Expected Financial Impact on the Southeast Resource Recovery Facility (SERRF)
Based on CARB's September 4, 2018 Proposed Amendments to the Cap & Trade Program

We conservatively estimate the financial impact to the Long Beach facility to be **$39.2M** in 2018$ over the period from 2018 – 2030, increasing the cost of managing waste by approximately $6.60 / ton. Landfills will face no additional costs from the cap & trade program until at least 2025. Landfills are already a cheaper option for waste management in California.

Actual net financial impacts on SERRF could be much greater:

- *Landfill prices could decrease due to supply and demand*
  With no change in landfill capacity and a lower demand for their services (as a result of diversion), landfill tip fees are likely to decrease. With supply constant, and demand decreasing, prices will likely drop as landfill operators seek to retain their market share. Furthermore, incremental costs for landfills are low; operators are incentivized to keep waste throughput as high as possible. This will worsen the cost differential between waste-to-energy (WTE) and landfills.
- *Actual allowance prices could be significantly higher than modeled*
  We have taken a very conservative approach to modeling the cost of allowances, assuming that allowances trade at only 6.7% above the minimum auction reserve price.
- *The fraction of waste that is fossil-based may be higher than assumed*
  Our analysis assumes that 50% of the carbon in waste will be fossil-based after implementation of SB 1383. However, at 75% diversion of organics, 62.8% of the carbon remaining may be fossil-based, based on CalRecycle's 2014 Waste Characterization study, the latest available. Under this scenario, costs for SERRF would increase to $50.7M.
- *Diversion of organics will likely increase waste heat content, reducing effective WTE capacity*
  Our modeling assumes no changes in the calorific value of waste as a result of diversion. The organics targeted by the diversion requirements (e.g. food & yard waste) have lower heat contents relative to other waste streams that will not be diverted (e.g. unrecycled paper, plastics). As the heat content per ton of waste increases, the capacity of our boilers on a mass basis decreases: our facilities are typically limited by the amount of heat they can accommodate. Higher heat contents can mean fewer tons of waste processed and, as a result, less revenue.

Our assumptions and calculation methodology are presented in more detail following the table.

Table 1. Expected Financial Impact by Year of CARB September 2018 Proposal

Year	Minimum Auction Reserve Price ($ US)	Modeled Allowance Price ($ US)	Cap Adj. Factor	MSW Combusted (tons)	Electricity Sold (MWh)	MSW Biogenic Carbon %	Covered CO2e (t CO2e)	Baseline Allocation (t CO2e)	Allowances Granted (t CO2e)	Emissions Obligation (t CO2e)	Est. Cost ($M)
2010				484,929	226,872	87.1%					
2011				471,037	213,588	75.1%					
2012				474,632	218,196	64.3%					
2013	$10.71		0.98	473,544	226,296	71.1%	130,729				
2014	$11.34		0.96	460,714	220,380	78.4%	104,318				
2015	$12.10		0.94	456,482	204,840	77.0%	101,734				
2016	$12.73		0.93	429,155	160,308	67.5%	141,377				
2017	$13.57		0.91	417,331	179,712	78.4%	94,390				
2018	$14.53	$15.74	0.89	390,921	185,713	75.0%	105,455	89,360	79,352	26,103	$0.4
2019	$15.26	$15.93	0.87	408,500	209,490	71.4%	121,419	89,360	77,654	43,765	$0.7
2020	$16.02	$17.19	0.85	410,750	210,641	67.9%	134,655	89,360	76,046	58,609	$1.0
2021	$16.82	$17.94	0.82	425,500	218,205	64.3%	152,845	89,360	73,007	79,837	$1.4
2022	$17.66	$18.84	0.78	457,250	238,151	60.7%	180,436	89,360	69,969	110,467	$2.1
2023	$18.54	$19.78	0.75	483,600	248,000	57.1%	206,595	89,360	66,931	139,664	$2.8
2024	$19.47	$20.77	0.72	483,600	248,000	53.6%	222,428	89,360	63,893	158,535	$3.3
2025	$20.45	$21.81	0.68	483,600	248,000	50.0%	238,355	89,360	60,854	177,501	$3.9
2026	$21.47	$22.90	0.65	483,600	248,000	50.0%	238,368	89,360	57,816	180,552	$4.1
2027	$22.54	$24.04	0.61	483,600	248,000	50.0%	238,297	89,360	54,778	183,519	$4.4
2028	$23.67	$25.24	0.58	483,600	248,000	50.0%	238,338	89,360	51,740	186,599	$4.7
2029	$24.85	$26.51	0.55	483,600	248,000	50.0%	238,334	89,360	48,701	189,632	$5.0
2030	$26.09	$27.83	0.51	483,600	248,000	50.0%	238,338	89,360	45,663	192,675	$5.4
									Total Expected Impact ($M), 2018 - 2030		**$39.2**

Minimum Auction Reserve Price
The minimum auction reserve prices are set by CARB in accordance with §95911(b). Prices for 2019 – 2030 are based on a 2018 reserve price of $14.53, escalated by 5% each year. An adjustment for inflation via the CPI is included in the regulatory procedure but is omitted here in this analysis to keep all figures in current year dollars.

Modeled Allowance Price
Exposure to potential market price risk could be significant for WTE facilities, especially since landfills will face no such risk, as long as they are excluded from the cap & trade program. For modeling purposes, we have assumed average futures market prices for 2018-2020 as of September 2018. For vintage years 2021 – 2030, we have assumed a 6.7% premium *above* that year's auction reserve price, based on the average premium exhibited by 2018 – 2020 futures, as of September 2018.

Cap Adjustment (Adj.) Factor
For modeling CARB's September 2018 proposal, the cap adjustment factors for "Standard Activities" from Table 9-2 have been used.

MSW Combusted
The Long Beach facility is permitted to manage 500,000 tons per year in accordance with its Title V Air permit. The period of time from 2011 through 2018 has seen declining waste processing at the Long Beach facility to levels below its permitted capacity, largely as a result of financial pressures that are already limiting expenditures on on-going facility maintenance.

However, the recently signed agreement between the City of Long Beach and Covanta calls for investment of $13.7 M which will help restore the operation of the facility closer to its rated capacity, while remaining in compliance with its permit. Our financial projections for the operation of the facility assume an 11.3% increase in MSW throughput by 2023 relative to the 2015-2017 average of 434,000 tons.

Electricity Sold
Projections for the amount of electricity exported to the grid is based on MSW combusted and overall facility thermal efficiency. Over the period from 2017 through 2019, we are expecting an increase in the net electrical energy exported from each ton of MSW of approximately 23% as a result of facility and operational improvements.

MSW Biogenic Carbon %
The fraction of carbon in the waste stream that is from biogenic sources (e.g. food and yard waste, unrecycled paper and cardboard) has a large impact on the emissions from WTE facilities that are potentially subject to the cap & trade program. California has a series of policies and laws, including SB 1383, that are designed to encourage the diversion or organics to anaerobic digestion and composting. Specifically, SB 1383 calls for 50% and 75% reductions by 2020 and 2025 respectively in the level of the statewide disposal of organic waste.

To model the expected impact of SB 1383, we conservatively estimate that the fraction of biogenic carbon will gradually decrease to 50% by 2025. This is within the range of the biogenic carbon content

we have seen over time at other facilities that we operate that are in jurisdictions with robust food waste diversion programs.

California's law is much more ambitious than programs in other jurisdictions. As a result, the predicted decrease in biogenic carbon as a fraction of total carbon is actually much greater. By applying known fossil and biogenic carbon contents for specific waste components to the waste composition identified in CalRecycle's most recent statewide waste characterization report, we can predict the changes in waste carbon composition that result from organics diversion. The projected diversion of 15 M tons from the state's waste stream could drastically shift the balance toward fossil carbon wastes, resulting in biogenic carbon fraction as low as 37.2%.

Covered CO_2e

For the period from 2013 – 2016, the covered CO_2e emissions are taken from the verified GHG reports submitted to CARB in accordance with Title 17, CCR, §§ 95100-95163. The Long Beach facility reports its annual CO_2 emissions based on CO_2 continuous emissions monitors (CEMS) and 24-hour flow weighted quarterly stack samples collected for radiocarbon analysis to ascertain the split between fossil and biogenic CO_2. This quarterly sampling is required by U.S. EPA and CARB regulations. N_2O and CH_4 emissions are calculated on the basis of heat input and emissions factors derived from stack testing performed at the facility.

For 2017, the currently verified and reported covered emissions are 81,320 t CO_2e. However, subsequent to the successful verification of the emissions statement, we noticed an error in the calculation, which was reported to CARB on September 14, 2018. The corrected value is used in the model, and reporting in the Table above. Our 2017 report is currently undergoing re-verification.

For the period from 2018 – 2030, emissions are estimated based on the projections for fossil CO_2, CH_4, and N_2O emissions from the facility. Fossil CO_2 emissions are estimated based on the anticipated changes in the biogenic fraction of carbon in MSW as described above, the total CO_2 emissions estimated from MSW combustion, and CO_2 emissions from the combustion of natural gas as an auxiliary fuel.

Fossil CO_2 emissions are calculated using the following formula, which predicts total CO_2 emissions based on the steam flow, and the historic ratio between measured CO_2 emissions and steam generation.

$$CO_{2\ fossil,i} = (1 - f_{bio,i}) \times \left(\frac{CO_{2\ total,2013-2017}}{Steam_{MSW,2013-2017}}\right) \times Steam_{MSW,i} + NG_i \times \frac{EF_{NG}}{1000}$$

Where:

$CO_{2\ fossil,\ i}$	=	Estimated fossil CO_2 emissions in year *i*
$f_{bio,i}$	=	Annual average biogenic carbon fraction in MSW in year *i*, as a percentage of total carbon
$CO_{2\ total,\ 2013\ -\ 2017}$	=	Total CO_2 emissions measured using CEMS over the period from 2013 - 2017
$Steam_{MSW,\ 2013\text{-}2017}$	=	Total steam production from MSW, calculated as measured total facility steam generation minus the steam generated from natural gas (klbs)
$Steam_{MSW,i}$	=	Total steam production from MSW in year *i* (klbs)

NG_i = Natural gas consumption in year *i* (MMBtu)

EF_{NG} = CO_2 emission factor for natural gas from U.S. EPA 40 CFR 98 Table C-1 (53.06 kg CO_2 / MMBtu)

Total CO_2 emissions (biogenic + fossil CO_2) from MSW is well correlated with MSW throughput; however, we have used steam production in our calculations because it is consistent with the reporting methodologies of the U.S. EPA that have been adopted by CARB.

Nitrous oxide (N_2O) and methane (CH_4) emissions from MSW combustion are estimated using the following formula adopted from equation Eq. C-9b of 40 CFR 98 to include the average facility specific emission factors for N_2O and CH_4 as measured during facility stack testing over the period from 2013-2017. N_2O and CH_4 emissions from auxiliary fuel combustion are not considered for modeling purposes for simplicity.

$$GHG_{i,j} = Steam_i \times B \times EF_j \times GWP_j$$

Where:

$GHG_{i,j}$ = Estimated emissions of GHG j (i.e. CH_4 and N_2O) in year *i* (t CO_2e)

$Steam_i$ = Total facility steam generation in year *i* (klbs)

B = Ratio of the boiler's maximum rated heat input capacity to its design rated steam output (MMBtu / klb)

EF_j = Average emission factor for GHG *j* over the period from 2013 – 2017 (t GHG / MMBtu)

GWP_j = 100-year global warming potential for GHG *j*

Baseline Allocation

As described in §95891(f) of CARB's September 4, 2018 proposal, the baseline allocation is the historical arithmetic mean of the annual covered emissions for the 2015-2017 data years adjusted for the historical arithmetic mean of annual electricity sold or provided for off-site use that was generated from non-biogenic fuel.

Allowances Granted

As described in §95891(f) of CARB's September 4, 2018 proposal, the number of allowances granted is the baseline allocation multiplied by the cap adjustment factor.

Emissions Obligation

The emissions obligation for a given year is the difference between the estimated Covered CO_2e and the calculated number of allowances granted.

Estimated Cost

The expected cost for a given year is the emissions obligation multiplied by the modeled allowance price.

Options for resolving challenge posed to WTE by the Cap & Trade Program's uneven treatment of the Waste Management Sector

Option 1 – Allowances tied to consistent coverage of waste management sector

CARB would provide allowances equal to the covered emissions from the state's two WTE facilities. The allowances would act as the necessary transition assistance called for by the 2017 Board Resolution to avoid an undue economic loss to WTE as a covered entity relative to landfills. After the prohibition of including landfills in the cap & trade program expires in 2025, WTE and landfills would be subject to a consistent approach applied to the entire waste management sector.

This approach aligns with the conclusions reached by CARB in its 1st update to the Scope Plan. In order to provide a level playing field, landfills and WTE should be treated the same way in the cap and trade program.

This option could be implemented through a "but for" clause, as follows:

> BE IT FURTHER RESOLVED that the Board directs the Executive Officer to develop a methodology that exempts emissions from the management of Municipal Solid Waste that would not be included in the Cap-and-Trade program "but for" their combustion in a waste-to-energy facility until such time that the entire waste management sector is subject to the Cap-and-Trade program.

Option 2 – Allowances tied to Organics Diversion

As SB 1383 is implemented, organics will be diverted from the waste shed, potentially reducing the GHG benefits of WTE relative to landfilling currently recognized by both CARB and CalRecycle. As organics are diverted from the landfills, we proposed that WTE's exposure to the cap and trade program would increased based on the actual organics diversion achieved in practice, based on CalRecycle's regular statewide waste characterization studies. This approach was proposed to CARB in comments dated January 20, 2017, which we refined in subsequent discussions. The proposal was rejected, not on its merits, but because the regulation wasn't designed to accommodate the approach.

This approach best matches the science, and the effects of organics diversion on the benefits of WTE relative to landfills, but is the most complex from a regulatory perspective, and raised concerns from CARB on precedents and the statutory definition of "leakage".

Option 3 – Allowances allocated using revised energy allocation methodology

CARB's September 4th proposal would be revised, keeping CARB's preferred route of using the energy allocation methodology, while recognizing the challenging situation WTE facilities face competing against a higher GHG intensity option (i.e. landfills) that have no cap & trade compliance obligation. Specifically, we propose three modifications to the CARB proposal:

- Use the "high leakage risk" cap decline factor to reflect the high leakage risk faced by WTE facilities as long as this risk persists (i.e. landfills are excluded from the cap),
- Switch from historic covered emissions to the fuel combustion energy benchmark already used in the regulation to establish baseline emissions, and
- Remove the current 2023 allowance sunset provision in §95871(i).

This approach wouldn't be science-based and doesn't provide policy equity, but would use existing mechanisms within the cap and trade regulation to reduce the financial impact on WTE. All three changes described above are necessary to keep financial impacts manageable.