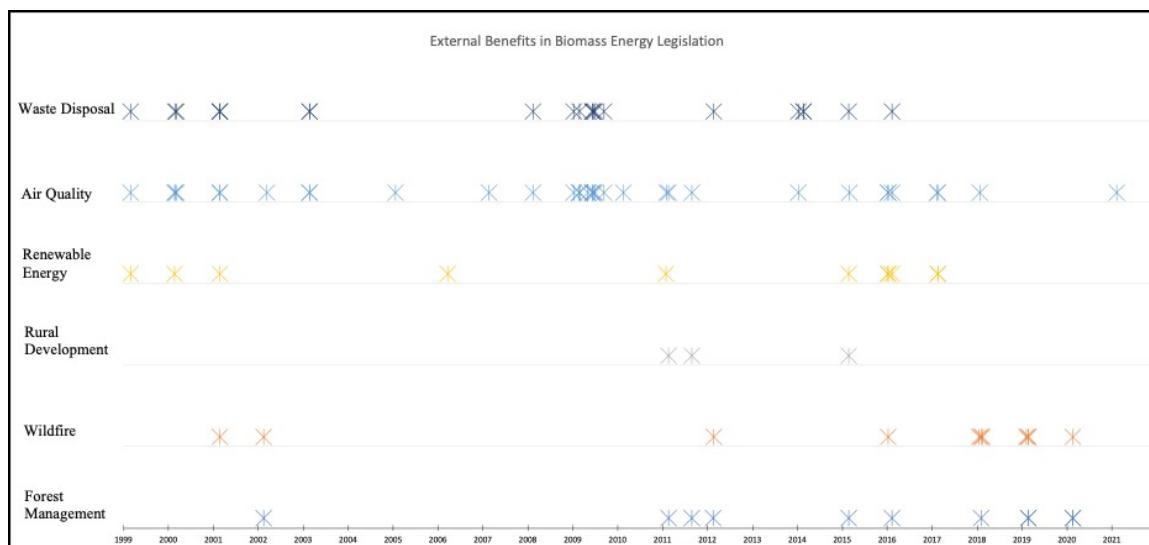


Figure 3: Language found in proposed legislation that link biomass energy to external benefits organized by the date the bill was introduced.

These six external benefits are *Forest Management*, *Wildfire Reduction*, *Rural Development*, *Renewable Energy*, *Air Quality*, and *Waste Disposal*. I will return to Figure

3 throughout my results section, using the language of the statutes themselves to highlight the connections between biomass energy generation and external benefits, as displayed in the figure.

### California's Biomass Energy Feed-In Tariff Programs

Throughout the interviews I conducted, interviewees repeatedly discussed two important bills that support the bioelectrical sector through a feed-in tariff program, which is a policy mechanism that is used to support renewable generation by providing a fixed price to producers, and a renewable auction mechanism, which allows independent producers to bid against each other to compete for contracts that fulfill a set procurement mandate for renewable energy. Both bills have had unique obstacles and levels of success, and both have been connected to external benefits to justify the required contracts. For these programs I will provide a brief history on the political climate of the state which allowed an opportunity for these bills to be introduced.

#### Bioenergy Market Adjusting Tariff

In 2012, the biomass energy sector made a push for the introduction of smaller facilities located closer to their source of fuel with the introduction of SB 1122, the Bioenergy Feed-in Tariff Program, or the Bioenergy Market Adjusting Tariff (BioMAT). This program aimed to encourage the development of smaller facilities (up to 3 MW) through a feed-in tariff program. The program would create fixed-price contracts with utility companies for 50 MW procured from bioenergy facilities whose fuel was byproducts of sustainable forest management. While there have been several projects that have attempted to utilize contracts through the BioMAT program, ultimately the program

has been generally unsuccessful and has required further legislation that assists in the implementation of the BioMAT program. In 2016, legislators passed AB<sup>3</sup> 1923, expanding the maximum size of the facility to 5 MW, which the author, Assembly member Wood of California's 2<sup>nd</sup> Assembly District, justifies as both a way to create competition with other generation facilities as well as provide a disposal method for local sawmill waste and forest residue that would otherwise be "kindling for the next wildfire". AB 1923 also addressed interconnection issues that had been a barrier to small scale biomass energy projects being able to connect to the grid.

#### Bioenergy Renewable Auction Mechanism Program

In January of 2014, Governor Jerry Brown proclaimed a State of Emergency due to severe drought conditions in California, followed in October of 2015 by another State of Emergency due to subsequent tree mortality. Language in the October 2015 proclamation ordered for the Department of Forestry and Fire Protection (CAL FIRE), the California Natural Resources Agency, the Department of Transportation, and the California Energy Commission to identify areas which represented elevated dangers for wildfire and falling trees due to the tree mortality, called High Hazard Zones. It also ordered the CAL FIRE and the California Energy Commission to identify potential funds to offset the higher feedstock costs for biomass energy facilities that accepted forest

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<sup>3</sup> California legislation in the form of Assembly Bills and Senate Bills are referenced as "AB" and "SB" respectively, followed by the bill number. Information about the bills referenced in this paper can be found at <https://leginfo.legislature.ca.gov/>

biomass from areas which were declared as high hazard zones. In October of 2016, Resolution E-4805 implemented the provisions of SB 859, known as the Bioenergy Renewable Auction Mechanism Program, or BioRAM. This program required the three largest electrical corporations to create contracts that establish procurement of a total of 125 MW from existing biomass energy generation facilities. The bill itself, named “Public resources: greenhouse gas emissions and biomass” contains language about multiple external benefits as they relate to the intention of the legislation, including language about wildfire and greenhouse gas emissions. However, the specific language supporting biomass energy links the legislation to sustainable forest management and the removal of biomass fuel from high hazard zones, stating that “at least 80 percent of the feedstock of an eligible facility, on an annual basis, shall be a byproduct of sustainable forest management, which includes removal of dead and dying trees from Tier 1 and Tier 2 high hazard zones and is not that from lands that have been clear cut.”

The BioMAT and BioRAM programs were commonly discussed among stakeholders during interviews, but interviewees mentioned other ways in which different forms of renewable energy generation put biomass energy at an economic disadvantage and suggested different types of legislation. One interviewee suggested that legislation promoted competition by making the market more representative of the cost of energy by considering what they called “grid integration adder”, which would consider the cost put on dispatchable generation to ramp up energy to offset the dramatic drop in intermittent energy during certain times of the day. Interviewee 8 discusses how policy can change the way energy generation is priced by moving the cost of ramping up energy sources to

the intermittent energy sources:

When solar and wind bid in, they're just bidding in their cost to generate that electricity. But what's not taken into account, or wasn't taken into account, is that you have to back that power up with something else, and typically that's Natural Gas, or out of state, coal. So what is the cost of integrating that renewable into the grid? So we actually had to get a bill to tell the PUC to figure out what the grid integration adder is for all renewables, knowing that biomass and geothermal didn't have that problem because they're baseload renewables, but wind and solar did. (Interviewee 8, Policy Advocate)

Several interviewees brought up how the low cost of solar and wind energy can be attributed to legislation that favors these sources of energy, thus making it more difficult for biomass to be cost competitive. In addition to the cost of ramping up, Interviewee 8 discussed more ways the solar industry was able to reduce the cost of generation through tax cuts, which creates a more favorable cost for solar generation.

A number of years ago there was a bill that was introduced at the last minute in the budget season that extended solar's property tax exemption and extended that property tax exemption for another ten years. So even though solar was winning all of these bids, they still claimed that they needed a property tax exemption on the improved property for another ten years. So this whole constantly giving other technologies props up, not fixing the RPS, and of course not letting forward bills that are trying to fix that forward. (Interviewee 8, Policy Advocate)

This demonstrates how even though biomass energy is considered in legislation used to promote renewable energy sources, proponents have felt that there continues to be obstacles against a competitive market within renewable energy generation.

### External Benefits: A case for Biomass Energy

In the following subsections, I describe the external benefits that were articulated throughout interviews and in legislation as a way to form arguments in support of

biomass energy generation. Included within the discussion of external benefits are counterarguments among stakeholders describing the ways in which using external benefits to justify biomass energy legislation can be problematic. These external benefits arguments are that biomass energy:

1. *Is a Renewable Energy Source:* RPS Policies have promoted renewable energy in California, which has led to an increase in wind and solar power generation, which are intermittent resources. Biomass energy is a dispatchable electrical source, which is required to meet the demands of the power grid. Proponents claim that the use of biomass energy can help California meet its renewable procurement goals.
2. *Improves Air Quality:* California generates a significant amount of wood waste, and proponents of biomass energy point to studies that have shown a reduction in overall emissions when this waste is burned in bioelectrical facilities rather than open pile burns. However, the location of facilities can contribute to existing environmental justice issues surrounding who experiences the emissions.
3. *Promotes Forest Management Projects:* Forest management has been getting attention in California because of widespread tree mortality due to drought conditions and increasing wildfire behavior. Biomass energy proponents frame bioelectrical facilities as wood disposal sites to relocate material that may be wildfire fuel, although there is disagreement about how policies can be implemented to promote the goals for both the forestry and biomass energy sectors.
4. *Utilizes Wood Waste:* California's agriculture and forestry sectors extend over most of the state's land and contribute to excessive wood waste that requires a method of



disposal. While biomass energy facilities originally provided a waste recovery service for wood waste from sawmills, sawmill closures pushed facilities to procure fuel from more distant sources and increased the cost of procurement with the added transportation costs.

5. *Facilitates Rural Economic Development:* Biomass facilities could promote rural development in areas of California that may have been historically impacted by the decline of other industries, such as mining and logging, according to proponents. These facilities may provide jobs to the surrounding community, can bring in state funding to support local projects, and facilitate forums for community advocacy that can bring together other projects that improve the community, such as partnering with sawmills.

### Renewable Energy

In this section, I am going to present the different ways in which biomass energy was discussed as a form of renewable energy. There were several different ways in which biomass energy was discussed as it related to renewable energy generation. One of the discussions was the ability of biomass energy to replace dispatchable and baseload energy sources and the ability to fill the gaps in energy needs when transitioning away from fossil fuel energy generation throughout the state. Interviewees also spoke of the problems that arise when there is an assumption that biomass energy generation is considered carbon neutral and thus creating a market for biomass energy as a renewable

source of energy generation. Other interviewees spoke to the difficulty that biomass has when competing with other, less expensive forms of renewable energy.

#### Competing with Wind and Solar

One of the arguments for subsidizing biomass energy is its consistency in providing dispatchable power to the grid. Dispatchable power is electricity which can be generated to meet demands, as opposed to intermittent power, such as wind and solar, which is dependent on an uncontrolled source. Typically, dispatchable power utilizes a form of storable fuel, such as coal, natural gas, or biomass. In contrast, intermittent power generates electricity as the source of generation is available, such as wind and solar.

Although dispatchable power generation from fossil fuels is being replaced with California's growing RPS goals, the renewable power generation that is rising to meet these RPS goals is mostly coming from intermittent power sources. California is seeing that although there is a consistently growing renewable energy target, renewable energy policies have not benefitted all renewables equally. Even with the added benefit of dispatchable generation, biomass energy is not competitive against wind and solar generation, and instead California's grid energy has maintained dependency on fossil fuels for a majority of their dispatchable generation needs.

In California, solar and wind have dominated the renewable energy market, growing in capacity as the RPS has required more renewable energy procurement by utility companies. Baseline and dispatchable renewables have not increased at the same rate to match California's renewable goals. Wind and solar energy have increased as components of the energy mix used in California, and as renewable energy is growing to

meet the RPS goals, intermittent energy makes up a majority of the renewable energy mix in California, with solar and wind energy making up 12.28% and 10.17% of the total energy mix, or 38.7% and 32.1% of the renewable energy mix respectively in 2019 (Nyberg, 2019), while nuclear and hydroelectric have been producing less of the total amount than in previous years (U.S. Energy Information Agency, 2017).

The need for dispatchable generation was a primary concern for several of the interviewees. Although wind and solar energy have become popular in California, where the climate is compatible with both forms of energy generation, there are setbacks for both energy sources that may prevent these forms of energy to meet the needs of the growing RPS standards in California on their own. The largest problem is that without major sources of energy storage, the amount of energy input to the grid from wind and solar generation is intermittent and dependent on the current weather and time of day.

Interviewee 12 described this:

Both solar and wind are pretty unpredictable particularly wind unpredictable from moment to moment. Even if they're predictable, there's big seasonal variations. (Interviewee 12: Policy Advocate)

In the absence of a form of energy storage, electricity generated for the power grid needs to be used as it is being generated, so these two forms of renewable energy sources need to be supplemented with a more consistent source of energy generation during hours when solar and wind energy are not producing (Osório et al., 2015).

Without a financially feasible way to store large amounts of energy to be used during the times of day when wind and solar are not producing, California has maintained dependence on fossil fuels to fill the energy demands of the state in the absence of wind

and solar energy generation. Even so, legislation continues to slowly increase goals of California's RPS, which has grown at a rate annually where wind and solar could reasonably continue to grow with the goals, but did not take into account the need for renewable sources of dispatchable energy as California's RPS goals approach 100% of grid energy from renewable sources. One interviewee explained that "Anytime the RPS is renewed and doesn't try to fix this imbalance of procurements is a problem." They went on to discuss how the general support for an increasing RPS goal overlooks the larger problem of imbalanced procurement, stating "You're only procuring wind and solar, peak and intermittent renewables, problems for the grid, and not baseload: biomass, geothermal, biogas" (Interviewee 8: Policy Advocate).

In document analysis for bills which promoted biomass energy, wind and solar proponents opposed AB 2208 (2017) which was proposed legislation that would give dispatchable and baseline renewables like biomass energy an incrementally growing procurement requirement from retail sellers, pointing out the competition between different forms of generation within the "renewable energy" umbrella in California. Since intermittent power utilizes weather patterns to generate their energy, the cost of fuel is low compared to dispatchable energy which utilizes fuel which can be stored. From a financial standpoint, this provides a low cost of renewable energy for rate payers, making it a more financially appealing choice when procuring renewable energy. As of 2018, there were no large-scale battery options which would enable wind and solar power to fulfill the demand for electrical power during low generation times. Instead, interviewees

spoke of the need to create diversity within the electrical generation portfolio to account for peak power demands during periods of low generation from intermittent sources.

Interviewee 19 added the perspective that just because intermittent power provides low-cost energy “you can’t just do solar and build a giant battery that can power the entire state to run it at night” when the state transitions to 100% renewable.

There’s going to need to be a mix of resources. That’s where, I think, the more variety, and particularly getting geothermal and biomass, are primary to a baseload renewable so you can just run steady. I think there’s certainly a role for those. (Interviewee 19, Community Choice Aggregation)

Interviewee 19 makes the transition from the low cost of solar power to the need to supplement the low cost with a higher priced dispatchable power to fill the gaps between the intermittent sources. Throughout my interviews, there was an emphasis on the importance of maintaining a variety of sources of energy in the state’s portfolio, especially between intermittent and dispatchable power. When interviewees spoke favorably about biomass energy in terms of considering it a renewable source of energy, the most common argument was that dispatchable power was needed to fill the needs in the absence of wind and sun, as reflected in this quote:

On the energy side, a lot of these bioenergy projects do tend to have the advantage of being dispatchable in one way or another so that you can operate them more flexibly than you could with a wind or solar project. (Interviewee 11: Government Agency)

Interviewees indicated that this flexibility with dispatchable and baseload energy was especially important when considering the RPS goal for California and the reduction of dependency on fossil fuel derived energy. Language supporting this argument appeared in legislation that promoted the biomass energy sector, especially as a way to

support biomass energy against other forms of renewable energy generation. AB 893 (2017) emphasized the need for dispatchable or “flexible” generation to complement intermittent, or “variable” sources:

Achieving the state’s climate change and renewable energy goals, while maintaining the reliability of the electricity grid and avoiding undue cost impacts on consumers, will require that the state maintain a balanced portfolio of eligible renewable energy resources, including biomass and geothermal resources that can operate flexibly and at high capacity factors to complement variable renewable energy resources, such as wind and solar. (AB 893, 2017)

Biomass proponents who participated in my interviews recognized that the state would need enough dispatchable energy to reasonably replace the current dispatchable generation load, and presented arguments that tied together various co-benefits to the ability of biomass energy to replace the type of generation currently provided by fossil fuels. For example, Interviewee 1 made the connection between creating a space to dispose of wood waste to create the dispatchable energy for the California grid system:

I guess the last thing I would point out is that bioenergy in general, like energy that we derive from waste, is something that we need to do because we need to get off fossil fuel, and there isn’t enough intermittent resources, which is solar and wind, to do what we need to do, especially in the middle of the night on a calm night. If you only have wind and solar and its calm and dark, what’s your plan? The bottom line is right now we back it up with natural gas and coal and oil. So, if we want to not do that anymore, we have tons of organic waste that we can supplement our intermittent resources with. (Interviewee 1: County Agency)

However, interviewees indicated that the problem that arose with biomass energy as a replacement for fossil fuel energy in the California grid system was that biomass energy was more expensive than either traditional natural gas power or solar and gas, making it less competitive on both fronts. With an increasing RPS goal, they argue that it will be important for biomass energy or other forms of dispatchable renewable generation

to fill the gaps as fossil fuel gets pushed out of the mix.

### Carbon Neutrality

Creating a space to promote biomass energy to fill the needs for renewable dispatchable generation in California assumes that biomass energy should be considered a renewable energy source by the state. Although the other topics that were discussed through the interviews had nuanced approaches from all sides, there was a clear distinction between the way environmental advocacy groups talked about biomass energy as a form of renewable energy and how other interviewees addressed the subject. While the topic of carbon neutrality is important in the discussions surrounding climate benefits, it carries over into conversations around whether the legitimacy of the carbon neutrality argument can justify the consideration of biomass energy as a renewable energy source. One environmental advocacy representative expressed their concerns with biomass energy as a form of renewable energy if the ultimate goal is to reduce carbon emissions from energy generation, stating “It’s not carbon neutral, we need to be cutting carbon yesterday if we're going to avoid catastrophic global warming impacts” (Interviewee 4: Environmental Advocate).

While Interviewee 4 implied the need to halt the production of biomass energy altogether to avoid the associated emissions, another environmental advocate (Interviewee 16) did not dismiss the use of biomass energy generation, but rather brought up the problem with biomass energy taking up space reserved for renewable energy in California. They discussed how California has different levels of enforcement for emissions, and how the biomass energy sector is given more relaxed standards under the

assumption of carbon neutrality, or “loopholes” to avoid accounting for their emissions. They stated that “you don’t have to get carbon permits for the smoke coming up from biomass emissions. That means it’s basically free under the program, which gives an assumption of climate neutrality” which, they said, was completely incorrect (Interviewee 16: Environmental Advocate). While they did not claim to oppose biomass energy in California, Interviewee 16 did point out the ways in which biomass energy may be getting an unfair advantage that is not beneficial to the overall goal of emission reduction in California.

The problem right now with California’s climate policy with respect to biomass isn’t a yes-or-no question or a how-much question. The issue is whether and how to accurately account for the climate impacts of harvesting forest-sourced biomass and then putting it through a process as an energy source. It’s not a matter of whether or how much we should have biomass, it’s the fact that California’s policies continually disregard the actual climate impacts and the emissions from the operations and from the combustion. (Interviewee 16, Environmental Advocate)

Interviewee 16 further discussed the problems with the assumption of biomass energy as a renewable source of energy generation, bringing attention to potential problems with the way studies had supported the idea that biomass energy production would reduce overall emissions by reducing the amount of fuel for wildfires. This was explained as a way that studies were overestimating the amount of biomass in the forest that would burn, both by assuming all biomass left in the forest would be subject to wildfire and that areas which were hit by wildfire would be completely incinerated. Instead, Interviewee 16 made the argument that rather than assuming all forest biomass would be subject to burning in a wildfire, calculate the probability of each area of a forest



burning and base emission reduction data on those calculations.

All of which is just a way of saying, or is getting around to saying, the assumption that 100 percent onsite burns or that it's going to burn with high-intensity fire or that you're going to lose all the carbon. All of those are incorrect calculations. (Interviewee 16, Environmental Advocate)

They continued by pointing out that "It's not that we shouldn't have biomass energy in California, it's that we can't have biomass energy by saying it's carbon neutral." They further brought up the idea that the motivation for presenting biomass energy as carbon neutral may be an attempt to fit the framework required to qualify for funding that the state has already set aside for climate funds.

### Air Quality

There were three distinct ways that biomass energy was linked to air quality concerns in California. These topics were environmental justice concerns with the placement of biomass energy facilities, emissions associated with energy generation, and the effects of wildfire smoke on air quality. Emissions associated with energy generation were often specifically discussed as they related to climate change and California's goals in greenhouse gas reduction, while environmental justice discussions centered around how geographic location of power plants can disproportionately impact certain communities due to the way pollution settles within the central valley. In the discussion of wildfire, it is difficult to disconnect the conversations between fuel reduction and smoke impacts on air quality. In this section, I link the discussions and use of wildfire to promote biomass energy policy to air quality, however it creates a segue into discussions about forest management.

### Geography and the Injustice of Biomass Facility Locations

When interviewees were asked about potential problems with the way biomass energy was generated in California, environmental justice concerns were brought up by several interviewees, even proponents of biomass energy. Much of the current biomass energy generation was within the Central Valley, which already disproportionately experienced the effects of pollution compared to more sparsely-settled and higher-elevation forested areas of the state. According to 2017 data, nine of the top 25 United States cities with the largest health impacts from PM<sub>2.5</sub>, which is particulate matter less than or equal to 2.5  $\mu\text{m}$  in aerodynamic diameter, were located in the San Joaquin Valley, where Fresno, Bakersfield, Visalia, Modesto, and Hanford were in the top 10 cities on the list (Cromar et al., 2019). The San Joaquin Valley was also home to several large-scale biomass energy facilities, some located within these cities. Interviewees indicated there had been political pressure to encourage contracts with these larger biomass facilities in areas that are already struggling with air quality concerns (Figure 4).

Our biomass-energy plants are largely located in the Central Valley. Very often, in those air basins, which are historically and continually out of compliance with the Clean Air Act—meaning we’re dumping more smoke into some of the most polluted basins and some of the most polluted communities in California—basically to give a break to polluters. (Interviewee 16: Environmental Advocate)

This was framed as a social justice issue by one interviewee, as the “underserved” Central Valley communities “don’t have the resources to fight” the siting of biomass facilities (Interviewee 5: State Agency).

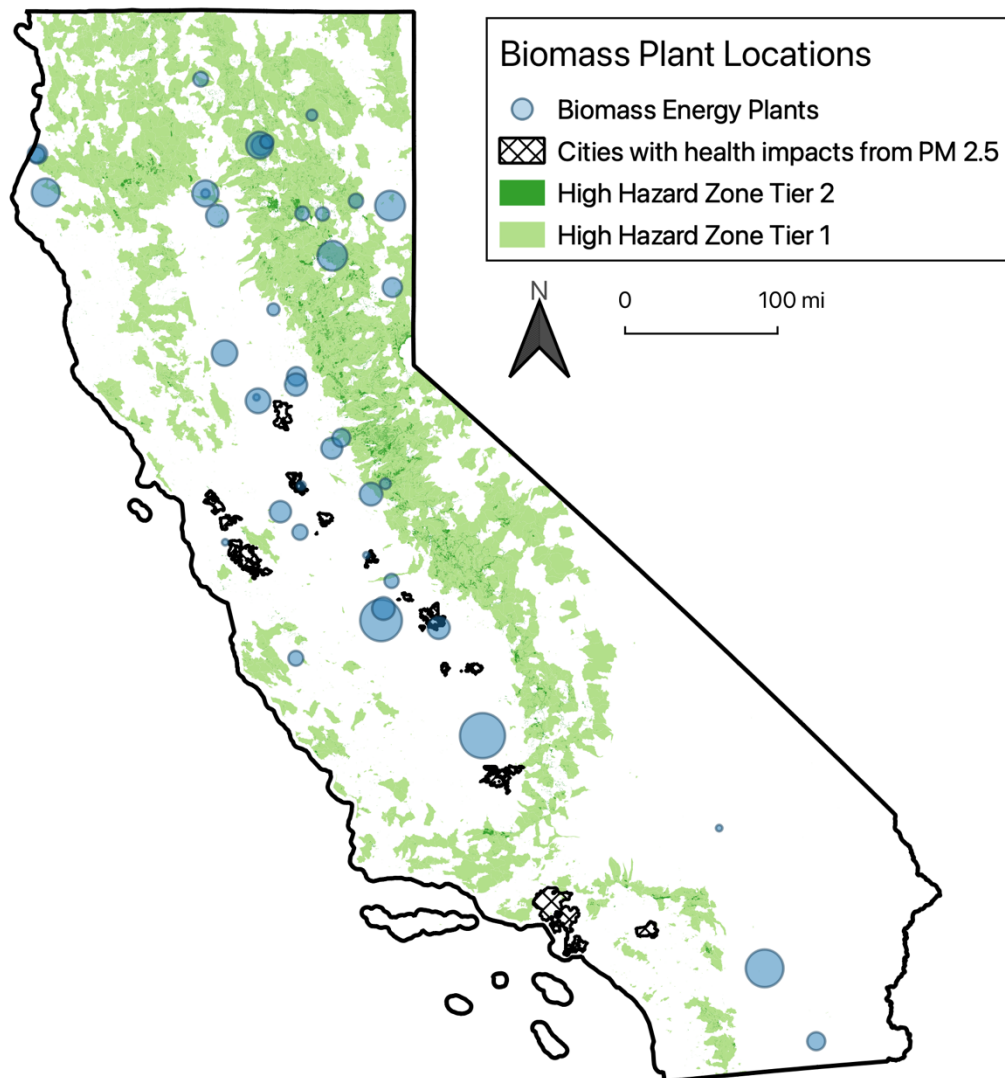


Figure 4: Map of California showing the location of High Hazard Zones, cities which experience the most health impacts from PM 2.5, and operating bioelectrical facilities as of 2020, where the size of the marker is scaled to be larger for higher capacity facilities and smaller for lower capacity facilities.

While much of the discussion about biomass energy utilization was centered around utilization of wood waste and the means of disposal, this waste was generally

attributed to forested regions and the forest products sectors, which are geographically very distant from the Central Valley, and have generally had fewer air quality issues. The larger biomass facilities located in the Central Valley are not adjacent to the forested lands that would benefit from the removal of biomass:

There's four facilities in the San Joaquin Valley, and all four of them rank among the top of PM2.5 emitters among 5000 polluters. And that's not like a by-MW comparison, that's just that they're emitting tons of fine particulate matter. (Interviewee 4: Environmental Advocate)

The BioRAM program generated contracts with the Central Valley facilities, enabling them to sell their energy to utility companies at a set rate as long as they met a standard of 80% of their fuel coming from forested land that was declared to be “High Hazard Zone” by CAL FIRE. While this program accomplished the goal of passing legislation that promoted the removal of dead and dying trees associated with the prolonged drought and bark beetle infestation, this brought up the new problem of moving pollutants from the forested lands of the Sierra Nevada to the Central Valley. This was summarized by an employee of a county agency located in the Sierras, who noted that not only did wood come from distant places, but it also often displaced locally-sourced wood from the Central Valley that then ended up being open burned:

The agricultural communities in the Central Valley already have a problem with wood waste. A huge problem with all the vineyards and orchard removals. Vineyards and orchards produce a ton of wood waste, and they can't compost it all. They try, but there's too much. They do compost a lot but they... so they have their own wood crisis. And they're ending up having to burn fields and burn old orchards and vineyard piles and that's a terrible situation. (Interviewee 1: County Agency)

This transfer of pollution from forested lands to the Central Valley posed a secondary problem for the region: the fuel those facilities once procured from the area, such as agricultural wood waste, now had to find a new source of disposal. Because all forms of wood waste disposal have associated emissions, and open pile burning is commonly the most economically feasible option, displacing these fuels in favor of forest fuels may contribute to even higher levels of pollution in the Central Valley.

While overall emissions in California may be reduced through the use of biomass facilities, these interviewees brought light to the injustice of moving the fuel, and thus the associated emissions, from places with low air quality concerns to places with significant air quality concerns. As Interviewee 8 (Policy Advocate) discussed, it did not matter how much reduction there was to the airsheds of California if there were people who were directly exposed to the resulting emissions of a biomass facility:

That stack, no matter how low those emissions are, it doesn't matter to the people who live one mile away. So what do you say? The air district says "Look, your air is cleaner because of that facility there." But they say, "disproportionately not the case." They would say that their air is cleaner, my air is not as clean as theirs because that plant is there. You haven't added the emissions from that plant to my clean air. So there's the conundrum. Do you shut down that plant and make the valley air worse for everybody? Do you keep it going? (Interviewee 8: Policy Advocate)

Interviewee 8 illustrated a concept that biomass energy may provide air quality benefits on a large scale by reducing smoke impacts across the state, but those benefits came at a cost to the communities adjacent to the biomass energy facilities. Biomass energy facilities create consistent sources of emissions for local communities of the Central Valley, and while air quality was the external benefit that was mentioned the

most in proposed legislation, the language did not touch on the environmental justice issues faced when placing large-scale facilities in areas that were already experiencing some of the worst air quality in the country.

#### Emission Regulation: Enforcement and Consistency Issues

Of the external benefits that legislators and policymakers have linked to biomass energy in an attempt to promote their legislation, air quality was mentioned in proposed bills the most (Figure 3). In fact, from 2007-2010, all 13 bills that were introduced about biomass energy included some language about air quality. One notable part of the language about air quality found in legislative bills was that it was typically very concise and at the end of other statements and was recycled in later bills. A common phrase that was found in bills was “improved air quality”, often added to the end of a statement in support of biomass energy (emphasis added):

California’s biomass power industry has the potential to supply renewable energy representing about two percent of California’s electrical demand while providing **improved air quality**. (AB 1641, 1999)

Incentives for reducing fuel costs, that are confirmed to the satisfaction of the commission, at solid fuel biomass energy facilities in order to provide demonstrable environmental and public benefits, including **improved air quality**. (SB 107, 2005) (SB 410, 2007) (SB 722, 2009) (SB 2561, 2010) (AB 33, 2009) (AB 1016, 2009) (SB 2, 2011)

Even though many bills linked biomass energy with air quality without providing much depth to the argument, some bill *analyses*, which are prepared by legislative staffers, provided more detail on the reasons biomass energy should be utilized to improve air quality. These explained the reduction in emissions when compared to other

waste disposal methods often used by the forestry and agriculture sectors when dealing with excess biomass waste:

According to the Author's office (Florez, (S)), the purpose of this bill is to reduce air pollution by offering incentives to biomass facilities, to use more agricultural waste in the facility's production of energy. By creating financial incentives less of that waste may be burned in open-fields giving farmers a cleaner alternative than burning their own on site. Reduced open-field burning will improve local air quality and help protect public health. (SB 704 bill analysis, 2003)<sup>4</sup>

Although the bill analysis explained why biomass energy could be beneficial for offsetting the emissions associated with waste disposal, this language was not included in the bill itself. While linking air quality to biomass energy, AB 590 (2015) more directly stated the reduced emissions associated with utilizing biomass energy generation had the ability to divert biomass waste from other forms of disposal associated with higher emissions:

Biomass power generation also provides valuable, environmentally preferred wood waste disposal service for the disposal of 7.5 to 8 million tons of California's annual solid waste stream and the avoidance of 1.5 to 3.5 million tons annually of biogenic CO<sub>2</sub> emissions. By diverting biomass residues away from open burning, landfill burial, and accumulation in forests, the state benefits from reduced criteria air pollutants and greenhouse gas emissions... (AB 590, 2015)

Opponents of biomass energy, however, used arguments that contradicted the benefits of biomass energy and point out that there are still emissions associated with biomass energy. Arguments and articles released by those who opposed biomass energy in California generally cited studies done outside the state that made claims about the

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<sup>4</sup> Bill analysis available:  
[https://leginfo.legislature.ca.gov/faces/billAnalysisClient.xhtml?bill\\_id=200320040SB704](https://leginfo.legislature.ca.gov/faces/billAnalysisClient.xhtml?bill_id=200320040SB704)

negative aspects of biomass energy, including higher emissions and the need for plantation farming to produce enough fuel to feed biomass facilities (Booth, 2014, 2018; Gonzalez et al., 2009). Interviewee 12 discussed how these studies were often cited as a source of information to argue the case against generating biomass energy in California:

On the air quality and climate benefit, a couple of environmental groups... point to a study in North Carolina where the operator was taking— was clear cutting healthy trees from a wet forest that had no bark beetles and no wildfire risk, shipping them across the ocean to Edinburgh where they were being burned in a direct combustion facility. That study found that the emissions from that power produced in England are worse than coal power emissions. (Interviewee 12: Policy Advocate)

This interviewee went on to discuss how their view of the study was that it was not necessarily relevant to what was going on in California, because “it has nothing to do with what we’re doing in California.” This raised the relevance of biomass energy studies done in different parts of the world. While California presents an unusual case, not all of the problems about biomass energy that were identified within the study should be discounted. One argument made by opponents of bioelectrical generation is that it is “dirtier than coal” because of the low energy density of wood compared to coal. When calculating emissions solely at the facility and removing life cycle considerations for the fuel, fuels that are used to generate biomass energy are less energy dense than coal and lead to higher emissions than that of coal-fired energy plants and thus more overall emissions when comparing units of fuel.

The carbon emissions, the climate impacts of woody biomass is going to be as much as three times what you would see from natural-gas combustion, which is the main source of electricity in California, and that it can be higher even than coal in its emissions from the smokestack. California is failing to deal with that reality. (Interviewee 16: Environmental Advocate)



As California sets more aggressive Renewable Portfolio Standards, the state is looking for low-emission ways to replace fossil-fuel generated grid energy. Interviewees discussed people's concern over replacing fossil fuel energy with other forms of incineration:

For instance, you can't talk about incineration at all. From the environmental side, anything that heats the biomass, converts the biomass by a thermal chemical process, they will argue that that's not allowed. It's a kind of incineration, therefore you should not be doing that and it's not really emission free because the definition said there should not be any emission at all. That for me is something that I think should be addressed. (Interviewee 13: State Agency)

SB 100 set a goal of 100% zero emission energy by 2045, and for biomass energy to have a future which is compatible with these standards, it would have to be able to account for direct emission reduction as a result of biomass energy generation. A common argument among interviewees was that biomass replaced the need for open pile burning for fuels reduction and wood waste disposal. This interviewee discussed how both open pile burning and biomass energy generation were associated with emissions, yet biomass energy facilities have the capability of reducing the emissions that would have been associated with an open pile burn when subjected to the filtration systems in the power plants:

Then there are those who are simply saying "look, you shouldn't be burning this in the open, and you shouldn't be burning it in a boiler because both have emissions". Granted, one is controlled and one isn't, but we think we should be investing in technologies that have zero emissions. To which we would say "well these get down pretty low." These aren't just slightly controlled combustion technologies, they're extremely controlled combustion technologies. And when you're ready for that alternative technology, I'm sure the market will determine that would be the better alternative, but until that happens, you have an existing infrastructure in the state of California that's doing a job right now to take that

material from being open burned or chipped and spread or landfilled or whatever is happening to the material. (Interviewee 8: Policy Advocate)

Though California's emission goals are some of the most ambitious in the United States, interviewees brought up consistency over concerns for specific emissions as a way to place burden on the biomass energy sector when they play a small role in creating emission when compared to other sources of emissions. One type of emissions, PM2.5, have been linked to greater health risks than other emissions, and biomass energy does produce PM2.5 pollution. However, one biomass proponent said:

PM2.5 is problematic, not just from a biomass standpoint, but PM2.5 is prevalent in diesel exhaust, fireplaces, wood stoves, wood heat concerns. They all emit PM2.5. Singling out the biomass industry I don't think is fair. (Interviewee 20: Biomass Facility)

This interviewee brought up the idea that while biomass energy may be a contributor to particulate emissions, these types of emissions were common among other activities that were more difficult to regulate. From my interviews, there were two ways biomass energy was talked about when it came to emission regulation: First, when compared to alternative treatments for the fuel, biomass energy may provide a net reduction in emissions that would positively affect air quality. Second, when comparing to other forms of energy generation, biomass energy was associated with higher emissions and there was an argument against allowing for biomass energy to bypass the "compliance obligations".

#### Wildfires and Air Quality

Most interviews occurred in the summer of 2018, just before many of the now record-breaking fires the state has experienced such as the Carr Fire, the Camp Fire, and

the historic 2020 wildfire season which burned over four million acres according to CAL FIRE (CAL FIRE, 2021). However, these interviews still occurred in the context of a progressively longer California fire season and the fear that devastating wildfires would occur following the historic drought that lasted from 2012 to 2015 and led to the widespread tree mortality incident killing millions of trees throughout California (Fettig et al., 2019).

Because of these wildfire concerns, air quality was a discussion that was brought up by over half of the interviewees that participated in this study. From a general standpoint, all arguments presented from the interviewees were in favor of lower carbon and particulate matter emissions and I found that there was agreement that air quality should be prioritized, but disagreement on whether increasing biomass energy would positively or negatively affect air quality. Some interviewees discussed their concern with investing in carbon-emitting energy generation, while others made the argument that burning material in a controlled facility may reduce overall emissions. Smoke was identified as a concern throughout California, both as a localized problem when considering burn days and a more widespread problem when there are wildfires occurring. In the words of one interviewee:

I think that the reason the air district supports forest biomass to energy is because smoke is bad. And smoke sucks. And it ruins summer days, and it ruins views, and it slows down sports events, and open pile wood waste is a bad alternative. And prescribed fire needs to happen, and we know we need more of that. So, what are we going to do if we do that and open pile burn? We know air, there's only so much air. It's like people forget that air is like water. We're swimming, just like the animals in the ocean. it's just our air is just – we don't have enough sense to

recognize that we're in an environment just like a pool. And so, it's very important that we stop using open pile burning as a disposal method so that we can do more prescribed fire, and so that we can keep forest health where it needs to be. (Interviewee 1: County Agency)

As they pointed out, clean air is a finite resource, and although California is a leader in the United States for emission reduction, these calculations do not consider the emissions associated with wildfire. There are many factors that affect air quality, but what sets wildfire apart is that the timing and severity of the air quality impacts cannot be controlled. Air quality concerns are tied to impacts not only in daily health, but can impact large events, recreation, and seasons that bring tourism to the state:

So, we have a lot of wildfires here in [our] county. 50% of our county is forested... And we have a lot of issues related to open pile burning permits that affect large nationwide events like Iron Man, bike races, things like that. We're trying to balance the needs of CAL FIRE and the US Forest Service and their forestry practices as well as wildfires. And we're trying to balance those needs with constituencies' and private events and other types of county activities. (Interviewee 1: County Agency)

In my discussion with Interviewee 1, they pointed out that the fuel in forests needed to be treated in order to maintain the low fuel loading in the area and minimize the possibility of destructive wildfires. However, the common practice of open pile burns emitted more pollution than if the fuel were treated in a biomass energy facility. The way they framed biomass energy in relation to air quality was the way most interviewees framed the topic, which was replacing commonly used disposal methods like open pile burning with burning wood waste in biomass energy facilities. These facilities regulate the particulate matter and have been shown to reduce the emissions by up to 98% when

compared to open pile burning (Springsteen et al., 2015). One interviewee who worked in the timber sector said:

There are many who have voiced concerns with particulate emissions associated with the burning of biomass, or other air emissions associated with it. The concern with that is with the context by which they speak to it. Compared to what? In California, one of the benefits of having a place for biomass to go to is so that it's not open burned, whether that's pile burning or through an out-of-control wildfire... biomass, because it's burnt through a cogen facility or a biomass facility, it's going to remove a lot of those air pollutants compared to the open burning. And more and more, technology is continuing to improve on that front as well. (Interviewee 3: Private Timber)

I heard these arguments several times from the biomass energy proponents that I interviewed. One of the main obstacles I observed through my interviews and analysis was that though arguments in favor of biomass energy surround positive impacts across multiple sectors, most of those positive impacts cannot be quantified in a way that can easily offset the cost of generation. In this instance, while burning fuel in a facility may reduce emissions compared to open pile burning, these emissions were difficult to calculate. Emissions in a facility would be associated with the energy sector, whereas if they were open pile burned they would not appear in the emission calculations associated with the energy sector at all. Ultimately the reduction of overall emissions would not be reflected within the state's emission reduction data.

As wildfires in California have made international headlines, legislators have utilized this attention and incorporated language in bills supporting biomass energy to frame this form of energy generation favorably for wildfire fuel reduction. Figure 5 shows the bills that were introduced by California Legislators that promote biomass

energy and incorporate language linking biomass energy generation to wildfire reduction, and the largest, most destructive, and deadliest wildfires in recent California History.

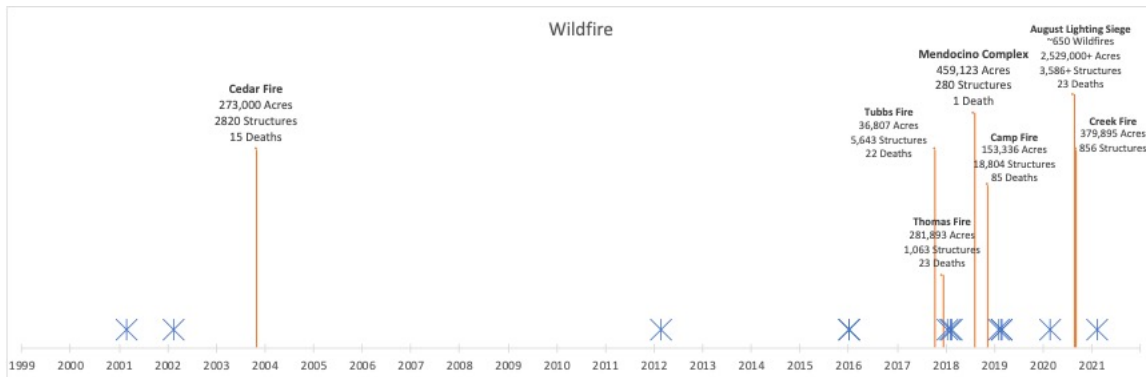


Figure 5: Bills which promote biomass energy and incorporate language about wildfire, including the dates of the largest, most destructive, and deadliest California wildfires during that time.

Wildfires shown on the graph were the top five fires that occurred between January 1999 and February 2021 in the following categories: largest area burned, most structures burned, and deadliest. Since the August Lightning Siege was a single weather event that sparked over 650 individual fires across California, those fires have been represented by the single incident on the graph. However, the fires started by the August Lightning Siege in August of 2020, including the August Complex, the SCU Lightning Complex, the LNU Lightning Complex, and the North Complex, were each in the top six largest wildfires in California. Figure 5 presents a visual that shows how language in the bills have included language about wildfire reduction more as wildfires in California have regularly become larger and more destructive.

Language that justified support for biomass energy generation by linking fuel procurement to wildfire risk was mentioned as early as 2001, in an Assembly Joint Resolution that states:

The measure would memorialize the United States Forest Service, Bureau of Land Management, National Park Service, and Environmental Protection Agency to recognize environmental benefits including improved air quality, decreased global-warming gases, and reduced threat of catastrophic forest fires that energy production from **biomass** waste can provide (AJR 4, 2001)

What stands out about AJR 4 is the ability for California legislators to call out to federal agencies to recognize the role of biomass energy in California, which is not commonly found in other forms of California Legislation.

Although the specific wildfires that are shown in Figure 5 give context to the major events that may impact the way legislators incorporate wildfire language into bills promoting biomass energy generation and procurement, it is important to note that the recent fires replaced previous destructive fires that may have also made headlines and impacted the way policymakers look at wildfire.

#### Forest Restoration and Fuel Reduction

In this section I am going to talk about the way forest restoration and fuel reduction is used as an external benefit that biomass energy can produce, and how this external benefit is linked to current events in California, beginning with the extended drought the state experienced leading to widespread tree mortality, and leading up to the record-breaking wildfire seasons. I also discuss the ways in which interviewees spoke about the potential problems with forest restoration work being used as an external benefit to biomass energy.

### Management Costs and a Mutually Beneficial Relationship

California's recent wildfire seasons have brought fire into the political spotlight for many California residents. In October of 2017, the Tubbs and Nuns fires had burned through Napa and Sonoma Counties, burning nearly 7,000 structures and causing 25 deaths, and the Thomas Fire had set the record for the largest wildfire in California history in December of 2017. While following years brought more wildfires throughout California, these fires formed the context for what interviewees had in mind during my interviews, which mostly occurred during the summer of 2018.

As the discussion of forest management has been brought to the forefront of policy in California due to the growth of wildfires throughout the state, an argument that has been used to promote biomass energy is the idea that there are millions of acres of forested land in California that need to be actively managed to reduce the risks associated with wildfires, and to build and restore healthy and sustainable ecosystems. California is covered by 33 million acres of forest, owned and managed by a combination of federal agencies, Native American Tribes, families, companies, industrial timber companies, and other individuals.

In 2017, a collaborative study done by the U.S. Forest Service, CAL FIRE, and the California Tree Mortality Task Force declared findings of 129 million dead trees as a result of drought and bark beetles across 8.9 million acres in California, resulting in increased wildfire threat and an increased risk to communities and firefighters in the event a wildfire does occur, according to a joint news release from CAL FIRE, the Forest Service, and the Tree Mortality Task Force. The news release quoted Randy Moore, a



Forest Service Regional Forester, highlighting the dangers that mortality brings: “The number of dead and dying trees has continued to rise, along with the risks to communities and firefighters if a wildfire breaks out in these areas” (Gomez & McLean, 2017, p. 1). These findings were used extensively as an argument in support of forest management, and thus utilized by advocates for biomass energy as a continued source of wood waste disposal, as “All of that vegetation that needs to be removed and dead and dying trees that are a hazard to public safety and for wildfire causes, all of that needs to go somewhere. I think among the options, doing nothing with it is not an option” (Interviewee 12: Policy Advocate). This was especially true because trees that experienced bark beetle and disease outbreak following drought stress rapidly deteriorate and lose value as a timber product (Lowell et al., 2010).

Forest management projects began getting political attention following the historic wildfire seasons California was experiencing. Following the Camp Fire in 2018, President Donald Trump directed national attention to forest management in California, tweeting “There is no reason for these massive, deadly and costly forest fires in California except that forest management is so poor”<sup>5</sup>, sparking an ongoing discussion surrounding California’s forest management. During the 2020 wildfires, California Governor Gavin Newsom emphasized the role climate change had on historic wildfires, but did state that “we had not done justice on our forest management.” This link between

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<sup>5</sup> Twitter Archive url: <https://www.thetrumparchive.com/?searchbox=%22costly+forest+fires%22>

forest health, wildfire risk, and biomass energy became a defining characteristic of the California biomass energy sector. In particular small-diameter wood material, which is particularly uneconomical and yet can create very hazardous wildfire risks, became intertwined with arguments for biomass energy facilities. When this material is not removed from the area by fire or transportation, small-diameter wood material that is not generally commodified as a forest product are left on the ground. One method of leaving the material in the vicinity of where it originated is when material is cut into small enough sections to maintain good ground contact and spread across the forest floor. Interviewee 7 (Environmental Group) explained how when planning restoration projects, the removal of smaller biomass material may be beneficial to the forest and that leaving the material covering the ground “retards significantly the growth of the understory” and “creates a fuel loading problem to the point it could be hazardous for fire” (Interviewee 7: Environmental Advocate).

Even across ownerships with extensive commercial timber sales, interviewees indicated that biomass energy could provide financial incentives for forest management. At the very least, they indicated it could offset the many costs associated with fuels reduction and forest restoration projects. Biomass energy facilities created a market for small diameter branches and tops, which could help offset some of the costs of forest management. One forest manager explained the value of creating a market for materials that could not be sold as timber products:

The other piece is just related to being a forest manager and needing to have markets for the lower value materials from the woods, whether that be with the challenge of thinning today, reducing densities, but not having a market for them

to go to, or for the tops and limbs of the trees that we harvest for lumber and other products. (Interviewee 3: Private Timber)

This commodification of small-diameter wood products was focused almost entirely on biomass energy production. However, the link between energy production and forest health was not supported by all interviewees. Interviewee 19 indicated that “this isn’t really an electricity problem. This is a forestry problem, so shouldn’t they be paying for [bioelectricity] rather than just having a hidden tax on electricity bills?” (Interviewee 19: Community Choice Aggregation).

In addition to this argument, interviewees expressed concern that if biomass energy could offset the costs of forest management projects, this could give an incentive to justify funding biomass energy for the benefit of the forestry sector. Similarly, Interviewee 16 expressed concerns about creating arguments to access funding:

There’s folks who have good intentions that want to see even restoration projects done in the forest in various places in California. Those projects are expensive, and they think that biomass energy could provide some funding that would help to get those projects done. (Interviewee 16: Environmental Advocate)

A concern that was brought up surrounding funding forest management projects was that commodification of biomass fuel could incentivize unnecessary harvesting practices. By building the biomass industry, fuel procurement could transition from a source of wood waste disposal to a more lucrative business of harvesting to fuel biomass power plants.

We hear arguments that by promoting this type of utilization that we’re in essence feeding a dragon. Feeding something that is going to have a continued growth or appetite and that it’s going to lead to massive deforestation. (Interviewee 5: State Agency)

Multiple interviewees explained these concerns about encouraging harvesting practices that were unnecessary because biomass energy could financially incentivize it. However, most interviewees indicated that forestry in California had adopted management practices that would prevent unsustainable overharvesting, leaving the state unlikely to be susceptible to deforestation.

The main argument is: you're going to incentivize commercial logging, especially clear cutting. Look, I hung from a goddamn 20 story building when I was... in 1993 for, don't ask. I love trees. But it's not your grandmother's forestry we're looking at anymore. We've learned a lot and a lot of people in their 60s are still running these organizations and they just aren't keeping up with science and they aren't keeping up with the times. (Interviewee 1: County Agency)

Interviewee 3 explained that they thought there was a lack of understanding about the influence the fuels for biomass energy powerplants have on forest management. Although there was discussion about creating a source of funding for management through biomass energy fuel procurement, the wood waste used for fuel was not as competitive as other forms of commodified forest products, in his view:

One of the other often arguments is that forests are being cut down for biomass energy, and that is not accurate. Biomass energy is the lowest value material, most wood that is coming from a harvest is going to lumber or to, in other regions in the United States, pulp mills, and the materials from biomass is the residual from that activity. (Interviewee 3: Private Timber)

In addition to the discussion about overharvesting for the purpose of creating fuel for biomass energy power plants, there were some concerns about the geography of forest health projects. In particular, many roadless areas and otherwise inaccessible areas may need forest health projects, creating an obstacle for procuring the material:

The second, more valid point they have, and I think it's something to really think about, and I haven't really wrapped my head around it, is when we do forest

work, when we do fuel reductions, what is happening in terms of our roadless and roaded areas, and how do we handle needing to get in, and how do we handle getting wood out, and does that justify new roads or not? New dirt roads and things like that. That's a really good question, I don't know. (Interviewee 1: County Agency)

In other words, removing biomass from the forest is not always as simple as traveling down existing roads, especially when deciding what to do about the issue of the drought mortality and beetle kill that was widespread across California. This created a point of agreement for the interviewees from environmental advocacy groups, and one interviewee demonstrated that the solution for one problem could create an entirely new problem, stating that “You don't need to take out 129 million dying trees. If you try to go in and do that, you're going to damage a lot of habitat unnecessarily.” This interviewee claimed the removal of all of the dying trees will “damage the forest more than you would have helped them out”, and that there was “way less material than the biomass advocates would say there is.” (Interviewee 4: Environmental Advocate).

In March of 2019, I attended a conference focused on policy advocacy for the forestry sector. During one workshop there was a conversation around the wildfires which had burned into the residential areas in Northern California; one speaker brought up a tongue-in-cheek phrase, implying it may be common among policy advocates: “Don't let a good tragedy go to waste.” This quote stood out to me as one interviewee questioned whether the 129 million dead trees was even a problem that required a solution at all.

“What about the 129 million dead trees?” They just are really offended by them being there? I mean, yes, they're not sequestering biocarbon; they're storing

carbon and they will for years and decades. (Interviewee 16: Environmental Advocate)

This interviewee went on to explain that the dead trees were not adding to wildfire risk after the initial decay process where trees lose their needles, as the remaining parts of the tree lacked the fine fuel characteristics that carry wildfire, explaining that “What the science is telling us is that by the time it has lost its needles, which is generally six-to-twelve months after the beetle kill, that it can’t sustain ground fire.” They went on to say that CAL FIRE had been expressing the need for surface fire, saying “Now this is what we want: To have surface fires, not ground fires. Now that we have surface fuels, everybody is saying we need to cut the trees because of these surface fuels?” Removing the bole, or the main stem of the tree, which is often left standing long after a tree dies and begins to decay, “is not going to have any effect on surface fuels”, and may even increase the surface fuels, because the process of harvesting the remainder of the standing dead tree will “generate a bunch of debris as you go through and do that” (Interviewee 16: Environmental Advocate). Interviewee 16 made a point to discuss the fuel buildup that would be added through management and removal of the standing dead trees, showing a contradiction between the goals that advocates for active management of the 129 million dead trees state and the reality of residue left after management activities.

It just seems like people are operating under the impression that if a tree is dead, that we have to kill it. Therefore, we have to figure out some way to dispose of these trees. That we have to remove it, and therefore, we need to find somewhere for it to go. That is just absurd. It’s not even what’s in the proposals coming out of CAL FIRE. They’re not proposing cutting down 129 million dead trees. (Interviewee 16: Environmental Advocate)

Through my interviews I found that the divergence in arguments between groups that supported and opposed the use of biomass energy to encourage the removal of fuel, especially regarding the drought mortality, was not a disagreement about the importance of reducing fuel for wildfires within forested areas. Rather, it was about the actual impact projects would have on the fuel loading and the necessity of removing that fuel when faced with the potential damage associated with the removal process. Additionally, I found that there was disagreement among interviewees who advocate for biomass to be used in collaboration with forest management projects when it came to using one to subsidize the other, as arguments were made for the mutually beneficial practice to financially benefit each side over the other.

California legislators and policy writers have also linked biomass energy to forest management. Language in the bills that promote biomass energy often include a brief link to forest management, with many bills recycling the same phrases. While the language in the bills itself generally was brief, language from the authors of the bills could often be found in the bill analyses, providing more depth to the reasons the author linked forest management to biomass energy.

There were several bills in which the same language could be found over the course of different years that related to forest management propping up biomass energy:

“Generate energy from community-scale, woody biomass facilities that promote safe and resilient forests...” (SB 28, 2011) (AB 724, 2011)

“For bioenergy using byproducts of sustainable forest management, 50 megawatts. Allocations under this category shall be determined based on the proportion of bioenergy that sustainable forest management providers derive from sustainable forest management in fire threat treatment areas, as designated by the

Department of Forestry and Fire Protection.” (SB 1122, 2012) (AB 1513, 2019) (AB 1365, 2020) (AB 843, 2021).

SB 515 was introduced in 2019, and although the bill itself was edited to change the overall intent of the bill, the original bill was titled “California Renewables Portfolio Standard Program: bioenergy renewable feed-in tariff” and built on a feed-in tariff program for biomass energy that utilized specific forest feedstock, expanding the eligible feedstock from high hazard zones. In the analysis of the original bill, several documents included language that directly linked dead and dying trees to biomass energy, implying a way to offset the decline of the biomass energy sector by utilizing the dead and dying trees in California:

“However, since the 1990s, biomass facilities have dropped from 63 to just 23 in California. With the nearly 148 million dead and dying trees, it is imperative that the state takes a proactive approach to dealing with this extra fuel”. (SB 515, 2019; Senator Caballero. Author’s Statement, Bill Analysis: Senate Energy, Utilities and Communications; Senate Floor Analysis; Assembly Utilities and Energy; Assembly Natural Resources; Assembly Appropriations)

In document analysis of proposed state legislation, Figure 3 shows how limited the use of forest management as an external benefit was until California began experiencing the prolonged drought period. Figure 3 also shows the occurrence of language about forest management in these bills was more consistent during the widespread tree mortality event in California. While Figure 3 shows the way the language about forest management and wildfire fuel reduction were very similar, Figure 5 gives context to the major wildfire events that California was facing as these bills were being developed.



### Utilization of Wood Waste from Agriculture, Forest Management, and Sawmill Activity

The arguments centered on the need to utilize waste generated by forestry and other activities was prevalent among interviewees, and it has a long history. Initially, biomass facilities were created to solve the problem of excessive wood waste from local sawmills while providing the added benefit of locally fueled and generated energy both back to the sawmills in a cogeneration setting and into the energy grid. Before the introduction of biomass facilities, sawmills would often burn the excess wood residue in large steel structures, built as conical structures with a screen or a grate at the top to prevent the spread of hot embers. Interviewee 15 explained to me that in California, original biomass facilities in the 1980s “were built to utilize sawmill residuals because it was the sawmills that were basically burning sawdust, bark, and miscellaneous wood waste” inside of these steel structures that you could “shove sawdust and bark into and you burn with uncontrolled emissions.” Interviewee 15 stated that it was “just a way of disposing of wood waste” and explained that if the waste products were not being incinerated in these structures, they were stockpiling the material. “Clearly this was a waste product, so the first power plants were targeting that” (Interviewee 15: Private Consultant).

Biomass facilities in California initially sought to solve the problem of open pile burning the remaining material from sawmill activity. Biomass facilities created a space in which wood waste could be utilized for energy production rather than creating a burden of disposal. As the biomass energy sector expanded, biomass plants evolved from

providing a service of wood waste disposal for sawmills to becoming dependent on the ability to find and source fuels to maintain the production of energy. Interviewee 15, who served as a member of the Quincy Library Group, discussed how as the timber industry declined in California and sawmills closed, biomass facilities had to find new sources of fuel.

As the sawmills started closing, the power plants had to look for other wood fuel available, and that's when sourcing forest biomass right from the forest scaled up and really became a significant part of the overall fuel blend for these power plants. (Interviewee 15: Private Consultant)

Over the past several decades, biomass facilities have become creative in their approach to fuel procurement, utilizing fuel sources which would otherwise create a burden of disposal. Utilizing these fuels has a variety of benefits linked directly to the burden of disposal, such as creating space in landfills:

And that proved pretty helpful to the landfills because landfills only have a certain service life because of the acreage they are sitting on, so in California it really worked well for the counties and the municipalities managing landfills because it extended their service life of their existing landfill infrastructure because they were able to divert the waste away from those landfills and transfer stations that were sorting waste. (Interviewee 15: Private Consultant)

Biomass energy was often argued by proponents as being a form of wood waste disposal, replacing other environmentally damaging or expensive forms of disposal of the residue from sawmills and the forestry and agriculture sectors. Following this argument, Interviewee 8 made the case that because the disposal of the wood kept wood waste out of a landfill or reduced the environmental impacts of open pile burning, some of the cost should fall on those who sourced the fuel. They stated that biomass facilities need to “function much like a landfill” or a “waste recovery station”, suggesting that the cost

needs to be on the supplier of the fuel, similar to how a landfill might operate. “We need to be looking at the future of how you keep the cost down for the power generation but make sure that those that create the waste and dispose of the waste are actually paid for that” (Interviewee 8: Policy Advocate).

This became especially necessary for the sectors that provided the fuel after the passing of AB 939 in 1989, which regulated solid waste management in California to reduce the amount of waste that would be sent to the state’s landfills. This opened an opportunity for alternative forms of waste management to provide a place for disposal.

You know, landfill diversion was probably one of the bigger topics of conversation, and that could have been because public policy at the time was focused on our concern about landfills, and landfills filling up, and land use policy, and probably more before my time, and then the legislature passed a bill, AB 939, that told local governments that they had to divert a certain amount of their material away from landfill, so it was really at the time, it was all about landfill diversion. (Interviewee 8: Policy Advocate)

After the initial connection to landfill diversion as an external benefit, biomass energy facilities were then promoted as a means of diverting wood and agricultural material from open burning. In both of these cases, the biomass energy facilities functioned to utilize otherwise “wasted” material that would have negative impacts, whether to landfill crowding or to air quality. Although biomass energy was initially developed in California as a disposal method for the abundance of wood waste produced by sawmill activity, when the sawmills began closing, the biomass facilities had to proactively find ways to procure fuel to keep the facilities operating. The initial connection to wood waste was still relevant, and language linking biomass energy generation to wood waste disposal is found in California both in legislation and in bill

analyses. Some of the language found in bills specifically allocates grant money to avoid landfill use, describing biomass energy generation as a means of waste disposal, framing the biomass energy as a solution to a waste problem:

...for the purpose of providing grants to persons that utilize agricultural biomass as a means of avoiding landfill use, preventing air pollution, and enhancing environmental quality. (SB 44, 2009) (AB 1150, 2009) (AB 36, 2009) (AB 36, 2009) (SB 39, 2009) (AB 84, 2009)

Whereas other language is framed in a way that justifies support for biomass energy by linking it to waste disposal:

California agriculture produces substantial quantities of residual materials from farming practices, including orchard and vineyard pruning and removals. These residual materials are disposed of primarily by open field burning, resulting in air emissions that would be substantially reduced if the residual materials instead were converted into energy at a biomass-to-energy facility. (AB 2872, 2000) (AB 2825, 2000)

Biomass energy was developed in California as a solution to a wood waste and sawmill residue problem, though its prevalence as an argument for biomass energy has declined over time (Figure 3).

### Rural Economic Development

The interviewees who focused on rural economic development pointed to biomass energy as a key player in job development, energy independence, and economic growth. In my interviews, I found three patterns of discussion surrounding the ways in which communities can benefit from development when it comes to biomass energy. The first, such as the Sierra-based Quincy Library Group, involved grassroots organizing through community support, advocacy, and initiative. The second was through local government and community initiatives, and the third was state funding support, moving grant money

into rural communities through biomass energy programs. In this section, I go through each of these topics.

One thing to note about all three of these community development topics is that they are all rooted from within the communities themselves. There has been statewide legislation to promote smaller scale biomass energy development, such as the BioMAT program, which created a feed-in tariff program for biomass energy from sustainable forest management for facilities no larger than 5 MW. However, though this type of legislation could have an impact on rural development, I found in my interviews that rural development was not a topic discussed in depth by most interviewees. Rural development was an external benefit that was hard to justify outside of the communities in which it was directly beneficial:

It's going to be harder to find somebody that isn't invested in [this county's] economy to say, "I also want to pay more to help jobs in [this] County." It's not going to be somebody else's priority like it is ours. (Interviewee 19: Community Choice Aggregation)

While the state-level discussions do discuss moving biomass energy facilities out of the Central Valley and into rural, forested communities, the conversation from there moves to one at the community level and how the community can work to ensure these projects happen and maintain an aspect of economic growth within the community they serve.

In communities once dependent on their wood product industry, a sawmill closure could be devastating for the local job market. Sawmills can become dependent on both cogeneration and on selling fuel to biomass facilities to offset the cost of running the mill,

and supporting the procurement of the surplus energy generated from the biomass facility can determine whether a sawmill stays open, and have an impact on the local economy.

As one interviewee mentioned, the closure of a single biomass facility can have a domino effect type of impact on the local community:

He's a local mill owner. He said, "If we don't have somewhere to send our waste, this could basically be a deal-breaker for the economic—having to truck that out of the county." His words, not mine. He said, "I've got hundreds of people that work for me that I might not be able to continue to employ if we don't have something to do." (Interviewee 19: Community Choice Aggregation)

One notable aspect about the conversation surrounding the role biomass energy plays in rural development is that a relatively small number of people I interviewed spoke on this subject, but those who did were very invested in the local communities being supported. Many of the interviews I conducted were with people who were involved in biomass energy at a state level, while a small number of interviewees were involved at a more local level. While these interviewees still participated in the other discussions surrounding biomass energy, they were more passionate about the ways in which communities could directly and indirectly benefit from the economic impacts of biomass energy facilities in their neighborhoods.

#### Sawmills, Biomass Energy, and the Impacts on Rural Economic Development:

##### The case of the Quincy Library Group

In the early 1990s, the environmental movement against the exploitation of the timberlands in California, known as the "Timber Wars", resulted in policies and laws that restricted timber harvesting practices. As a result of these new policies and laws, California was harvesting less than half the amount of timber in the late 1990s as it had

been the decade before (Morgan et al., 2012) The Quincy Library Group developed in 1992 as a response to the Timber Wars, and the decline of the timber industry. One of its aims was to mitigate the economic and social impact on rural communities that had been affected by the reduction in the timber industry. The Group began as a collaboration between an industry forester, a county supervisor, and an environmental lawyer where they could acknowledge their differences and work toward building community stability in Lassen, Plumas, and Sierra Counties:

There was a concern in Quincy about community stability. Sawmills were closing and families were being impacted. Substance abuse rates were going up, divorce rates were going up, and general well-being of communities were going south. So this group started meeting in the Quincy Library to try and hammer out what became known as the community stability agreement. (Interviewee 15, Private Consultant)

Interviewee 15 described the community stability agreement as an “initiative to be a little more proactive in the management of the Plumas National Forest, the Lassen National Forest, and the Tahoe National Forest.” The quote from this interviewee highlighted the impacts that the timber industry had on communities in the Sierra Nevada, particularly with the decline of the industry in the early 1990s. The Quincy Library Group grew from the initial three members to around 30 members representing different parts of the conversation and the community, including foresters, county supervisors, homemakers, political volunteers, recreators, and industry workers. Interviewee 15 was among the members of the Quincy Library Group, and in the interview, they stated that “If the Quincy Library Group was going to initiate more landscape level fuels treatment activities of between 40,000 acres and 70,000 acres per

year, there needed to be a home for the forest biomass that was generated because of the activity.” This led to the inclusion of biomass energy generation in the discussions (Morgan et al., 2012).

### Biomass Energy Advocacy as a Community Development Strategy

Within the conversations about rural development, there was a clear ripple effect being discussed that implied that the closure of a biomass facility could not only impact the employees from that facility, but also the financial stability of the local sawmill which sold its wood waste to the local biomass energy generation facilities, and in turn impacted the value of the timber from the area. From one biomass plant manager, a single biomass facility could benefit the community by having direct employees, as well as providing indirect employment in the community:

I employ 20 people here, but the impact is wide ranging. If this plant didn't exist, beyond the loss of the employment from my employees, you also have truck drivers who deliver the material, vendors who supply their expertise and/or materials in support of us, lots of different things. (Interviewee 20: Biomass Facility)

Interviewee 20 explained that although the biomass facility employed 20 people, there were more indirect employees that had jobs as a result of the biomass facility. In addition to the indirect employees who interact with the facility, like truck drivers and vendors, Interviewee 20 went on to add “you get into the country... you've got your tax base, fuel deliveries, fuel usage.” Biomass facilities can have an extended range on community employment, negatively impacting community development in areas where biomass facilities have ceased operations. In policies, language in the bills themselves are generalized:



Generate energy from community-scale, woody biomass facilities that promote safe and resilient forests, provide rural community benefits, protect air and water quality, and are ecologically sustainable. (AB 724, 2011) (SB 28, 2011)

However, the bill analysis for the original text of SB 515 (2019) gave some more depth to the influence the biomass energy sector can have on rural communities:

In addition to serving as a local energy source, biomass is responsible for sustaining over 1,000 California jobs, many in rural communities where unemployment is highest. (SB 515 Bill Analysis, 2019)<sup>6</sup>

In April of 2018, Loyalton Biomass regained operations after 8 years out of service. This interviewee spoke of the impacts that the sawmill closure and subsequent closure of Loyalton Biomass in 2010 had on the rural community where it was located.

The 25 MW facility in Loyalton just refired. Was purchased and revamped and it's the greatest thing since sliced cheese for that town. It's an industry in that town. It's a job creator. It's bringing money to that town and people. When the mill shut down there, when Sierra Pacific Industries shut down the mill there and then subsequently shut down the biomass facility, the town is just disappearing. Sierra county is really struggling. (Interviewee 5: State Agency)

In addition to biomass energy generation's role in economic development in rural communities, the skills that community members get from their work on community development through biomass energy can translate to other forms of community development. The work communities do to build their own space is important because, as Interviewee 14 explains, often other resources are not available for them.

Once a community has some experience doing this kind of development, who knows what they'll do next economically or in terms of social services. To me, this is part of the large picture of the sustainability of these small towns that were

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<sup>6</sup> Bill analysis available:  
[https://leginfo.legislature.ca.gov/faces/billAnalysisClient.xhtml?bill\\_id=201920200SB515](https://leginfo.legislature.ca.gov/faces/billAnalysisClient.xhtml?bill_id=201920200SB515)

economically built around, most of them, around lumber mills, and those mills have gone away. How do they reinvent themselves? Well, the county's not going to step in and do it. Counties, in our region, have very little capacity. They don't usually even have economic development staff, so it's up to the communities to do it. This is helping them develop these bioenergy facilities is one way for them to get the capacity to continue on their own sustainability quest. (Interviewee 14: State Agency)

According to this view, not only is development from inside the community itself beneficial for the community to advocate for what they want, but it builds community members' skills and resources to continue to grow their community in a self-sufficient manner, rather than relying on the creation of new legislation.

In recognizing the benefits a biomass power plant may have on the community they serve, local governments could use biomass energy as a way to promote community economic development in the absence of state policies. Interviewee 19 was a part of a community choice aggregation (CCA), which gives local government the authority to purchase energy from distributors of their choice, rather on relying on the energy provided by the local utility company. In this way, communities can choose where the money that the local rate payers spend on grid energy goes, such as into local generation or renewable energy. In comparison to the statewide average in-state energy generation portfolio where biomass energy made up of 2.44% in 2019 (Nyberg, 2019), the energy procured from local biomass energy facilities makes up 20% of the portfolio within the CCA, according to Interviewee 19.

Our budget is over \$50 million a year. That's a lot of spending power to say, "Oh, are you sending that \$50 million out of the county, or are we spending it here in [the county] on local projects?" (Interviewee 19: Community Choice Aggregation)

Interviewee 19 went on to add that with their “goal to maximize the use of local renewables”, the CCA recognized that their biomass plants were “the existing local renewable resources we have.” Although purchasing local biomass energy in an area which has an active timber industry can put money back into the local economy, the decision to procure energy from biomass facilities is not necessarily straightforward for the CCA. Interviewee 19 explained to me that it was not simply a decision to put money back into the community, but by doing so they were actively passing up an opportunity to invest less money for more energy in other forms of renewable energy, though out of the area. When considering whether to invest in a local biomass energy facility by purchasing energy at a higher cost than energy they could get out of the area, Interviewee 19 explained that biomass energy “is a little more expensive, but we see all that other community importance, so we want to support it and pay a little bit more for electricity” because of the direct benefit it would bring to the community by “keeping dollars local”:

We could pay a little bit less for solar from the desert, but is that really, in the grand scheme of things, doing as much? It’s keeping dollars local and employing local people to work at those facilities. I think, for our community, there is this question of like, “Oh, well, if our local resources are a little more expensive, is that something that we want to invest in?” My board has said yes, so we’re doing it. (Interviewee 19: Community Choice Aggregation)

This CCA is a joint agency between local governments, and it demonstrates one way in which local government agencies can use their power to invest in biomass energy on a more local level. The intention of this thesis was originally to look at biomass energy through a political lens at a statewide level, though it became clear through the interviews that there was a need to look at how local communities and counties were

dealing with biomass energy a well.

## DISCUSSION AND CONCLUSIONS

The findings of this thesis are in line with the findings of other studies which have stated that biomass energy is not cost effective, and thus requires policy mechanisms such as subsidies or incentives to maintain economic viability (Bilgili et al., 2017), which in turn requires the support of policy makers to create policy that will support the industry. Highlighting the need to find a way to gain the attention of policymakers, Interviewee 1 stated “There are no glaciers left, the ocean’s full of plastic. There are so many problems, we’re always fifth on the list. We are never the top problem.” To gain political resonance, the biomass energy sector has connected itself to external benefits to demonstrate reasons the ways in which policy initiatives will benefit California beyond the sector itself. In response to the need for policies to promote the biomass energy sector, this paper observed the specific obstacles that the sector faces in California, and how proponents have overcome these barriers through linking biomass energy to external benefits. The prevalence of these external benefits, both as discussion points and within legislation, is linked to the continuously changing political climate in California, and most recently there is an increased frequency of language in proposed legislation that draws the connection between biomass energy generation and wildfire risk reduction. In addition, I found that the external benefits that stakeholders have used depend on geographic locality of biomass energy facilities to offset the barriers that the sector faces.

External Benefits: The biomass energy sector links itself to external benefits

This paper has discussed how biomass energy in California has linked itself to external benefits in order to promote policies that will support the sector, but these external benefits do not exist without critique. First, debate exists about how external benefits of the biomass energy sector are used to determine where along the supply chain for biomass fuel the external benefits can offset the cost. Next, stakeholders did not always agree with the use of external benefits to promote the biomass energy sector, and I discuss how those stakeholders push back against the way external benefits are framed. Finally, I note that biomass energy has linked itself to external benefits that expand over a wide range of beneficiaries across different sectors, while most competitors to biomass energy are connected to a single sector, such as renewable energy or wood waste disposal.

Where along the supply chain should biomass energy be subsidized?

As shown in Figure 2, the process of generating biomass energy has a series of associated costs that occur before energy is ever input to the electrical grid. Assuming the price of biomass energy stays competitive with energy from other forms of generation, the associated costs of biomass energy cannot be offset by selling the energy to utility companies for distribution. Instead, proponents of biomass energy use policy mechanisms to create an economically viable sector. One obstacle to policy development that would support the economic viability of biomass energy is that there are multiple associated

costs along the supply chain, and each associated cost comes with its own debate about the benefit or lack thereof for creating a policy mechanism to offset that cost.

Within the stakeholder discussions about how to offset the supply chain costs associated with biomass energy, there is disagreement about where along the supply chain the sectors that benefit from the procurement of fuels can offset the costs. The external benefits discussed among stakeholders were inconsistent when considering their economic impacts. For example, one argument was that procuring fuel from forest management, restoration, and wildfire fuel reduction projects could offset the cost of these management tools and ultimately allow for more land to be treated. However, interviewees also talked about biomass energy generation as a source of wood waste disposal, diverting fuel from landfills and other harmful disposal methods. During these arguments, multiple interviewees suggested commodifying the disposal of the wood waste to offset the cost of procurement for the biomass facility. These two arguments conflict with each other, where one suggests biomass energy could offset costs for the forestry sector, while the other suggests sectors that create wood waste, such as the forestry sector, could offset costs for the biomass energy sector.

One alternative to finding ways to offset the costs on a large scale is to allow CCAs to decide whether the external benefits provided by biomass energy are worth the increased cost of energy to the local rate payers, as one interviewee had discussed.

Stakeholder perception: Do the external benefits justify policy initiatives?

There are debates between proponents and opponents about the degree to which the arguments in favor of external benefits associated with biomass energy are valid, and whether the associated benefits are worth investing in with state funding or requiring consumers to pay more for their energy to offset the costs. In my interviews with stakeholders who did not actively support policy promotion of biomass energy, I found that rather than expressing opposition to the sector as a whole, they made arguments against each of the ways biomass energy advocates have used external benefits to gain political momentum.

Examples of this were evident surrounding the arguments about reducing carbon emissions associated with energy generation. While proponents of the sector described biomass energy as net carbon neutral because of the carbon sequestration that occurs in the growth of the fuel, several interviewees questioned whether biomass energy should be benefitting from climate funds when the actual process of energy generation has associated carbon emissions, regardless of the fuel source. In the discussions about the need move high hazard fuel off the forested landscape and into biomass facilities, interviewees again questioned the validity of this argument by pointing out how the standing dead trees that remain after widespread mortality do not require removal for wildfire fuel reduction.

The opposing perspectives to the external benefit arguments demonstrate the ways in which stakeholders have found political opportunities to connect biomass energy to



external benefits, but also the ways that these arguments have been critiqued, resulting in nebulous political support for biomass energy.

Linking biomass energy to multiple external benefits: more ways to influence policy

Biomass energy is unique in that proponents claim it can provide a wide range of external benefits, including air quality, wood waste disposal, rural development, forest restoration and fuel reduction, and renewable energy. I found there was an average of 1.5 external benefits mentioned in each piece of proposed state legislation. However, a logical follow-up question is whether biomass energy is the *best* option available for each external benefit it provides. The external benefits associated with biomass energy expand across different political categories, and within each of these categories are other programs competing for the same political backing.

Although the discussions surrounding all the external benefits of biomass energy combined can create a favorable view of the sector, much of the proposed legislation is an attempt at subsidizing biomass energy through grant allocation. Since state grants are commonly developed with the purpose of solving a single issue, there is minimal opportunity for biomass energy to demonstrate the wide range of external benefits it could provide to the state when developing policies. For each of the single issues biomass energy is linked to, there are often more competitive projects that are compared alongside biomass energy. For example, biomass energy as a source of renewable energy for California's grid is often outcompeted by other, lower cost renewable energy sources such as wind and solar, and dispatchable generation could be provided by small hydro facilities or geothermal generation. Similarly, there are alternative ways to repurpose

small diameter wood waste from agricultural and forestry sectors such as chipping the wood or producing engineered wood products. If biomass energy is to succeed, proponents could consider ways to incorporate multiple external benefits in their arguments for support of biomass energy legislation and use the unique range of external benefits associated with the sector to create more political power.

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## APPENDIX

## Sample Interview Questions:

- 1) Can you tell me how you got involved with the biomass sector?
- 2) Could you tell me about why you support/oppose the biomass energy sector?
- 3) How have you or your organization supported/opposed the biomass energy sector?
  - a. *Prompt:* Have you supported bills, or created educational materials?
- 4) What are arguments that you hear made by people who support/oppose (different view) biomass energy?
  - a. Do you find any of their arguments legitimate?
  - b. [Possible additional follow up] Why do you find them legitimate?
- 5) What am I missing about the debates surrounding the biomass energy sector?
  - a. [Possible additional follow up] What are some arguments specific to your expertise that aren't heard often? (policy, air quality, cost, etc.
- 6) Who else should I talk to?