Green Power Institute

Greenhouse Gas Emissions Analysis for Sierra Pacific Industries Cogeneration Facility in Anderson, California

Gregory Morris, Ph.D.

Green Power Institute
October 17, 2011
Berkeley, California

Greenhouse Gas Emissions Analysis for Sierra Pacific Industries Cogeneration Facility

The following report analyzes greenhouse gas emissions for the proposed Sierra Pacific Industries cogeneration facility (Cogen Facility) in Anderson, California, in relation to Chapter 3.2.4 of the partially Recirculated Draft Environmental Impact Report (RDEIR) for the project.

I. BACKGROUND

The RDEIR discusses the benefits of using biomass for fuel and reduced emissions associated with alternate forms of disposal. These comments expound upon the concept of carbon neutrality, which is central to understanding the Cogen Facility's GHG emissions and any impacts.

Facilities fueled or fired by biomass are traditionally treated as "carbon neutral" by national and international carbon tracking and trading systems, including the systems in use by the European Union, and the Regional Greenhouse Gas Initiative, which tracks greenhouse gas emissions in the northeastern U.S. The conventional rationale for conferring carbon neutrality on biomass is that the carbon in the biomass, known as biogenic carbon, is already part of the global carbon cycle. Growth of biomass removes carbon from the atmosphere, while combustion of biomass returns the carbon to the atmosphere, thus completing the loop.[1]

In California, the designation of the biomass fuels that are used for energy production as carbon neutral is based on a more sophisticated analysis, which tracks carbon flows associated with the biomass resources that are used as fuels.[2] This methodology – discussed in more detail below – led the California Public Utilities Commission in 2007 to find, in a major Commission decision regulating greenhouse gas emissions: "electric generation using biomass (e.g., agricultural and wood waste, landfill gas) that would otherwise be disposed of under a variety of conventional methods (such as open burning, forest accumulation, landfills, composting) results in a substantial *net reduction* in GHG emissions."[3]

On December 16, 2010, as part of its ongoing implementation of AB 32, the California Air Resources Board (CARB) considered draft regulations to implement a cap-and-trade program for greenhouse gas emissions.[4] In section 95852.2 of the proposed regulations, CARB has specifically

---

[1] See, e.g., U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2008* (April 15, 2010) at 3-1 ("It is assumed that the carbon (C) released during the consumption of biomass is recycled as U.S. forests and crops regenerate, causing no net addition of CO2 to the atmosphere."); U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station, *Biomass to Energy: Forest Management for Wildfire Reduction, Energy Production, and Other Benefits*, California Energy Commission report no. CEC-500-2009-080 (January 2010); Intergovernmental Panel on Climate Change, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Vol. 1, General Guidance and Reporting (treating biomass used for energy production as having zero emissions in the Energy Sector); Western Governors' Association, Clean and Diversified Energy Initiative, *Biomass Task Force Report* (January 2006).

[2] Morris, G., *Biomass Energy Production in California: The Case for a Biomass Policy Initiative*, NREL Report No. NREL/SR-570-28805, November 2000.

[3] California Public Utilities Commission, Interim Opinion on Phase 1 Issues: Greenhouse Gas Emissions Performance Standard, D.07-01-039, pg. 18, January 25, 2007, emphasis in original.

[4] Since December 2010, the proposed cap-and-trade regulations have gone through two sets of revisions, and CARB is scheduled to act on the final proposal at its meeting on October 20, 2011. Under both the original and current proposed regulations, verified emissions from the types of biomass fuels to be used at the Cogen Facility would be exempt from

exempted from any compliance obligation a series of listed fuel types that have been demonstrated to be carbon neutral, and in many cases carbon negative.[5] These exemptions cover all of the fuel sources that will be utilized at the Anderson biomass plant. This means that these fuels are *not* considered emission sources that need to be capped or offset either by the use of allowances, or other available offsets in the California regulatory program.[6] Additionally, biomass cogeneration facilities are eligible for inclusion in the state's Renewable Portfolio Standard (RPS) program, discussed in the RDEIR; indeed, the Cogen Facility has been pre-certified as a participating renewable energy facility by the California Energy Commission.

An article in the October 23, 2009, issue of *Science* magazine challenged the notion that biomass should be granted a blanket finding of carbon neutrality, pointing out that under some conditions, some types of biomass fuels, such as fuels derived from forest harvesting conducted specifically for energy production, may not be carbon neutral.[7] However, the article explicitly acknowledges that the use of waste and residue forms of biomass does not entail this concern, and that waste and residue forms of biomass should be considered carbon neutral. In fact, all of the fuels that will be used by the proposed Cogen Facility are waste and residue forms of biomass, and thus the use of these fuels should be considered carbon neutral or carbon negative fully within the context of the concerns expressed in the *Science* article.

Some commenters have additionally asserted that biomass combustion should not be considered carbon neutral within timeframes relevant to current efforts to mitigate the impacts of climate change. The proper way to account for the carbon budget of forest fuels is to look at the status of the source forest as a whole, on a landscape basis. If total biomass in the source forest is increasing over time in conjunction with the supply of forest removals to biomass power production, then the enterprise is not only carbon neutral, it actually contributes to the sequestration of atmospheric carbon.[8] In fact, it is well documented that California forests as a whole are acting as a sink (net sequestration) for atmospheric carbon, and that this is a long-term trend that has proceeded in conjunction with past and current levels of forest harvesting and management in the state.[9]

Moreover, in the specific case of the Cogen Facility, this assertion does not apply. The concern pertains specifically to the use of forest fuels that are harvested specifically for their energy value, and no such fuels will be used by the proposed Cogen Facility. In fact, as described in the Project

---

any compliance obligation. See http://www.arb.ca.gov/regact/2010/capandtrade10/capandtrade10.htm for more information on the rulemaking process.

[5] By comparison, the U.S. Environmental Protection Agency has not yet determined whether or how emissions from biomass generation must be incorporated into permits for GHG emissions. On January 12, 2011, the EPA announced its intention to defer rulemaking on biomass GHG permitting requirements for a three year period in order to be able to more fully study the underlying science.

[6] The biogenic emissions from biomass power generation will be reported to the CARB under the Mandatory Reporting Rule, but in a separate category from fossil emissions. Only the fossil emissions will be subject to the regulation.

[7] Timothy D. Searchinger et al., *Fixing a Critical Climate Accounting Error*, at 527.

[8] This is supported by the IPCC, which states: "In the long term, sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual yield of timber, fibre, or energy from the forest, will generate the largest sustained mitigation benefit." Nabuurs, G.J., et al., 2007: Forestry. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz et al. (eds)], Cambridge University Press.

[9] See attached document from the CARB illustrating net sequestration in California's forests.

Description of the RDEIR, the proposed project will not result in any additional timber harvesting operations for the sole purpose of biomass combustion. All commercial timber harvesting in California requires a Timber Harvest Plan (THP) that is certified, by the Director of the Department of Forestry and Fire Protection, as being in compliance with the intent of the Z'berg Nejedly Forest Practice Act (FPA). The FPA requires, among other things, that a THP demonstrate that the harvesting will result in the maximum sustained production of high quality timber products. Additionally, power generation is the lowest-valued use for biomass resources, and only waste and residual materials are used as fuels.

With respect to the Cogen Facility, the RDEIR states, on page 3.2.4-15, that

> a GHG impact would be considered significant if implementation of the proposed project would:
>
> - Conflict with, or impede implementation of, the State's Renewable Energy Standard that aims to have 33% of the State's electricity come from renewable energy sources by 2020; or
> - Not assist in meeting the Statewide GHG reduction goals outlined in AB 32.

Based on this threshold, the RDEIR goes on to conclude that GHG impacts are less than significant because "Project implementation would result in the generation of GHG emissions, but would not conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases." The identified threshold is appropriate, in accordance with CEQA Guidelines section 15064.4(b) and for the additional reasons discussed in the RDEIR. Moreover, it is appropriate to conclude that the GHG-related impacts are less than significant and do not require mitigation. However, the results of the model described below provide additional support for this conclusion.

II. METHODOLOGY

A. Overview

The methodology used in the RDEIR is one approach to describe and quantify the GHGs associated with the Cogen Facility, as required by CEQA.[10] Nevertheless, alternative approaches to quantifying GHGs also lead to the conclusion that the project does not have a significant GHG impact. For example, the model set forth below has been used in state regulatory proceedings relating to renewable energy.[11] Accordingly, GHG emissions have been calculated using the model and methodology described in the Pacific Institute report, *Bioenergy and Greenhouse Gases*, which was referenced on page 3.2-1 of the original DEIR, and included as an appendix to that document.

[10] See CEQA Guidelines sec. 15064.4(a)(1).

[11] See, e.g., California Public Utilities Commission, Interim Opinion on Phase 1 Issues: Greenhouse Gas Emissions Performance Standard, D.07-01-039, pg. 18, January 25, 2007. The model is a successor to the model described in Morris, G., *Biomass Energy Production in California: The Case for a Biomass Policy Initiative*, NREL Report No. NREL/SR-570-28805, November 2000.

The model keeps separate accounts for biogenic and fossil GHGs. Biogenic carbon is carbon that is already part of the active carbon cycle, which includes the carbon in biomass fuels. Fossil carbon, the carbon in fossil fuels, is carbon that is locked away in geological storage, unavailable to the atmosphere unless the fossil fuel is mined and burned. The model tracks both the biogenic and fossil carbon emissions associated with biomass power generation, and the biogenic and fossil carbon emissions that are avoided by biomass power generation. Each account (biogenic, fossil) is then netted. Carbon flows are tracked over a 100-year period following fuel use.

Biogenic CO_2 will be emitted directly at the stack of the Cogen Facility. In addition, there will be relatively low emissions of fossil GHGs from construction, the diesel fuel used in the processing and transportation of the biomass fuel to the power plant, and from natural gas used for startup and shutdown. On the other hand, the use of the fuel at the power plant will not only avoid the generation of a like amount of electricity using fossil fuel,[12] it also will avoid the alternate disposal of the biomass fuel material, which would occur in the absence of the cogeneration facility. Existing alternate disposal options include landfill burial, open burning, combustion in a traditional low-pressure kiln boiler, and accumulation in the forest as overgrowth material due to failure to perform forest treatments. Thus, the net greenhouse gas emissions of a specific biomass project are the emissions produced by the construction and operations of the facility, less the emissions that are avoided by the operations of the facility.

B. GHG Measurement

Carbon dioxide equivalents (CO_2e) provide a universal standard of measurement against which the impacts of releasing, or avoiding the release of, different GHGs can be evaluated. Every greenhouse gas has a Global Warming Potential (GWP), a measurement of the impact that particular gas has on radiative forcing; that is, the amount of heat/energy that is retained in the Earth's atmosphere through the addition of this gas to the atmosphere. The GWP of a given gas describes its effect on climate change relative to a similar amount of carbon dioxide (the GWP of CO_2 is 1.0 by definition).

The GWP of a gas depends on two factors, the ability of the gas to absorb energy, and the lifetime of the gas in the atmosphere. GWPs can be expressed on an instantaneous basis, which reflects only the relative ability of the gas to absorb energy, or with an explicit time factor built-in. The residence time of CO_2 in the atmosphere is generally believed to be in excess of 100 years, and some of the other GHGs have even longer residence times. Thus, most analyses use a timeframe in the range of 25 – 100 years in determining the warming potential of GHGs that are emitted into the atmosphere today.

According to the U.S. Environmental Protection Agency, the following five gases are considered the principal GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halocarbons, and sulphur hexafluoride. Of these five, only CO_2 and CH_4 are emitted during the combustion of fuels, or via the degradation of biomass. On a per-carbon basis, CH_4 has a GWP that is 25 times greater than the GWP of CO_2 on an instantaneous basis. However, the average residence time of CH_4 in the atmosphere is only about one-tenth as long as the average residence time of CO_2, and its

[12] See, e.g., Battles, J. et al., *Projecting Climate Change Impacts on Forest Growth and Yield for California's Sierran Mixed Conifer Forests*, California Climate Change Center, CEC Report No. CEC-2009-047-F (2009).

clearance involves conversion to CO_2, so when a time factor is added the relative GWP of CH_4 goes down to values in the range of 7.5–12.5 on a per-carbon basis, depending on the length of the timeframe being used in the analysis. GWPs are often reported on a per-weight basis, rather than a per-carbon basis. The instantaneous GWP of methane on a weight basis is 69 relative to the same weight of CO_2, and with a time factor built-in it falls to a range of about 20–35.

III. ANALYSIS OF COGEN FACILITY EMISSIONS

Applying the Pacific Institute model, it is apparent that the project will result in net cumulative *reductions* of greenhouse gas emissions due to the fact that the Cogen Facility's emissions of GHGs are lower than the emissions that would be created by alternative disposal of the biomass fuels and use of fossil fuel energy in the absence of the project.

A. Operational Emissions – Methodology

As recognized in the RDEIR, operational GHGs generated by the proposed project would come from three categories of sources: 1) fossil-carbon emissions from the equipment and vehicles associated with the production and transport of biomass materials to the project site, 2) fossil-carbon emissions from the use of natural gas for startup/shutdown of the boiler, and 3) biogenic-carbon emissions from the operation of the proposed cogeneration plant.[13] Operation of the Cogen Facility will avoid the use of fossil fuel to generate the energy that the proposed facility displaces, and also will avoid the emissions of biogenic GHGs associated with 1) the existing cogeneration facility on site and 2) the alternative disposal of the biomass-fuel material. Thus, the net emissions associated with the project are the emissions generated by the proposed project, less the emissions avoided by the proposed project. The RDEIR calculation mistakenly counts wood waste from the sawmill in the emissions total without appropriately also counting (subtracting) the avoided emission from its alternate fate analysis.

1. Avoided Emissions

Each of the avoided emission categories are discussed in more detail below.

Replacement of existing cogeneration facility. The Cogen Facility will replace a much smaller biomass-powered CHP facility that currently serves SPI's Anderson mill operation. The existing operation is fueled exclusively by residues produced by the on-site sawmill.

Avoided emissions from alternative biomass disposal. As described in Chapter 2 of the RDEIR, the proposed Cogen Facility will use approximately 220,000 bone-dry ton equivalents (bdt) per year of fuel.

[13] As noted in the RDEIR (p. 3.2.4-15 to 16), construction of the new Cogen Facility would also generate approximately 120.29 tons of CO_2e before mitigation. Construction-related emissions have not been specifically accounted for in the analysis discussed here. However, those emissions – even without implementation of other required mitigation measures that will reduce their levels – represent only a small fraction of the emissions avoided by operation of the Cogen Facility.

The model begins with an annual inventory of the biomass fuels that will be used for energy production at the proposed Cogen Facility. It identifies factors for partitioning each type of biomass fuel into alternative fates (open burning, landfilling, etc.) in the absence of the power project, and the amounts of biomass that would be subject to each category of alternative fate. Table 1 presents a summary of the alternative fates of biomass residues that will be used for energy production at the proposed Cogen Facility.

Table 1: Alternative Fates for Biomass Fuel Used at Cogen Facility

	Mill	Slash	Thinnings	Ag	Urban	Total
Annual Fuel Use (th.bdt/yr)	140	20	20	25	15	220
If No Fuel Use, % that Would Be Disposed of by						
Open Burning	0.0%	85.0%	10.0%	60.0%	2.0%	34
Forest Accumulation	0.0%	0.0%	90.0%	0.0%	0.0%	18
Controlled Landfill	43.0%	0.0%	0.0%	2.0%	55.0%	69
Uncontrolled Landfill	15.0%	0.0%	0.0%	18.0%	20.0%	29
Spreading	1.0%	15.0%	0.0%	0.0%	10.0%	6
Composting	1.0%	0.0%	0.0%	10.0%	13.0%	6
kiln or utility boiler	40.0%	0.0%	0.0%	10.0%	0.0%	59

The model follows the carbon flows for power production, and for each alternative fate, over a 100-year time period. The atmospheric concentrations of the GHGs CO_2 and CH_4 are compared for the energy production alternative, and for the alternative fates for the biomass residues should energy production not be carried out.[14] Because the model tracks the carbon flows over a long timeframe, it uses the instantaneous warming potential of 25 for CH_4 on a per-carbon basis, thus avoiding the need to construct a time-period dependent GWP.

Avoided fossil fuel emissions. The greenhouse gas emissions of avoided fossil-fuel use for electricity production are also determined. The fossil-carbon emissions associated with biomass power production are netted from the avoided power-generation emissions. Fossil-carbon GHGs and biogenic-carbon GHGs are tracked in separate accounts. Figure 1 shows the logic flow of the model. Biomass resources under consideration are either used for energy production, or they meet some alternative fate, typically a conventional disposal option as outlined above.

[14] The alternative fate of burning the fuel at a different utility boiler is usually not considered in this type of analysis, as it would require making assumptions about how other biomass generators will adjust their operations when the proposed facility enters operation, which is outside of the scope of the analysis. However, in the present case the proposed facility is directly replacing an existing, albeit smaller, generating facility, so the fuel that is currently being burned in the existing facility is indeed material whose alternative disposal is combustion in a utility boiler.

Figure 1: Logic Flow in Greenhouse Gas Model

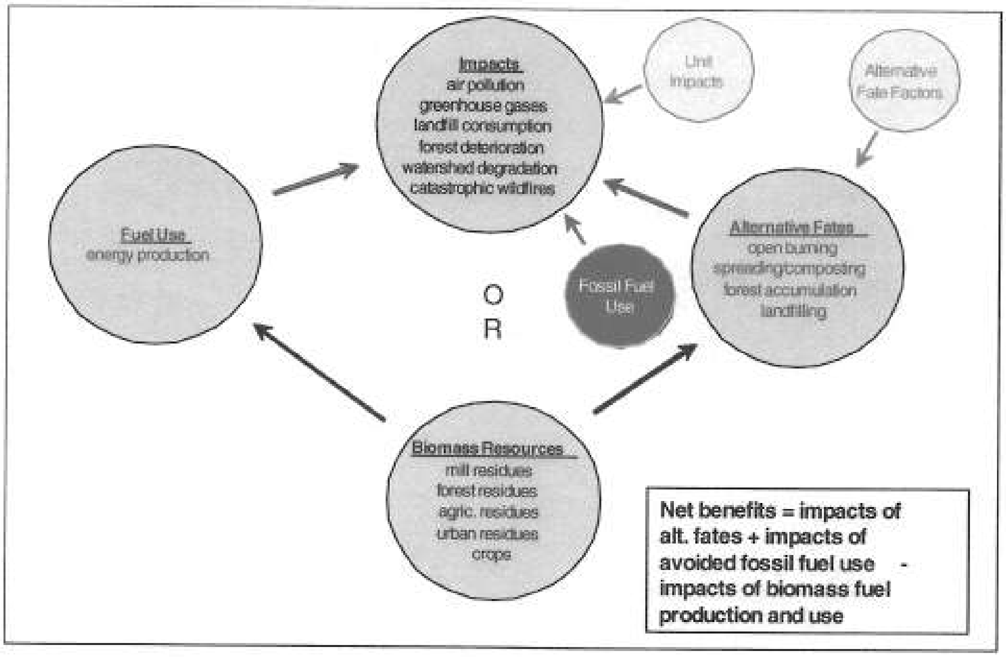
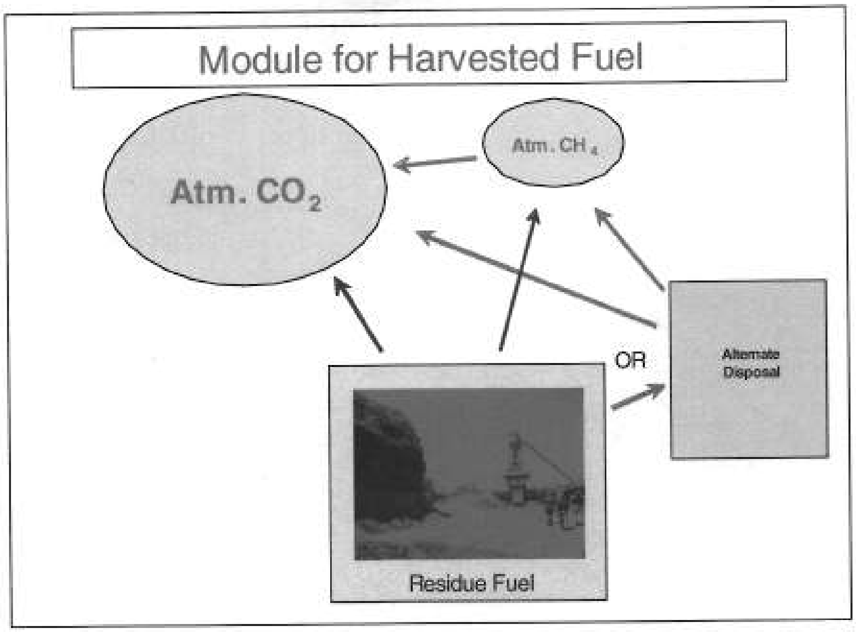


Figure 2 shows the stocks and flows in the Biomass Greenhouse Gas Model's already-harvested fuel module. This is the model's basic module that is used for all of the fuels considered in the model, with the exception of fuels that are taken from a growing stock of biomass, such as forest thinnings. The avoided emissions of CO_2 and CH_4 from alternative disposal can include both immediate emissions, like the emissions from open burning, and delayed emissions, like the emissions from landfill disposal of biomass, which continue for decades after burial of the biomass. Virtually all of the emissions from both biomass and avoided fossil-power production are immediate.

Figure 2: Harvested Fuel Module

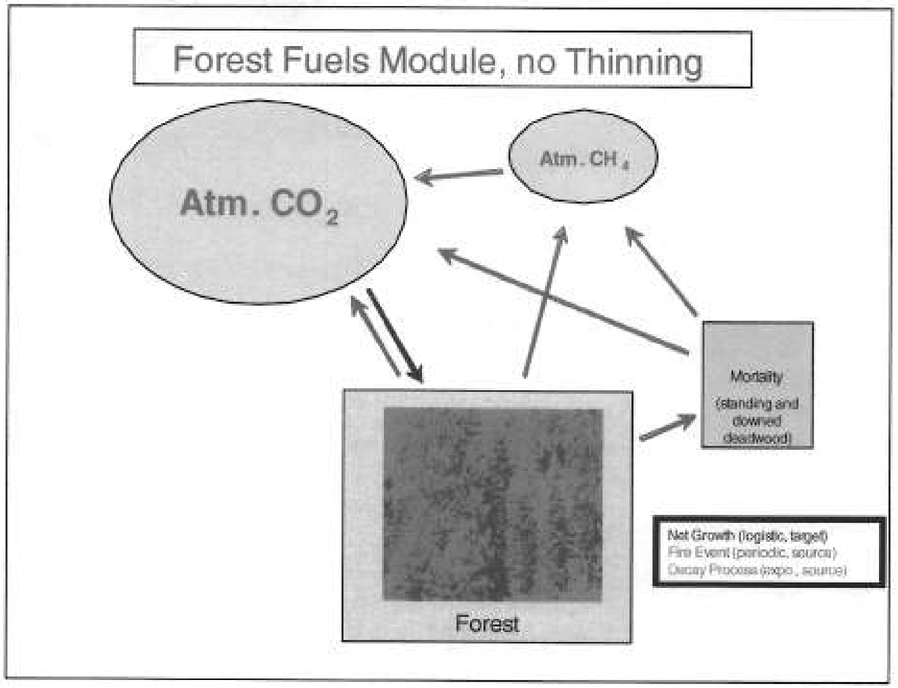


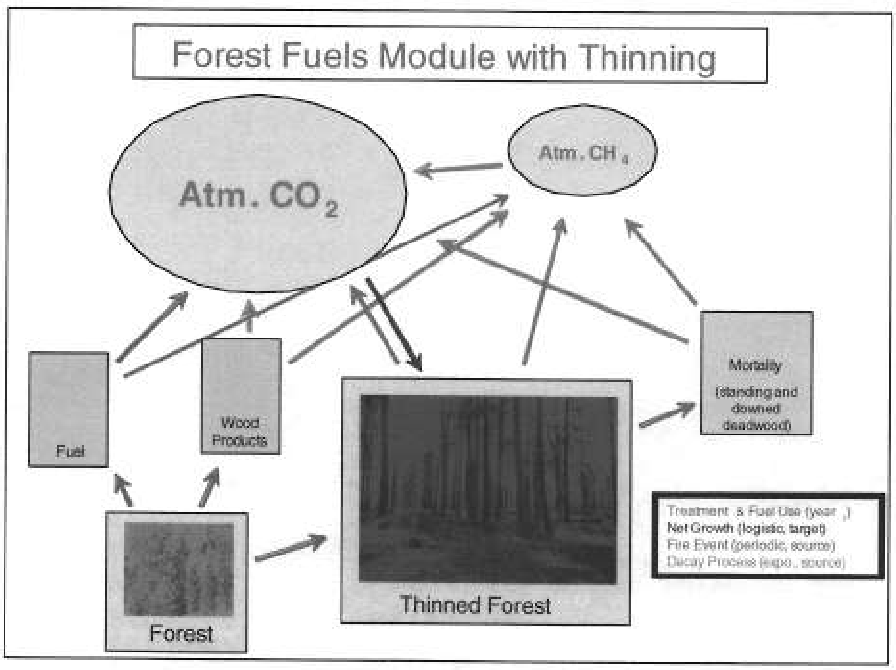
Analyzing the GHG fate of biomass fuel that is derived from a growing stock of biomass is more complicated than that of already-harvested biomass, because living biomass sequesters CO_2 from the atmosphere, as well as being a source of carbon emissions during wildfires and insect or disease events.[15] The proposed Cogen Facility will use one type of fuel that is derived from a growing stock: thinnings from forest-treatment operations.

Left in the forest, overstocked biomass initially is treated as being part of a long-term storage reservoir, which is the overstocked forest itself. The overstocked forest has a higher probability of destructive wildfires than a thinned forest, and has a net annual growth rate (bdt/acre) that is lower than that of a thinned forest. When a wildfire does occur, it consumes not only some or all of the overstocked material that would have been removed in a thinning, but also a portion of the growing stock that would have remained in the forest after a thinning. For modeling purposes, the greenhouse gas impact of leaving biomass in the forest as overstocked material is determined as the difference between the emissions of GHGs from overstocked forests, and the emissions associated with thinned forests. Biomass carbon in a thinned forest has a longer residence time than in the overstocked situation (lower annual probability of fire), thinned forests have greater net annual growth than overstocked forests, and fires in thinned forests cause less extensive damage to the growing stock than fires in overstocked forests. Figure 3 shows the model's forest-fuels modules.

[15] Fire is often used in this analysis as a proxy for a variety of vectors that hit overstocked and stressed forests harder than healthy forests, including insect infestations and disease outbreaks that kill the trees.

Figure 3





B. Operational Emissions – Results

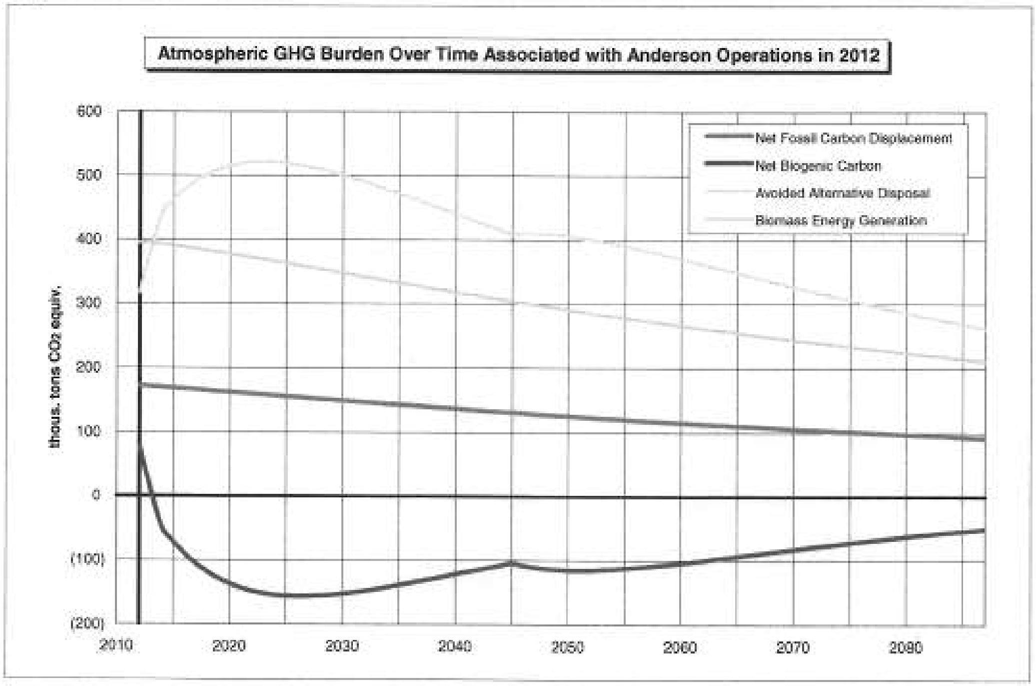
1. Fossil Carbon Emissions

The Cogen Facility will convert approximately 220,000 bdt of biomass fuel to energy annually, in the process displacing the equivalent use of approximately 36,000 tons of coal, and 1,200 million cubic feet of natural gas for power generation, and avoiding net emissions of approximately 172 thousand tons per year of fossil CO_2 emissions. The project will avoid the generation of 176 thousand tons per year of fossil CO_2 emissions from avoided power generation, but the diesel fuel used in fuel production, transportation and handling will produce approximately 4 thousand tons per year of emissions, resulting in a net avoidance of 172 thousand tons per year of fossil CO_2 emissions.

2. Biogenic Carbon Emissions – Effects of Immediate Operations

The proposed Anderson facility itself will emit approximately 317 thousand tons of biogenic CO_2 emissions annually, but it will avoid the emissions of GHGs that would occur with the alternative disposal of the biomass fuels. This includes avoiding both immediate and delayed emissions from each operating year's batch of fuel use. Figure 4 shows the atmospheric greenhouse gas burden over time of fossil and biogenic carbon gases associated with the fuel used by the proposed Cogen Facility during a single year of operations (2012). The immediate emissions of GHGs are shown on the vertical axis of the graph, including fossil-carbon emissions avoided (brown), biogenic emissions of alternative disposal that are avoided (blue), and biogenic emissions produced by the power plant (red). The net GHG burden of biogenic carbon gases over time associated with the project (prompt power plant emissions less prompt and delayed avoided emissions, or red curve minus blue curve) are shown by the green curve. The avoided fossil-carbon emissions (brown curve) are shown net of the fossil-carbon emissions associated with operations of the proposed Cogen Facility.

Figure 4



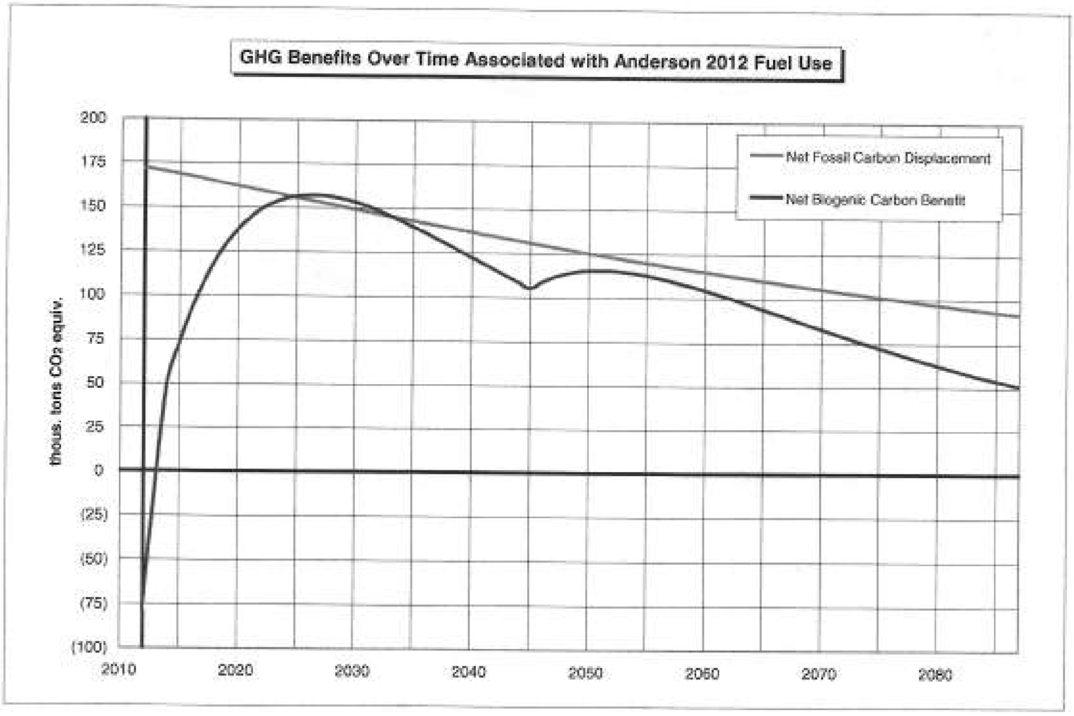
The figure shows the fate of the various GHG emissions associated with a single year's operation (2012) of the proposed project over an ensuing 75-year time horizon.[16] One of the interesting features of the curve for the avoided emissions of alternative disposal (blue) is the hitch in the curve in the year 2045, which is reflected in the net biogenic curve (green) as well. This is the result of the fact that some 30 years after closure of a cell in a landfill gas collection will be discontinued, resulting in a temporary increase in effective GHG emissions due to the change in the mix of gases emitted, even as overall emissions from the closed cell are decreasing annually on an exponential trajectory.

The emissions of biogenic GHGs from the biomass power plant, and the (avoided) emissions of fossil carbon emissions, are both almost entirely in the form of immediate emissions of CO_2. The CO_2 slowly decays out of the atmosphere with a characteristic residence time of 120 years (85-year half-life). The biogenic emissions of GHGs from alternative disposal, which are avoided as a result of the operations of the biomass power plant, follow a different trajectory. Some of the avoided emissions are prompt, but a good portion of the emissions are delayed; the result, for example, of storage in overgrown forests with enhanced fire risk, or slow degradation of the waste biomass in a landfill. For this reason, the avoided emissions of alternative disposal (blue) curve in the figure increases for the first ten years after the fuel is used, before decaying away.

In order to compare the magnitudes of the net reduction in biogenic GHGs resulting from a single year's operation of the proposed Cogen Facility with the avoidance of fossil carbon emissions, Figure 5 below shows the net biogenic emissions curve (green) from Figure 4 flipped, in order to show it as a benefit, superimposed on the avoided fossil-emissions curve. As Figure 5 shows, the warming potential of the avoided fossil fuel peaks in the year in which it is avoided (2012 in the figure), then slowly decays. The benefit of reduced warming potential associated with the reduction in biogenic GHG levels peaks approximately 15 years following the use of the fuel, before decaying away. From about 10 to 40 years following the use of the fuel, the benefit provided by the biomass power plant, in terms of reduced biogenic GHGs, is approximately the same, measured in terms of total warming potential, as the magnitude of the benefit of fossil fuel avoidance. However, it must be noted that avoiding fossil carbon emissions has the additional significant benefit of not adding new, geologically-stored carbon (fossil carbon) to the pool of carbon in the active atmospheric-biospheric carbon cycle.

[16] As noted previously, the model does the accounting over a 100-year time period, but the results are shown graphically for 75 years because it makes for a clearer presentation, and the longer-term trends are clear.

Figure 5

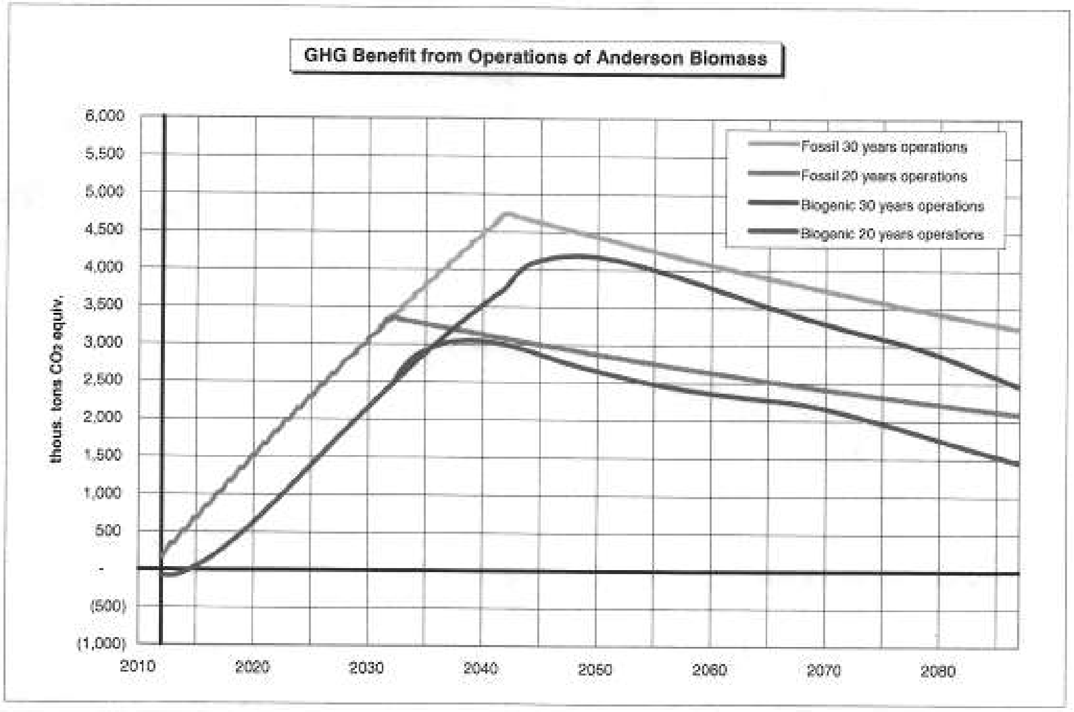


3. Effects of Long-Term Operations

Again, the curves presented in Figures 4 and 5 correspond to a single year's worth of operations and fuel use for the proposed Cogen Facility. In fact, the project is expected to have a 20 - 30 year operating lifetime. Figure 6 shows the long-term cumulative effects of operating the proposed project over a 20 and 30 year operating lifetime, with the biogenic curve flipped like in Figure 5 to show net reductions as a benefit. As Figure 6 shows, the avoided atmospheric burden of fossil GHGs increases for the period during which the project operates, then decays with a characteristic residence time of 120 years.[17]

[17] Again, the figure shows the atmospheric burden of GHGs associated with the project over a 75-year time period, but the analytical timeframe used by the model is from the beginning of commercial operations to 100 years after the time that the project ends commercial operations.

Figure 6



The net biogenic GHG consequences (biogenic emissions at the power plant less avoided biogenic emissions of alternate disposal of the material used as fuel) of operating the facility are positive within three years after the facility begins operations. There is a slight lag in the curve for avoided net biogenic emissions compared with the avoided fossil-carbon-emissions curve, due to the lag in time between when some residues are generated and disposed of, and when their carbon is recycled to the atmosphere. This is the case with residues that would otherwise be buried in a landfill, for example, or material that is not removed from a forest in need of treatment, leading to enhanced losses at some time in the future when the forest is hit by fire, pests, or disease. This lag persists after the power plant ceases operations, so that the maximum level of reduction of biogenic GHGs associated with 30 years of operations of the facility occurs approximately eight years following closure of the facility. Integrated over the long term, the net reduction in the atmospheric level of biogenic GHGs associated with the fuel used by the Cogen Facility is approximately 80 – 90% of the atmospheric level of fossil emissions that are avoided by the operations of the facility.

By the end of 20 years of operations, the proposed Cogen Facility will have avoided the emissions of 3.44 million tons of fossil CO_2e (or 171,600 ave MT/year), thus reducing the atmospheric level of fossil GHGs in 2032 by approximately 3.35 million tons of CO_2e (167,500 average MT/year). Net atmospheric levels of biogenic GHGs are reduced in 2032 due to project operations by approximately 2.45 million tons of CO_2e, but even if the project shuts down at that time, net biogenic greenhouse gas levels associated with the project will continue to decline for an additional eight years, compared to what would have happened in the absence of the project. By the year 2040 the benefits of reduced biogenic GHGs due to 20 years of operation of the Cogen Facility are approximately the same, in terms of total warming potential, as the project's benefits derived from avoiding fossil greenhouse gas emissions, although it must be repeated that eliminating fossil carbon emissions has the additional significant benefit of avoiding adding new carbon to the system released from long-term geological storage. Integrated over the long term the biogenic benefits of the proposed Cogen Facility are approximately 80 – 90% as large as the avoided fossil carbon benefits, due to lifetime operations of the project.

The proposed Cogen Facility avoids the use of both coal and natural gas for electricity production. The avoided fossil GHG emissions from coal and natural gas generation are 0.78 tons of CO_2e per MWh (172 th.ton / 220 th.MWh), as shown in Figure 5, where the brown curve crosses the Y axis (2012) for the 31 MW, 220,000 MWh/yr facility. The avoided fossil GHG emissions shown are the net between the avoided emissions of fossil generation, less the emissions of fossil carbon associated with the diesel fuel used in the course of biomass power generation.

The reduction in the biogenic GHG burden resulting from Anderson operations in 2012, averaged over a long term period, is approximately 85% of the amount of avoidance of fossil CO_2 emissions. This is equivalent to a prompt emissions rate of 0.66 tons of CO_2e per MWh for the reduction in biogenic emissions. The total GHG benefit attributable to the proposed Cogen Facility is the sum of the net avoided emissions of fossil carbon, and the reduction in the net emissions of biogenic carbon, or a total reduction of 1.44 tons of CO_2e per MWh (0.78 + 0.66).

4. Comparison to RDEIR

Following the RDEIR's approach with the two adjustments for alternate fate treatment of the mill waste and the offset of fossil fuel from the electricity generated, one would arrive at a modified table as shown below:

Updated Table 3.2.4-4: GHG Emissions Generated and Avoided by Cogen Project

SOURCE	RDEIR Projection: CO_2E (MT/YEAR)	Adjusted Projection: CO_2E (MT/YEAR)	
OPERATIONAL EMISSIONS			
Biomass Combustion at Power Plant	317,497	317,497	
Natural Gas Combustion at Power Plant 3,419	3,419	3,419	
Fuel Yard Loader 926	926	926	
Truck Idling at Power Plant	18	18	
Employee Trips	39	39	
Biomass Hauling	1,979	1,979	
Ash Hauling	26	26	
Biomass Harvesting/Processing	5,944	5,944	
Subtotal of emissions generated	329,848	329,848	
AVOIDED EMISSIONS			
Decomposition of Urban Wood Waste	10,586	10,586	
Agricultural Woody Waste Burning	35,294	35,294	
Forest Thinning/Slash Burning	62,246	62,246	
Existing 4 MW Cogeneration Facility	46,181	0	*
Original Subtotal of emissions avoided	154,307		
Additional Alternative Fate of Mill Waste		217,861	
Additional avoided emission from the production of electricity		171,600	
Updated Subtotal of emissions avoided		497,587	
RDEIR CONCLUSION: NET <u>INCREASE</u> IN OPERATIONAL EMISSIONS	175,541		
UPDATED CONCLUSION: NET <u>DECREASE</u> IN OPERATIONAL EMISSIONS		(167,739)	

* (Note: included in the fuel from the mill avoided fate treatment)

While different methodologies were used to calculate these values, both the adjusted RDEIR approach and the Pacific Institute Model arrived at an avoided annual emissions value that is nearly identical (167,739 as compared to 167,500 MT CO_2e per year for the 20 year life of the project).

These efforts are both conservative, because neither includes the original natural gas emissions produced when this plant site burned natural gas to make steam to dry lumber, which would be the case without the current or proposed biomass fueled boiler.

IV. CONCLUSION

The proposed Cogen Facility has a strongly positive carbon footprint that extends well beyond the operating lifetime for the project. The project has the same approximate benefits of avoiding fossil-carbon emissions that would be associated with any renewable energy project with the same energy output. In addition, it provides the benefit of reducing net emissions of biogenic GHGs by providing a superior alternative for the disposal of the biomass residues used as fuel, by an amount that is approximately 80 – 90% of the amount of the avoided fossil greenhouse gas emissions, expressed in terms of total warming potential.

Under the threshold of significance identified for this EIR, the project will not adversely affect meeting the statewide emission reduction goals set forth in AB 32, or the statewide renewable energy goals set forth in the RPS program, nor will the project have cumulatively considerable effects on climate change. In fact, it will facilitate not only the state's efforts to comply with RPS standards, but also AB 32. The proposed Cogen Facility is not just carbon neutral, it actually reduces the emissions of GHGs associated with the disposal of some of the region's biomass wastes and residues. This conclusion is supported by both the Pacific Institute Model and the adjusted RDEIR approach.