

Docket No.: R.20-11-003  
Exhibit No.: SC-02  
Witness: Mary Booth, PhD

**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF CALIFORNIA**

Order Instituting Rulemaking to Establish  
Policies, Processes, and Rules to Ensure  
Reliable Electric Service in California in the  
Event of an Extreme Weather Event in 2021.

Rulemaking 20-11-003  
Filed November 19, 2020

**PREPARED REPLY TESTIMONY OF  
MARY S. BOOTH, PH.D**

**ON BEHALF OF SIERRA CLUB**

**JANUARY 19, 2021**

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## LIST OF EXHIBITS

<b>Exhibit 2-A</b>	Mary S. Booth, PhD Resume
<b>Exhibit 2-B</b>	Trees, Trash, and Toxics: How Biomass Energy Has Become the New Coal

1 **I. SUMMARY OF TESTIMONY AND FINDINGS**

2 **Q. What are your main recommendations in this testimony?**

3 **A.** Through this testimony, I recommend that the Commission provide no additional  
4 incentive or authorization for the procurement of biomass capacity from either existing or  
5 new facilities.

6 **II. INTRODUCTION**

7 **Q. Please state your name, occupation, and business address.**

8 **A.** My name is Mary S. Booth, PhD. I am the Director of the Partnership for Policy Integrity  
9 (“PFPI”). My business address is 54 Arnold Rd, Pelham, MA 01002.

10 **Q. On whose behalf are you testifying?**

11 **A.** I am testifying on behalf of Sierra Club.

12 **Q. Please summarize your professional and educational background.**

13 **A.** I am an ecosystem scientist by training, and I lead PFPI, a nonprofit organization that  
14 uses science, legal action, and strategic communications to promote sound energy policy.  
15 Our organization focuses on science and advocacy work related to greenhouse gas, air  
16 pollutant, and forest impacts of biomass energy and has provided science and policy  
17 support to hundreds of activists, researchers, and policy makers across the US and EU.  
18 Prior to working at PFPI, I worked as a Senior Scientist at the Environmental Working  
19 Group on mapping and modeling pollution.

20 I have a doctoral degree in ecology from Utah State University, where I focused on  
21 biogeochemistry and plant ecophysiology. I have completed postdoctoral fellowships at  
22 the Ecosystems Center of the Woods Hole Biological Laboratory and at the Earth  
23 Institute at Columbia University. A full resume is attached as Exhibit 2-A.

24 **Q. Could you please explain your level of familiarity with biomass power plants?**

25 **A.** Yes, I am very familiar with biomass power plants through my work at PFPI. I am deeply  
26 involved in biomass energy issues, including air pollution, climate, and forest impacts. I

1 have researched biomass impacts for 12 years and have drafted multiple reports relating  
2 to biomass facilities in the United States and in Europe. Most recently, I completed an  
3 analysis of how biomass sustainability rules in the European Union fall short of the  
4 protections needed for forests and the climate.

5 **Q. Are you familiar with biomass facilities in California?**

6 **A.** Yes, I am familiar with biomass facilities in California, particularly through investigating  
7 incentives for biomass plants through California’s Bioenergy Market Adjusting Tariff  
8 (BioMAT) as administered through the Commission’s Renewable Portfolio Standard  
9 (“RPS”) proceeding. I have consulted with the Sierra Club and the Center for Biological  
10 Diversity in relation to that proceeding and have contributed my expertise in reviewing  
11 and improving the BioMAT program.

12 **Q. Have you ever testified before a Public Utilities Commission?**

13 **A.** No.

14 **Q. What is the purpose of your testimony?**

15 **A.** In this testimony, I outline the climate, public health, and air quality impacts that biomass  
16 facilities produce. In particular, I explain why the environmental and public health  
17 impacts from biomass plants far outweigh the potential benefits in further contracting  
18 with biomass facilities in preventing future grid emergencies due to extreme weather.

19 **III. THE CLIMATE AND AIR QUALITY IMPACTS OF BIOMASS PLANTS ARE**  
20 **SO SEVERE THAT THE COMMISSION SHOULD NOT INCLUDE BIOMASS**  
21 **FACILITIES IN ANY EXPEDITED PROCUREMENT ORDER**

22 **Biomass Facility Emissions**

23 **Q. Please briefly describe the types of criteria pollutant emissions that biomass**  
24 **facilities generate.**

25 **A.** Biomass facilities have extremely high emissions factors, meaning that they emit  
26 enormous amounts of pollutants per megawatt-hour of generation. Even the cleanest  
27 biomass plant can emit over 150% the nitrogen oxides, over 600% the volatile organic  
28 compounds, over 190% the particulate matter, and over 125% the carbon monoxide of a

1 coal plant per megawatt-hour.<sup>1</sup> Emissions from a biomass plant can exceed those from a  
 2 natural gas fired power plant “by more than 800% for every major pollutant.”<sup>2</sup> This is in  
 3 part due to the fact that biomass fuels are relatively carbon-rich but not energy-rich  
 4 compared to fossil fuels.<sup>3</sup> Additionally, biomass plants tend to be much less efficient than  
 5 gas and coal-fired plants, in part because biomass fuels tend to have far more water  
 6 content to burn off to produce “useful” energy.<sup>4</sup>

7 **Figure 1: Biomass power plants emit more CO<sub>2</sub> than coal or gas plants.<sup>5</sup>**

<b>Technology</b>	<b>Fuel CO<sub>2</sub> emissions (lb/MMBtu heat input)</b>	<b>Facility efficiency</b>	<b>MMBtu required to produce one MWh</b>	<b>Lb CO<sub>2</sub> emitted per MWh</b>
Gas combined cycle	117.1	45%	7.54	883
Gas steam turbine	117.1	33%	10.40	1,218
Coal steam turbine	206	34%	10.15	2,086
Biomass steam turbine	213	24%	14.22	3,029

8  
 9 **Q. Are those numbers representative of California biomass plants?**

10 **A.** Most of my biomass research to date has included many facilities in the Eastern United  
 11 States. Because emissions control requirements for biomass and gas plant facilities in  
 12 California are unique, I would highlight the recent emissions factors considered by the  
 13 Commission in the Integrated Resource Planning (“IRP”) proceeding. There,  
 14 Commission staff recently improved on previous iterations of criteria emissions modeling  
 15 by including biomass facilities in its analysis.<sup>6</sup> Commission staff cited that Biomass have  
 16 high total emissions due to high emissions factors for nitrogen oxides, fine particulate

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<sup>1</sup> Mary S. Booth, *Trees, Trash, and Toxics: How Biomass Energy Has Become the New Coal*, Partnership for Policy Integrity, at 5 (Apr. 2, 2014) [hereinafter “Biomass is the New Coal”] (attached as Exhibit 2-B).

<sup>2</sup> *Id.*

<sup>3</sup> *Id.* at 16.

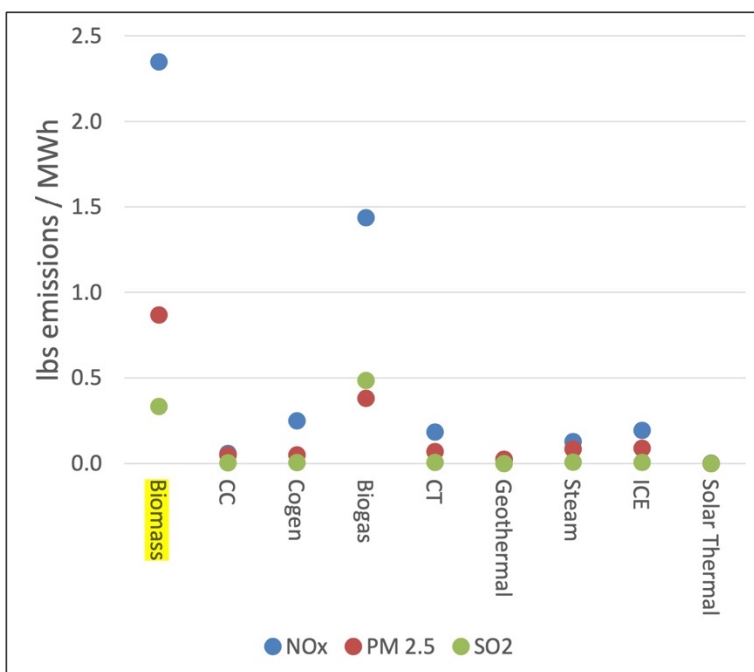
<sup>4</sup> Typical moisture content for green wood chips, a very common fuel for bioenergy facilities, is around 45%, meaning by weight, the fuel is almost one-half water.

<sup>5</sup> Biomass is the New Coal at 16.

<sup>6</sup> Energy Division, Updated Criteria Pollutant Analysis at Slide 3 (Feb. 20, 2020), *available at* <https://www.cpuc.ca.gov/General.aspx?id=6442459770> [hereinafter “Updated Criteria Pollutant Analysis”].

1 matter, and sulfur oxides.<sup>7</sup> The table below shows the modeled emissions factors for each  
2 resource type modeled in the Commission’s Updated Criteria Pollutant Analysis.<sup>8</sup>

3 **Figure 2: Modeled emissions factors, lbs/MWh, by resource type from CPUC Updated**  
4 **Criteria Pollutant Analysis<sup>9</sup>**



5  
6 **Q. How do these California-specific biomass emissions compare to California’s gas-**  
7 **fired power plants?**

8 **A.** Among all the resource types considered in the Updated Criteria Pollutant analysis,  
9 biomass facilities have the highest emissions factors for NOx and fine particulate matter,  
10 and the second highest emissions factor for SO<sub>2</sub> (behind biogas).<sup>10</sup> Comparing the  
11 average biomass facility’s emissions factors against the average California combustion  
12 turbine gas plant, a biomass facility would produce nearly 13 times the NOx emissions,

<sup>7</sup> *Id.* at Slides 6-7.

<sup>8</sup> *Id.* at Slide 7.

<sup>9</sup> *Id.*

<sup>10</sup> *Id.*

1 just over 12 times the PM<sub>2.5</sub> emissions, and over 49 times the SO<sub>2</sub> emissions that the gas  
2 plant would produce for the same quantity of energy generation.<sup>11</sup>

3 **Q. Please describe the greenhouse gas emissions from biomass power plants.**

4 **A.** Biomass power plants generate enormous quantities of greenhouse gas emissions. On  
5 average, a plant burning wood chips will emit nearly 50 percent more carbon dioxide per  
6 megawatt-hour of electricity than a coal plant.<sup>12</sup> It is possible that some of these  
7 emissions can theoretically be offset by regrowth of trees, or, if fuel is sourced from  
8 forestry residues that would have decomposed and emitted CO<sub>2</sub>, the emissions can be  
9 treated as if they would have occurred “anyway.” However, there are numerous scientific  
10 studies that show that cumulative CO<sub>2</sub> emissions from a biomass plant can exceed  
11 emissions from a fossil fuel-burning plant for several decades.<sup>13</sup> This extra CO<sub>2</sub> warms  
12 the atmosphere just as effectively as CO<sub>2</sub> derived from burning fossil fuels.

13 **Q. Are there any other types of emissions from biomass power plants?**

14 **A.** Yes, in addition to greenhouse gases and criteria pollutants, biomass facilities emit  
15 hazardous materials, including dioxins, lead, arsenic, mercury, and even emerging  
16 contaminants like phthalates.<sup>14</sup> All of these are dangerous to human health.

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<sup>11</sup> Using the emissions factors used by the Commission to in its Updated Criteria Pollutant Analysis (*see* slide 17), the biomass emissions factor divided by the combustion turbine emissions factor result in the following calculations: Biomass average NOx emissions factor (2.3482 lbs/MWh) divided by CT average NOx emissions factor (0.1835 lbs/MWh) yields 12.797 times the NOx emissions. Biomass average PM<sub>2.5</sub> emissions factor (0.8684 lbs/MWh) divided by CT average PM<sub>2.5</sub> emissions factor (0.0701 lbs/MWh) yields 12.388 times the PM<sub>2.5</sub> emissions. Biomass average SO<sub>2</sub> factor (0.3340 lbs/MWh) divided by CT average SO<sub>2</sub> factor (0.0068 lbs/MWh) yields 49.118 times the SO<sub>2</sub> emissions.

<sup>12</sup> Biomass is the New Coal at 5.

<sup>13</sup> *See* Tara W. Hudiburg et al., *Regional carbon dioxide implications of forest bioenergy production*, Vol. 1 Nature Climate Change 419 (2011), available at <http://dx.doi.org/10.1038/nclimate1264>; Jérôme Laganière et al., *Range and uncertainties in estimating delays in greenhouse gas mitigation potential of forest bioenergy sourced from Canadian forests*, Vol. 9 GCB Bioenergy 358 (2017), available at <http://dx.doi.org/10.1111/gcbb.12327>; Dominick A DellaSala and M. Koopman, *Thinning Combined With Biomass Energy Production May Increase, Rather Than Reduce, Greenhouse Gas Emissions*, Geos Institute (2015), available at [http://www.energyjustice.net/files/biomass/library/biomass\\_thinning\\_study.pdf](http://www.energyjustice.net/files/biomass/library/biomass_thinning_study.pdf).

<sup>14</sup> Biomass is the New Coal at 6.

1 **Biomass Facilities in the Context of California’s Climate and Air Quality Targets**

2 **Q. Are you familiar with California’s greenhouse gas reduction targets?**

3 **A.** Yes, I am familiar with California’s greenhouse gas laws for the electric sector, including  
4 SB 350. SB 350 set greenhouse gas reduction goals of reducing GHG emissions to 40  
5 percent below 1990 levels by 2030 and to 80 percent below 1990 levels by 2050.<sup>15</sup> In  
6 addition, I am familiar with the target to obtain carbon neutrality by 2045.<sup>16</sup>

7 **Q. Are you familiar with California’s long-term criteria pollutant reduction target?**

8 **A.** Yes. In addition to setting greenhouse gas reduction targets, SB 350 also established a  
9 requirement to minimize localized air pollutants and other greenhouse gas emissions,  
10 with early priority for disadvantaged communities.<sup>17</sup>

11 **Q. In your opinion, would increased procurement of capacity from biomass facilities  
12 reduce criteria pollutant emissions within the state?**

13 **A.** No, additional biomass procurement would likely increase, not decrease, localized air  
14 pollutants because biomass facilities emit more criteria pollutants per megawatt-hour of  
15 energy generation than any other utility-scale resource.

16 **Q. Do you have any recommendations on how to reduce localized air pollutants from  
17 the electric sector in order to comply with SB 350’s requirement?**

18 **A.** Yes, I recommend that the Commission decrease its reliance on biomass facilities to  
19 provide electricity. The most straightforward way to reduce localized air pollutants from  
20 the electric sector is to run biomass facilities less often. Alternatively, California could  
21 require better emissions control technologies on biomass facilities, but I do not believe  
22 the Commission has jurisdiction over energy facility emissions controls, and in any case,  
23 additional emissions controls could have less effect than running the facilities less often.

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<sup>15</sup> Pub. Util. Code § 454.52(a)(1)(A) (directing the CPUC to set a process for each load-serving entity to file an integrated resource plan that will achieve “the economywide greenhouse gas emissions reductions of 40 percent from 1990 levels by 2030.”).

<sup>16</sup> Executive Order B-55-18, *available at* <https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>.

<sup>17</sup> Pub. Util. Code § 454.52(a)(1)(I) (requiring that load-serving entities must “minimize localized air pollutants and other greenhouse gas emissions, with early priority on disadvantaged communities”).



1 In addition to jurisdictional problems, the Clean Air Act and lax regulation by state  
2 permitting agencies allow biomass facilities to emit far more than other resources do. The  
3 Commission should not plan for new biomass air emissions regulations to decrease air  
4 pollutants from biomass facilities. If the Commission wants to decrease localized air  
5 pollutants, the most direct way to do that is to decrease—rather than increase—the  
6 procurement of biomass-fired energy.

7 **Q. In opening testimony, California Biomass Energy Alliance (“CBEA”) stated that**  
8 **“California state policy strongly favors the production of biomass energy in order to**  
9 **assist with the solution of a variety of environment[al] problems, including assisting**  
10 **in efforts to reduce the risks of wildfires in California’s forests, reducing the open**  
11 **burning of agricultural and forestry residues, and reducing the landfill disposal of**  
12 **organic wastes . . . . [T]he multitude of ancillary benefits that biomass provides**  
13 **deserve to be taken into account in judging whether to pursue the option of**  
14 **returning some of the state’s idle biomass generators to service.”<sup>18</sup> Do you agree**  
15 **with this statement?**

16 **A.** No.

17 **Q. Why not?**

18 **A.** State policy favoring biomass energy is limited and under review. For example, the  
19 Commission manages the BioMAT program, which is a specific procurement mandate to  
20 provide procurement contracts for a small number of biomass facilities. In 2018, the  
21 Commission produced a report on the program due to the very small number of facilities  
22 participating in the program.<sup>19</sup> The report noted that the costs of procuring biomass  
23 energy remain high compared to other resources, including \$187.72/MWh for dairy and  
24 other agriculture BioMAT projects and \$199.72/MWh for “sustainable forest” BioMAT

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<sup>18</sup> CBEA Opening Testimony on Emergency Capacity Procurement at 3:4-11 (Jan. 11, 2021).

<sup>19</sup> Cal. P.U.C., Draft BioMAT Program Review and Staff Proposal, at 7-8 (Oct. 30, 2018), *available at* [https://www.cpuc.ca.gov/sb\\_1122/](https://www.cpuc.ca.gov/sb_1122/) (noting that less than five unaffiliated applicants are in the statewide queue for each BioMAT category and only 22 contracts signed for 33 MW of capacity, or 13% of the 250 MW BioMAT procurement goal).

1 projects.<sup>20</sup> The Commission recently incorporated some changes to the BioMAT program  
2 in D.20-08-043, including forming a technical working group to develop a project-  
3 specific lifecycle GHG emissions reduction model to quantify the impacts of each  
4 project.<sup>21</sup>

5 **Q. Do you agree with the CBEA testimony that biomass energy produces a “multitude**  
6 **of ancillary benefits?”<sup>22</sup>**

7 **A.** No. To the contrary, biomass energy produces significant costs to California. As I stated  
8 above, the average emissions factors for California’s biomass facilities are extremely  
9 high, much higher than almost any other electricity-generating resource type. Those  
10 emissions have harmful impacts on human health. Additionally, the science on whether  
11 thinning forests can actually reduce fire intensity and frequency has produced mixed and  
12 conflicting results, thus the practice does not deserve to be classified as “ancillary  
13 benefit.”

14 **Q. Would authorization to procure additional biomass capacity comply with state law**  
15 **regarding early priority for disadvantaged communities?**

16 **A.** No, additional biomass procurement would increase the air pollutants in disadvantaged  
17 communities because multiple biomass facilities are located in or near disadvantaged  
18 communities. New capacity contracts would lock in additional years of operation for the  
19 state’s dirtiest power plants, making it more difficult to develop cleaner alternative  
20 energy sources in the same areas. Additionally, to the extent that operation of these units  
21 claims subsidies and incentives for renewable energy, this may actually suppress  
22 development of truly zero-emissions renewable energy technology such as wind and  
23 solar.

24 **Q. Does this conclude your testimony?**

25 **A.** Yes.

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<sup>20</sup> *Id.* at 8.

<sup>21</sup> D.20-08-043 at 38.

<sup>22</sup> CBEA Opening Testimony on Emergency Capacity Procurement at 3:9.