

**PERMIT APPLICATION REVIEW
GREENHOUSE GAS (GHG) EMISSION REDUCTION PLAN
Covered Source Permit (CSP) No. 0232-01-C
Application for Significant Permit Modification No. 0232-06**

Applicant: Maui Electric Company, Ltd. (MECO)
Facility: Kahului Generating Station
Located At: 200 Hobron Avenue, Kahului, Maui
UTM Coordinates: 2,313,143 Meters N and 763,673 Meters E

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Background

MECO has applied for a significant modification to CSP No. 0232-01-C for Kahului Generating Station to incorporate a facility-wide GHG emissions cap as defined in Hawaii Administrative Rules (HAR) §11-60.1-202. Site specific limits were previously established in the Hawaiian Electric Companies' GHG emission reduction plan that was updated on October 17, 2018, for modifying the permit. Affected facilities subject to GHG reductions are existing covered sources with maximum potential carbon dioxide equivalent (CO_{2e}) emissions (biogenic plus non-biogenic) equal to or greater than 100,000 tons per year. The GHG emission reductions are required by HAR Subchapter 11 pursuant to Hawaii Act 234, 2007 which directed the Department of Health Clean Air Branch (CAB) to develop rules for regulating GHGs. Partnering will be used as a measure to comply with the cap in accordance with HAR §11-60.1-204(d)(6)(A).

Kahului Generating Station is partnering with affected facilities of three (3) independent power producers (IPPs) and nine (9) affected plants owned and operated by the Hawaiian Electric Companies to allow flexibility in dispatching generating units for meeting requirements to cap GHGs. The three (3) IPPs are AES Hawaii, LLC, Hamakua Energy, LLC, and Kalaeloa Partners, L.P. Hawaiian Electric Companies' affected plants are from HECO, Hawaii Electric Light Company, Inc. (HELCO), and MECO. Flexibility for dispatching units is a concern in the event a facility has unplanned outages or there is reduced output from renewable generation such as solar (e.g., due to extended cloudy or rainy weather) or geothermal (e.g., deactivation of 38 megawatt (MW) geothermal plant due to volcanic activity on Hawaii Island). The table below lists affected facilities that have mutually agreed to partner.

Partnering Facilities^a			
IPP Plants			
Facility	Permit No.	Description	Island
AES Hawaii, LLC Cogeneration Plant	CSP No. 0087-02-C	203 MW Coal Fired Generation Plant Consisting of Two (2) CFB Boilers and Two Limestone Dryers. The Boilers are Each Equipped with Lime Injection, SNCR, and a Baghouse.	Oahu
Hamakua Energy, LLC Cogeneration Plant	CSP No. 0243-01-C	65 MW Cogeneration Facility Consisting of Two (2) 23 MW CTs with Water Injection and SCR, Two (2) HRSGs, 1,250 kW Black Start DEG, and 19 MW Steam Turbine.	Hawaii
Kalaeloa Partners, L.P. Cogeneration Plant	CSP No. 0214-01-C	Two (2) 86 MW CTs with Steam Injection, Two (2) HRSGs, and 51 MW Steam Turbine.	Oahu
HECO Plants			
Facility	Permit No.	Description	Island
Campbell Industrial Park Generating Station	CSP No. 0548-01-C	135 MW CT with Water Injection and Two (2) 2,250 kW Black Start DEGs.	Oahu
Honolulu Power Plant	CSP No. 0238-01-C	56 MW Boiler and 57 MW Boiler.	Oahu
Kahe Power Plant	CSP No. 0240-01-C	Six (6) Boilers (92 MW to 142 MW) and Two (2) 2.5 MW Black Start DEGs. A 142 MW Boiler is Equipped with Low NO _x Burners.	Oahu
Waiiau Power Plant	CSP No. 0239-01-C	Six (6) Boilers (49 MW to 92 MW), 50 MW CT and 52 MW CT.	Oahu
HELCO Plants			
Facility	Permit No.	Description	Island
Kanoelehua-Hill Power Plant	CSP No. 0234-01-C	14.1 MW Boiler, 23 MW Boiler, 11.6 MW CT, 2.0 MW DEG with Oxidation Catalyst, and Three (3) 2.75 MW DEGs with Oxidation Catalyst.	Hawaii
Keahole Power Plant	CSP No. 0007-01-C	Two (2) 20 MW CTs with Water Injection and SCR, Two (2) HRSGs, Three (3) 2.5 MW DEGs with FITR and Oxidation Catalyst, 500 kW Black Start DEG, 16 MW Steam Turbine, and 18 MW CT with Water Injection.	Hawaii
Puna Power Plant	CSP No. 0235-01-C	20 MW CT with water injection, 1,250 hp Black Start DEG, and 15.5 MW Boiler with Multicyclone Dust Collector.	Hawaii
MECO Plants			
Facility	Permit No.	Description	Island
Kahului Power Plant	CSP No. 0232-01-C	Two (2) 5.0 MW Boilers, One (1) 11.5 MW Boiler, and 12.5 MW Boiler.	Maui
Maalaea Power Plant	CSP No. 0067-01-C	Three (3) 2.5 MW DEGs with Oxidation Catalyst and Lube Oil Separator, Six (6) 5.6 MW DEGs with Oxidation Catalyst and Open Crankcase Filtration System, Two (2) 12.5 MW DEGs with Oxidation Catalyst and Open Crankcase Filtration System, Two (2) 12.5 MW DEGs with Oxidation Catalyst, Crankcase Filtration System, and FITR, Two (2) 20 MW CTs with Water Injection, Two (2) HRSGs, 18 MW Steam Turbine, Two (2) 20 MW CTs with Water Injection, HRSG, Two (2) 2.5 MW DEGs with Oxidation Catalyst, Lube Oil Separator, and FITR, and 600 kW Black Start DEG.	Maui
Palaau Power Plant	CSP No. 0031-04-C	Two (2) 1.25 MW DEGs with FITR and Oxidation Catalyst, Four (4) 1.0 MW DEGs with FITR and Oxidation Catalyst, Three (3) 2.2 MW DEGs with FITR, Oxidation Catalyst, and intake cooling, and 2.0 MW CT.	Molokai

^aCFB-circulating fluidized bed, CT- combustion turbine, DEG-diesel engine generator, FITR-fuel injection timing retard, HRSG-heat recovery steam generator, kW-kilowatt, MW-megawatt, SCR-selective catalytic reduction, and SNCR-selective non-catalytic reduction.

The GHG emission reduction plan for Kahului Generating Station was used to establish the following for the significant permit modification to CSP No. 0232-01-C to incorporate GHG emission caps:

1. A total combined cap on CO₂e emissions from affected facilities operated by HECO, HELCO, MECO, and three (3) IPPs not to exceed 7,023,058 short tons (6,371,392 metric tons) per calendar year;
2. Individual facility-wide limit on CO₂e emissions from the Kahului Generating Station not to exceed 154,633 short tons (140,281 metric tons) per calendar year that will not apply as long as the total combined cap among partnering facilities is met; and
3. An equation allocating GHG emissions in excess of the total combined cap for facilities violating the individual and total combined GHG emission caps.

CSP No. 0548-01-C for Campbell Industrial Park (CIP) Generating Station will be the main permit for specifying individual and total combined GHG emission caps for all partnering facilities that will be referenced in permits issued to the HECO, HELCO, and MECO affected facilities. This will enable the modification of a single permit if CO₂e emission caps need to be revised and reduce the burden of modifying all of Hawaiian Electric Companies' permits had the caps been incorporated separately into each facility's permit.

The IPPs will have separate permits specifying individual and total combined GHG caps. Any GHG emissions cap revision will require each IPP to submit a separate permit application for significant modification since caps are incorporated separately into each affected facility's permit.

An opportunity for public comment on the draft GHG emissions reduction plan and revised permit for Kahului Generating Station will be provided in accordance with HAR §11-60.1-205.

The Standard Industrial Classification Code (SICC) for this facility is 4911 – Electric Services.

Permitted Equipment Subject to GHG Emissions Cap

The following permitted equipment and associated appurtenances are subject to GHG emission reductions specified in Subchapter 11 of the HAR:

<u>Unit</u>	<u>Description</u>
K-1	5.0 MW (Nominal), 94 MMBtu/hr, Combustion Engineering Boiler, Serial No. 13413, with Electric Igniters;
K-2	5.0 MW (Nominal), 94 MMBtu/hr, Combustion Engineering Boiler, Serial No. 15345, with Total Combined 2.5 ft ³ /hr Capacity Gas Fired Igniters;
K-3	11.5 MW (Nominal), 172 MMBtu/hr, Combustion Engineering Boiler, Serial No. 17343, with Total Combined 2.5 ft ³ /hr Capacity Gas Fired Igniters; and
K-4	12.5 MW (Nominal), 181 MMBtu/hr, Babcock and Wilcox boiler, Serial No. PF13030, with 10 ft ³ /hr capacity gas fired igniters.

Air Pollution Controls

There are no air pollution controls for the boilers.

Applicable Requirements

State Requirements:

Hawaii Administrative Rules

Title 11, Chapter 60.1	Air Pollution Control
Subchapter 1	General Requirements
HAR 11-60.1-1	Definitions
Subchapter 2	General Prohibitions
HAR 11-60.1-31	Applicability
HAR 11-60.1-32	Visible Emissions
HAR 11-60.1-38	Sulfur Oxides from Fuel Combustion
HAR 11-60.1-39	Storage of Volatile Organic Compounds
Subchapter 5	Covered Sources
HAR 11-60.1-81	Definitions
HAR 11-60.1-104	Applications for Significant Modification
Subchapter 6	Fees for Covered Sources, Noncovered Sources, and Agricultural Burning
HAR 11-60.1-111	Definitions
HAR 11-60.1-112	General Fee Provisions for Covered Sources
HAR 11-60.1-113	Application Fees for Covered Sources
HAR 11-60.1-114	Annual Fees for Covered Sources
HAR 11-60.1-115	Basis of Annual Fees for Covered Sources
Subchapter 9	Hazardous Air Pollution Sources
HAR 11-60.1-174	Maximum Achievable Control Technology (MACT) Emission Standards
Subchapter 11	Greenhouse Gas Emissions

HAR Chapter 11-60.1, Subchapter 11, §11-60.1-204 GHG Emission Reduction Plan

1. Applicability to Subchapter 11 Pursuant to HAR §11-60.1-204(a)

HAR §11-60.1-204 is applicable to the Kahului Generating Station since this facility is a permitted covered source with potential CO₂e emissions (biogenic plus non-biogenic) equal to or above 100,000 tons per year.

2. Baseline Emission Rate and Cap

Pursuant to HAR §11-60.1-204(b) and (c), MECO is proposing to establish an annual facility-wide GHG emissions cap for Kahului Generating Station as shown in the table on Page 6 of this permit application review. As provisioned in HAR §11-60.1-204(d)(6)(A), MECO is further proposing to combine the Kahului Generating Station's GHG emissions cap with other GHG emission caps established for partnering facilities to leverage emission reductions. The combined emissions cap was determined by multiplying the total combined baseline GHG emissions (less any biogenic carbon dioxide (CO₂) emissions) for the partnering facilities by 0.84 (1.0-0.16).

On May 3, 2018, Kilauea Volcano on Hawaii's Big Island erupted from new fissures sending lava flowing over streets and neighborhoods which continued and caused the shutdown of the 38 MW Puna Geothermal Venture (PGV) plant. The loss of this renewable energy source resulted in the need for HELCO to increase dispatch of fossil fuel units for supplying power on the island.

HAR §11-60.1-204(h)(4) allows the facility-wide GHG emissions cap to be re-evaluated and revised in the event a renewable energy producer ceases operations or fails to meet contractual obligations. HAR §11-60.1-204(h)(5) also allows the facility-wide GHG emissions cap to be re-evaluated and revised when there are unforeseen events beyond the control of the permittee, resulting in long-term or temporary emissions changes, whereby the maintenance of the GHG emissions cap would be detrimental to the health and welfare of the public. Although these provisions allow the GHG emissions cap to be re-adjusted, the Hawaiian Electric Companies decided not to make an adjustment to the baseline emissions level for re-establishing the GHG emissions cap due to the PGV shutdown.

Partnering facilities used 2010 as the baseline year to establish the cap, except for the Kalaeloa Cogeneration Plant which used 2009 as the baseline year because 2010 was deemed unrepresentative due to an overhaul of the facility's steam turbine generator.

Each facility may exceed its individual cap as long as the total combined sixteen percent (16%) GHG reduction from the baseline year is met.

The combined emissions cap will be made part of the permit for each partnering facility pursuant to HAR §11-60.1-204(d)(6)(C) and must be achieved by 2020 and maintained thereafter. Pursuant to HAR §11-60.1-202, a “facility-wide GHG emissions cap” means a permit emissions limitation, applicable to a covered source, limiting the entire source’s annual non-biogenic greenhouse gas, and biogenic nitrous oxide and methane emissions. In accordance with HAR §11-60.1-202, a facility-wide GHG emissions cap may also be defined in multiple covered source permits to identify partnering facilities with an approved combined GHG emissions cap as described in HAR §11-60.1-204(d)(6)(A). The total combined GHG baseline and GHG emission caps proposed for the partnering facilities are as follows:

Actual GHG Baseline and Proposed CO₂e Facility Emission Caps

Plant	CSP Permit No.	Emissions (short tons)				% Reduction
		Baseline CO ₂ e	Baseline Biogenic CO ₂	Baseline CO ₂ e Less Biogenic CO ₂	CO ₂ e Cap	
		(a)	(b)	(c)=(a)-(b)	Proposed	
AES	0087-02-C	1,681,605	0	1,681,605	1,691,605	-0.6%
Hamakua	0243-01-C	182,975	0	182,975	153,699	16.0%
Kalaeloa	0214-01-C	1,094,813	0	1,094,813	1,094,813	0%
HECO CIP	0548-01-C	19,179	4,233	14,946	53,740	-259.6%
HECO Honolulu ^a	0238-01-C	133,609	0	133,609	0	100%
HECO Kahe	0240-01-C	2,776,073	0	2,776,073	2,133,752	23.1%
HECO Waiau	0239-01-C	1,074,359	0	1,074,359	808,286	24.8%
HELCO Hill	0234-01-C	222,784	0	222,784	172,456	22.6%
HELCO Keahole	0007-01-C	191,387	0	191,387	242,208	-26.6%
HELCO Puna	0235-01-C	99,691	0	99,691	31,747	68.2%
HELCO Shipman	0236-01-C	10,192	0	10,192	0	100% Plant Closed
MECO Kahului	0232-02-C	230,839	0	230,839	154,633	33.0%
MECO Maalaea	0067-01-C	620,654	1,142	619,512	459,864	25.8%
MECO Palaau	0031-04-C	28,236	0	28,236	26,454	6.3%
Combined		8,366,396	5,375	8,361,021 ^b	7,023,257 ^b	16.0%

^aThe HECO Honolulu Generating Station is currently deactivated (not operating but could restart if necessary).

^bTotal combined partnering facility proposed GHG baseline and GHG emission cap are 8,361,022 and 7,023,258 short tons, respectively. Totals may not sum due to independent rounding.

For information, the table below titled “Actual GHG Baseline and Notional 16% CO₂e Facility Emission Caps” shows the total combined baseline and GHG emissions cap if a sixteen percent (16%) reduction had been applied to each partnering facility separately. The total combined emissions cap in the table below is the same as that proposed for the partnering facilities that have combined their facility-wide emission caps to leverage emission reductions in meeting the combined GHG emission caps in accordance with HAR Subparagraph 11-60.1-204 (d)(6)(A). Please refer to the table titled “Actual GHG Baseline and Proposed CO₂e Facility Emission Caps” on Page 6 of this permit application review. The total combined CO₂e cap in the table below for the notional cap is 7,023,258 short tons per year. The total combined CO₂e emission cap proposed, as shown in the table on Page 6 of this review, is 7,023,258 short tons per year.

Actual GHG Baseline and Notional 16% CO₂e Facility Emission Caps

Plant	CSP Permit No.	Emissions (short tons)				% Reduction
		Baseline CO ₂ e	Baseline Biogenic CO ₂	Baseline CO ₂ e Less Biogenic CO ₂	CO ₂ e Cap	
		(a)	(b)	(c)=(a)-(b)	Notional	
AES	0087-02-C	1,681,605	0	1,681,605	1,412,548	16.0%
Hamakua	0243-01-C	182,975	0	182,975	153,699	16.0%
Kalaeloa	0214-01-C	1,094,813	0	1,094,813	919,643	16.0%
HECO CIP	0548-01-C	19,179	4,233	14,946	12,555	16.0%
HECO Honolulu ^a	0238-01-C	133,609	0	133,609	112,232	16.0%
HECO Kahe	0240-01-C	2,776,073	0	2,776,073	2,331,901	16.0%
HECO Waiau	0239-01-C	1,074,360	0	1,074,360	902,462	16.0%
HELCO Hill	0234-01-C	222,784	0	222,784	187,139	16.0%
HELCO Keahole	0007-01-C	191,387	0	191,387	160,765	16.0%
HELCO Puna	0235-01-C	99,691	0	99,691	83,740	16.0%
HELCO Shipman	0236-01-C	10,192	0	10,192	8,561	16.0%
MECO Kahului	0232-02-C	230,839	0	230,839	193,905	16.0%
MECO Maalaea	0067-01-C	620,654	1,142	619,512	520,390	16.0%
MECO Palaau	0031-04-C	28,236	0	28,236	23,718	16.0%
Combined		8,366,396	5,375	8,361,022	7,023,258	16.0%

^aThe HECO Honolulu Generating Station is currently deactivated (not operating but could restart if necessary).

The CAB used a Tier 1 methodology in 40 Code of Federal Regulations (CFR) Part 98, §98.33, to validate the proposed individual and total combined GHG emission caps. Enclosure 1 provides a bar chart of fuel consumption for Kahului Generating station. Enclosure 2 provides data on fuel consumption and spreadsheet calculations of GHG emissions. Enclosure 3 shows curves in short tons and metric tons of GHGs emitted from Kahului Generating Station between years 2005 and 2016. Emissions for these curves are provided in Enclosure 2. Enclosure 4 shows curves in short tons and metric tons of the total combined GHGs emitted by partnering facilities between years 2005 and 2016.

Calculations in Enclosure 2 show that the 2010 baseline GHG emissions proposed for Kahului Generating Station are about 0.036% higher than those estimated by the CAB. The CAB used default heating values for estimating GHGs whereas MECO used the Tier 2 methodology prescribed by Environmental Protection Agency (EPA) under 40 CFR Part 98 with actual heating values from fuel sampling. Since actual heating values were used, MECO's estimates are considered to be more representative of actual emissions.

3. Proposed Control Strategy

MECO is forecasting a sixteen percent (16%) combined facility-wide reduction in GHG emissions based on implementation of various strategies that will allow a portion of the increased demand for electricity to be met from non-fossil fueled resources. As new renewable energy projects come online, the operation of existing fossil-fuel units can be reduced. As indicated by HECO at a meeting that took place on May 2, 201, an E3 Plan in the Power Supply Improvement Plan (PSIP) will be used as the preferred plan to achieve one hundred percent (100%) renewable energy. According to Hawaiian Electric Companies' December 2016 PSIP Update Report, new alternative generating resources from the E3 Plan include:

- a. A 24 MW Na Pua Makani Wind Project, 109.6 MW Replacement Waiver Projects, 15 MW Grid-Scale photovoltaic (PV)-Community Based Renewable Energy (CBRE), 70 MW Contingency Battery, and 20 MW West Loch PV project by the end of 2019, as forecasted for HECO;
- b. 5.74 MW from PV Projects, Install 1 MW Grid-Scale PV-CBRE, Install 2 MW Wind-CBRE, and 9 MW Contingency Battery by the end of 2019 as forecasted for MECO; and
- c. Install 1 MW Grid-Scale PV-CBRE and 2 MW Wind-CBRE by the end of 2019, as forecasted by HELCO.

Federal Requirements:

40 CFR Part 98, Subpart A, Mandatory Greenhouse Gas Reporting is applicable to this facility because actual CO₂e emissions from stationary fuel combustion units at Kahului Generating Station are greater than 25,000 metric tons per year.

40 CFR Part 98, Subpart C, General Stationary Fuel Combustion Sources is applicable to this facility because the boilers are stationary fuel combustion sources as defined in 98.30 and Kahului Generating Station meets the applicability requirements of 40 CFR §98.2(a)(2).

40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard, Subpart JJJJJJ, National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for Area Sources: Industrial, Commercial, and Institutional Boilers Area Sources apply to Boilers K-1, K-2, K-3, and K-4. As indicated on Page 3-1 of MECO's Energy Assessment of February 2014, Boilers K-1 through K-4 are equipped with oxygen trim systems that continuously measure the amount of free oxygen in the boiler combustion air, and then adjusts the amount of air into the combustion chamber for optimum performance. Since the units use oxygen trim systems, the boilers are subject to five (5) year tune-ups instead of biennial tune-ups. Subpart JJJJJJ standards will be incorporated into the permit under permit renewal application No. 0232-05.

Non-Applicable Requirements

State Requirements:

Hawaii Administrative Rules (HAR)

Title 11, Chapter 60.1	Air Pollution Control
Subchapter 3	Open Burning
Subchapter 4	Noncovered Sources
Subchapter 7	Prevention of Significant Deterioration Review
Subchapter 8	Standards of Performance for Stationary Sources
Subchapter 9	Hazardous Air Pollution Sources
HAR 11-60.1-180	National Emission Standards for Hazardous Air Pollutants
Subchapter 11	
HAR 11-60.1-204(d)(2)	GHG Control Assessment
HAR 11-60.1-204(d)(3)	Available Control Measures
HAR 11-60.1-204(d)(4)	The Technically Feasible Measures
HAR 11-60.1-204(d)(5)	Control Effectiveness and Cost Evaluation

GHG Control Assessment

MECO has determined that a total combined GHG emissions reduction of sixteen percent (16%) is achievable by 2020 using the total combined baseline emissions estimated for the partnering facilities. Pursuant to HAR §11-60.1-202, a facility-wide GHG emissions cap may be defined in multiple covered source permits to identify partnering facilities with an approved combined GHG emissions cap as described in HAR §11-60.1-204(d)(6)(A). As specified in HAR §11-60.1-204(d)(2), if the required GHG emissions cap requiring a sixteen percent (16%) emissions reduction from baseline year is deemed unattainable, the permittee shall conduct a GHG control assessment. Since the facility-wide GHG emissions cap (total combined GHG cap for partnering facilities) is sixteen percent (16%) below the total combined baseline GHG emissions level, MECO is not required to perform a GHG control assessment as specified in HAR §11-60.1-204(d)(2) for determining whether the required GHG emissions cap is attainable.

Although a GHG control assessment is not required, the GHG emission reduction plan for the Hawaiian Electric Companies provided an evaluation of options for controlling GHG emissions. The following table summarizes the GHG control assessment provided on Pages 7 through 11 of the GHG emission reduction plan for the Hawaiian Electric Companies' affected facilities:

GHG Control Option	Feasibility and Benefit
Carbon Capture and Storage (CCS)	Not economically viable. Please refer to Attachment B of the GHG emission reduction plan.
Fuel Switching or Co-Fired Fuels (Natural Gas)	Not feasible – Hawaiian Electric Companies explored importing liquefied natural gas. However, the Hawaii Public Utilities Commission (PUC) rejected that option as part of its decision to deny the merger of the Hawaiian Electric Companies with NextEra. Please refer to Attachment C of the GHG emission reduction plan.
Fuel Switching or Co-Fired Fuels (Biofuels)	Not feasible on a large scale – Hawaiian Electric Companies are currently permitted and are burning limited quantities of biodiesel as indicated in Attachment D of GHG emission reduction plan.
Energy Efficiency Upgrades and Combustion Improvements	No economically viable improvements were identified that would contribute significantly towards reducing GHG emissions. Please refer to Attachment E of the GHG emission reduction plan.
Restrictive Operations or Equipment Retirement Restrictive Operations or Equipment Retirement (continued)	<p>If one of the generating facilities in the Hawaiian Electric Companies' electrical grids restricts operation to limit its GHG emissions, other facilities must operate more to meet customer demand. The Partnership concept provides flexibility for lower emitting facilities to operate more to lower overall emissions and Hawaiian Electric intends to do this as much as possible within the system and economic constraints.</p> <p>As new renewable energy projects come online, the operation of existing fossil-fueled units can be reduced or these units can be retired. The Hawaiian Electric Companies' have deactivated or retired the following facilities:</p> <ul style="list-style-type: none"> • Shipman Generating Station closed on December 31, 2015. • Honolulu Generating Station was deactivated January 2014.
Renewable Energy Projects (Wind and Solar) and Battery Energy Storage Systems.	Please refer to control strategies in the December 2016 PSIP for the Hawaiian Electric companies.

Federal Requirements:

40 CFR Part 52.21 - Prevention of Significant Deterioration of Air Quality
40 CFR Part 60 – Standards of Performance for New Stationary Sources (NSPS)
40 CFR Part 61 – NESHAPS

Best Available Control Technology (BACT)

A BACT analysis is required for new or modified sources that have the potential to emit or increase emissions above significant amounts as defined in HAR 11-60.1-1. Since this is not a new source, nor are any modifications proposed that have the potential to cause a significant increase in air emissions, a BACT analysis is not required.

Prevention of Significant Deterioration (PSD)

The boilers are grandfathered from the PSD regulations because the units were constructed prior to January 6, 1975.

PSD review applies to new major stationary sources and major modifications to these types of sources. The facility is not a new major stationary source, nor does this application propose any major modifications to a major stationary source as defined in 40 CFR Part 52.21. A major modification is defined as a project at an existing major source that will result in a significant and a significant net emissions increase above specified emission thresholds for pollutants subject to regulation.

Major Source/ Synthetic Minor Applicability

The facility's classification as a major source remains unchanged from the previous permit application review.

A synthetic minor source is a facility with operational limitations in order to keep potential emissions lower than major source levels (\geq one hundred (100) tons per year of criteria pollutants or \geq ten (10) tons per year of individual hazardous air pollutants (HAP) or twenty-five (25) tons per year of a combination of HAPs). This facility is a major source and therefore is not a synthetic minor source.

Compliance Assurance Monitoring (CAM), 40 CFR Part 64

The purpose of CAM is to provide reasonable assurance that compliance is being achieved with large emission units that rely on air pollution control device equipment to meet an emissions limit or standard. Pursuant to 40 CFR Part 64, for CAM to be applicable, the emissions unit must:

- (1) Be located at a major source;
- (2) Be subject to an emissions limit or standard;
- (3) Use a control device to achieve compliance;
- (4) Have potential pre-control emissions that are greater than the major source level; and
- (5) Not otherwise be exempt from CAM.

Although the boilers are located at a major source, the units do not use a control device to achieve compliance with an emissions limit or standard. Therefore, CAM does not apply to this facility.

Air Emissions Reporting Requirements (AERR)

40 CFR Part 51, Subpart A – AERR, is based on the emissions of criteria air pollutants from point sources (as defined in 40 CFR Part 51, Subpart A), which exceed the AERR thresholds as shown in the following table:

Pollutant	Potential Emissions (TPY)	AERR Triggering Levels ¹ (TPY)		Pollutant	In-house Total Facility Triggering Levels ¹ (TPY)
		1 Year Cycle (Type A)	3 Year Cycle (Type B)		
NO _x	1,247	≥2,500	100	NO _x	≥25
SO ₂	5,219	≥2,500	100	SO ₂	≥25
CO	130	≥2,500	1,000	CO	≥250
PM ₁₀ /PM _{2.5}	1,110	≥250/250	100	PM ₁₀ /PM _{2.5}	≥25/25
VOC	10.8	≥250	100	VOC	≥25
Pb ²	0.024	---	≥0.5 (actual)	Pb	≥5
HAPs	3.308	---	---	HAPs	≥5

¹Criteria pollutants include nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), particulate matter less than ten (10) microns in diameter (PM₁₀), particulate matter less than 2.5 microns in diameter (PM_{2.5}), ozone (formed from precursor volatile organic compounds (VOCs)), and lead (Pb).

²Based on actual 2016 emissions reported in the State and Local Emissions Inventory System (SLEIS).

This facility exceeds Type A and B triggering levels. Therefore, AERR requirements are applicable.

The CAB also requests annual emissions reporting from those facilities that have facility-wide emissions of a single air pollutant exceeding in-house triggering levels or is a covered source. Annual emissions reporting for the facility is required for in-house recordkeeping purposes since this is a covered source.

Insignificant Activities

Insignificant activities identified in the previous permit application review are as follows:

- a. A 400 kW Waukesha black start diesel engine generator (DEG) is considered an insignificant activity pursuant to HAR §11-60.1-82(f)(7). As indicated by the applicant, the diesel engine does not supply power to the grid and only operates during emergencies to start the boilers when there is a power outage. Also, this DEG operates on average about fifty-six (56) hours per year.
- b. Three (3) 27,976 barrel fuel oil No. 6 storage tanks are considered insignificant activities pursuant to HAR §11-60.1-82(f)(7) due to the low vapor pressure of the fuel oil No. 6.
- c. A 35,300 gallon used lube oil storage tank (Tank No. 5) is an insignificant activity pursuant to HAR §11-60.1-82(f)(1).
- d. A 9,492 gallon fuel oil No. 2 storage tank (Tank No. 6) is an insignificant activity pursuant to HAR §11-60.1-82(f)(1).
- e. A 460 gallon diesel tank for the black start DEG is an insignificant activity pursuant to HAR §11-60.1-82(f)(1).
- f. A 500 gallon propane tank for boiler igniter fuel is an insignificant activity pursuant to HAR §11-60.1-82(f)(1).
- g. 250 gallon tote tank(s) for specification used oil qualify as an insignificant activity pursuant to HAR §11-60.1-82(f)(1).
- h. Fuel burning equipment less than one (1) MMBtu/hr, other than smoke house generators and gasoline fired industrial equipment are exempt in accordance with HAR §11-60.1-82(f)(2).
- i. Paint spray booths that emit less than two (2) tons per year on any regulated air pollutant are exempt pursuant to HAR §11-60.1-82(f)(6).

- j. Other activities that emit less than 500 lb/yr of HAP, except lead; 300 pound per year of lead; 3,500 tons per year of CO₂e; two (2) tons per year of each regulated pollutant not already identified above pursuant; and which are determined on a case by case basis to be insignificant activities are exempt pursuant to HAR §11-60.1-82(f)(7).

Alternate Operating Scenarios

Alternate operating scenarios for equipment will be updated, as applicable, under permit renewal application No. 0232-05.

Project Emissions

Emissions of NO_x, CO, VOCs, particulate matter (PM), PM₁₀, PM_{2.5}, SO₂, sulfuric acid (H₂SO₄), and HAPs were evaluated. Emissions were based on the maximum capacity of the equipment and 8,760 hours per year of operation. The H₂SO₄ emission rate was based on information from source testing that indicated H₂SO₄ is proportional to 13.83% of the SO₂ emission rate. It was assumed that forty-five percent (45%) of the total PM was PM_{2.5} and 79% of the total PM was PM₁₀ based on AP-42, Appendix B.2, Table B.2-2 (Page B.2-12) for boilers firing a mixture of fuel including petroleum. A total combined 300,000 gallon per year fuel limit was assumed to calculate HAP emissions for firing the boilers on specification used oil. Emissions are as follows:

5 MW (94 MMBtu/hr) Boiler Emissions (Unit K-1)			
Pollutant	Boiler Emissions		Boiler Emissions (TPY)
	lb/hr	g/s	8,760 hr/yr operation
SO ₂	207.04	26.14	907
H ₂ SO ₄	28.62	3.61	125
NO _x	54.22	6.85	237
CO	6.23	0.79	27.3
VOC	0.35	0.04	1.5
PM	36.17	4.57	158
PM ₁₀	28.57	3.61	125
PM _{2.5}	16.28	2.06	71.3

5 MW (94 MMBtu/hr) Boiler Emissions (Unit K-2)			
Pollutant	Boiler Emissions		Boiler Emissions (TPY)
	lb/hr	g/s	8,760 hr/yr operation
SO ₂	207.04	26.14	907
H ₂ SO ₄	28.62	3.61	125
NO _x	54.22	6.85	237
CO	6.23	0.79	27.3
VOC	0.35	0.04	1.5
PM	36.17	4.57	158
PM ₁₀	28.57	3.61	125
PM _{2.5}	16.28	2.06	71.3

11.5 MW (172 MMBtu/hr) Boiler Emissions (Unit K-3)			
Pollutant	Boiler Emissions		Boiler Emissions (TPY)
	lb/hr	g/s	8,760 hr/yr operation
SO ₂	378.83	47.83	1,659
H ₂ SO ₄	52.38	6.61	229
NO _x	106.21	13.41	465
CO	11.39	1.44	49.9
VOC	0.87	0.11	3.8
PM	138.08	17.43	605
PM ₁₀	109.08	13.77	478
PM _{2.5}	62.14	7.85	272

12.5 MW (181 MMBtu/hr) Boiler Emissions (Unit K-4)			
Pollutant	Boiler Emissions		Boiler Emissions (TPY)
	lb/hr	g/s	8,760 hr/yr operation
SO ₂	398.66	50.34	1,746
H ₂ SO ₄	55.12	6.96	241
NO _x	121.42	15.33	532
CO	11.99	1.51	52.5
VOC	0.92	0.12	4.0
PM	110.48	13.95	484
PM ₁₀	87.28	11.02	382
PM _{2.5}	49.72	6.28	218

HAP Emissions						
HAP	Emissions (TPY)					Total
	K-1	K-2	K-3	K-4	Spec Oil ^a	
Acetaldehyde	8.975E-04	8.975E-03	1.642E-03	1.728E-03		0.132
Benzene	1.260E-03	1.260E-03	2.305E-03	2.426E-03		0.007
Ethylbenzene						
Formaldehyde	1.705E-03	1.705E-03	3.119E-03	3.282E-03		0.010
HCL					4.950E-03	4.950E-03
Naphthalene						
Phosphorus	1.095E-03	1.095E-03	2.004E-03	2.109E-03		0.006
Toluene	2.528E-03	2.528E-03	4.626E-03	4.868E-03		0.015
Antimony Compounds	1.956E-03	1.956E-03	3.578E-03	3.766E-03		0.011
Arsenic Compounds	1.392E-03	1.392E-03	2.546E-03	2.680E-03	1.650E-02	0.008
Beryllium Compounds	5.229E-05	5.229E-05	9.568E-05	1.007E-04		3.010E-04
Cadmium Compounds	9.305E-04	9.305E-04	1.703E-03	1.792E-03	1.395E-03	0.007
Chromium Compounds	1.676E-04	1.676E-04	3.066E-04	3.227E-04	3.000E-03	0.004
Cobalt Compounds	8.893E-03	8.893E-03	1.627E-02	1.712E-02	3.150E-05	0.051
Lead Compounds	2.174E-03	2.174E-03	3.978E-03	4.186E-03		0.008
Manganese Compounds	9.634E-03	9.634E-03	1.763E-03	1.855E-02	1.020E-02	0.049
Mercury Compounds	2.050E-03	2.050E-03	3.752E-03	3.948E-03		0.012
Nickel Compounds	5.352E-01	5.352E-01	9.794E-01	1.031E+00		3.081
Polycyclic Organic Matter	1.482E-03	1.482E-03	2.712E-03	2.854E-03	1.650E-03	0.007
Selenium Compounds	7.411E-04	7.411E-04	1.356E-03	1.427E-03		0.004
Total	0.572	0.572	1.031	1.102	0.031	3.308

^aAccounts for a 300,000 gallon per year specification used oil limit.

^bTotals may not sum due to independent rounding.

Maximum potential GHG emissions, shown in Enclosure 5, are listed as follows:

Greenhouse Gas Emissions^{a,b}			
GHG	GWP	GHG Mass-Based Emissions (TPY)	CO ₂ e Based Emissions (TPY)
Carbon Dioxide (CO ₂)	1	392,321	392,321
Methane (CH ₄)	25	15.672	392
Nitrous Oxide (N ₂ O)	298	3.136	935
Total Emissions→			393,648

^aEmissions are provided in Enclosure 6 on Page 19 of this review

^bTotals may not sum due to independent rounding.

MECO is proposing an individual CO₂e emissions cap of 154,633 short tons (140,281 metric tons) per calendar year for Kahului Generating Station. This individual cap is an approximate 33.0% decrease in GHG emissions from the baseline GHG level of 230,839 short tons (209,414 metric tons). While this individual limit may be exceeded, the proposed total combined GHG emissions limit is expected to reduce overall GHG emissions among partnering facilities by sixteen percent (16%) from the total combined baseline emissions by the start of 2020.

Ambient Air Quality Assessment

An ambient air quality impact assessment was not performed since there are no increase in emissions for the modification to incorporate GHG emission caps.

Significant Permit Conditions

1. Kahului Generating Station shall not emit or cause to be emitted CO₂e emissions in excess of 140,281 metric tons (154,633 short tons) per calendar year except as specified in, Attachment II – GHG Special Condition No. C.1.c.iv. This CO₂e emissions limit will be specified in Attachment II – GHG, Special Condition No. C.1.a of CSP No. 0548-01-C for CIP Generating Station and referenced in Attachment II – GHG, Special Condition No. C.1.a of CSP No. 0232-01-C for Kahului Generating Station.

Reason: Required by HAR §11-60.1-204(d)(6)(A).

2. All partnering facilities shall not emit or cause to be emitted total combined CO₂e emissions in excess of 6,371,392 metric tons (7,023,258 short tons) per calendar year. This total combined CO₂e emissions limit will be specified in Attachment II – GHG Special Condition No. C.1.b of CSP No. 0548-01-C for CIP Generating Station and referenced in Attachment II – GHG, Special Condition No. C.1.b of CSP No. 0232-01-C for Kahului Generating Station.

Reason: Required by HAR §11-60.1-204(d)(6)(A).

3. For purposes of the CO₂e emission limits in Attachment II – GHG Special Condition Nos. C.1.a and C.1.lb for Kahului Generating Station:
 - a. The CO₂e emissions shall have the same meaning as that specified in HAR §11-60.1-1;
 - b. In accordance with HAR §11-60.1-204(d)(6)(B), biogenic carbon dioxide (CO₂) emissions are not included when determining compliance with the emissions limits;

- c. The permittee shall be in compliance with the emissions limits by the end of 2019 and each calendar year thereafter;
- d. The permittee may exceed the emissions cap specified in Attachment II – GHG, Special Condition No. C.1.a, if the GHG emissions limit specified in Attachment II – GHG Special Condition No. C.1.b. is met; and
- e. At no time shall the permittee exceed Attachment II – GHG Special Condition Nos. C.1.a and C.1.b simultaneously over a calendar year. For incidences when Attachment II – GHG Special Condition Nos. C.1.a and C.1.b of this permit are exceeded simultaneously, emissions in excess of the total combined cap shall be allocated according to the following equation for compliance purposes:

$$X = XG \frac{(A - C)}{\sum_{A_i > C_i} (A_i - C_i)}$$

Where:

- X = Adjusted portion in metric tons or short tons of GHG emissions that are in excess of total combined cap specified in Attachment II – GHG, Special Condition No. C.1.b. The equation applies to all affected facilities that do not meet the individual and total combined GHG emission caps specified in Attachment II – GHG, Special Condition Nos. C.1.a and C.1.b, respectively.
- XG = Total combined actual GHG emissions from affected facilities minus total combined GHG emissions cap. Total combined emissions cap cannot be less than sixteen percent (16%) total combined baseline emission.
- A = Actual GHG emissions from the affected facility.
- C = GHG emissions cap for the affected facility.
- $\sum_{A_i > C_i} (A_i - C_i)$ = The sum of the difference between the actual emissions and cap emissions for all facilities that did not achieve the individual facility-wide GHG emissions cap.

Reason: Required by HAR §11-60.1-3, §11-60.1-5, §11-60.1-90, §11-60.1-204.

- 4. By **August 29, 2019**, and **within 60 days** following the end of each semi-annual calendar period (January 1 – June 30 and July 1 – December 31) thereafter, Kahului Generating Station shall submit written reports to the Department for monitoring CO₂e emissions to verify compliance with:
 - a. The individual GHG emissions cap and allocating excess emissions pursuant to Attachment II - GHG Special Condition No. C.1.c.v; and
 - b. The total combined GHG emissions limit and allocating excess emissions pursuant to Attachment II – GHG Special Condition No. C.1.c.v.

Reason: Required by HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90.

Conclusion and Recommendation

MECO submitted an application for significant permit modification to incorporate GHG emission caps and significant permit conditions to implement GHG reduction measures established in the GHG emissions reduction plan.

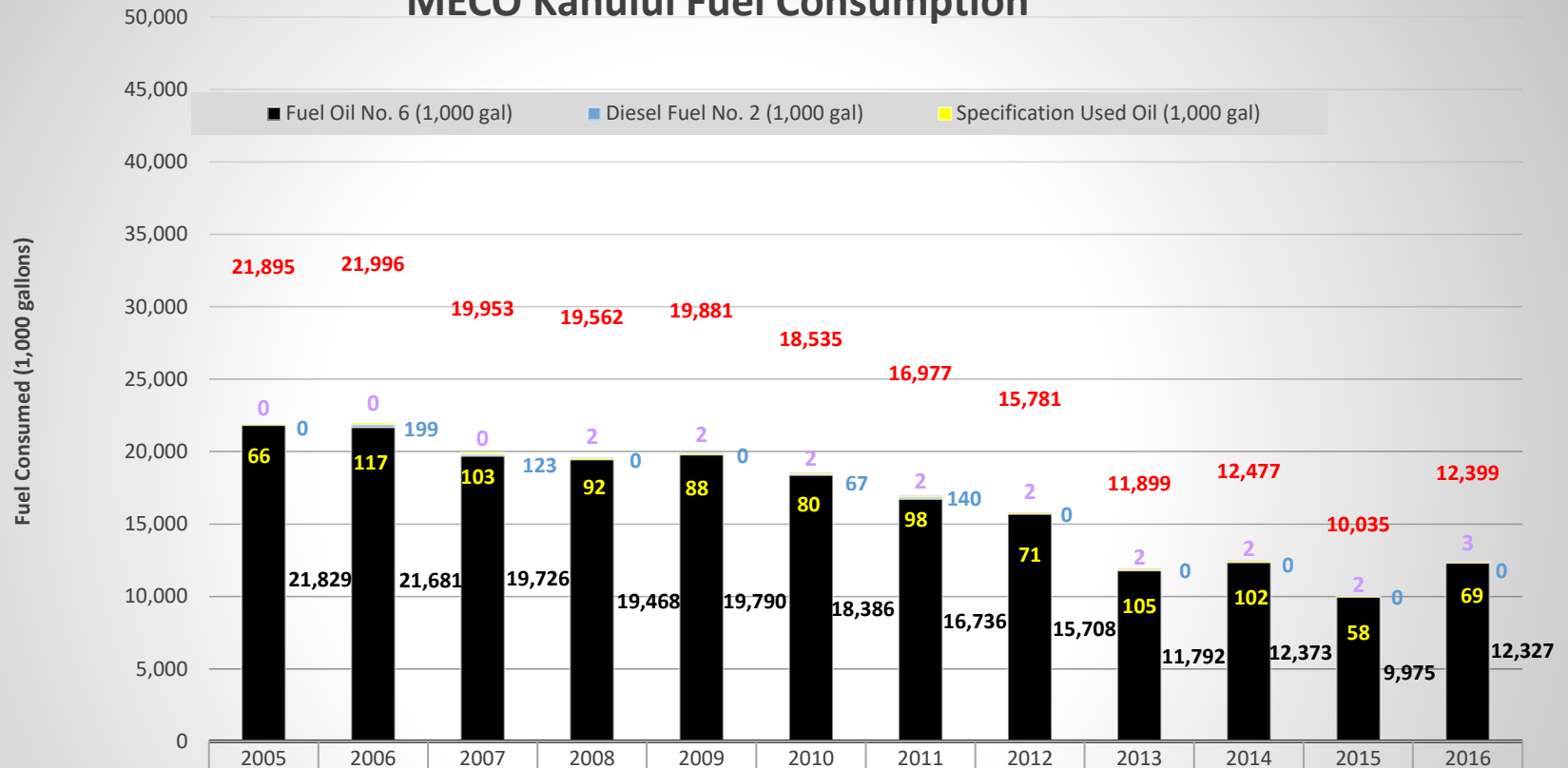
The HECO, HELCO, MECO, and IPP affected facilities are proposing a sixteen percent (16%) GHG emissions reduction from the total combined baseline GHG emissions; and to use a total combined GHG emission cap by partnering pursuant to HAR §11-60.1-204(d)(6)(A).

MECO's GHG emissions reduction plan for Kahului Generating Station was reviewed and determined to be in compliance with HAR §11-60.1-204. The proposed baseline emission rate and emission caps were evaluated using past fuel consumption data and determined to be reasonably representative as documented in Enclosures 1 through 3. Further review based on a Tier 1 calculation methodology in Enclosure 4 shows total combined GHG emissions from partnering facilities following calendar year 2005 have steadily declined to slightly more than sixteen percent (16%) below a 2010 baseline emission level as of the end of calendar year 2016. As specified in HAR §11-60.1-204(g), once a facility-wide GHG emission cap is established and incorporated into the CSP, the GHG emission reduction plan shall become part of the permit application process for renewals and any required modifications.

Recommend issuance of the significant modification to the CSP subject to thirty-day (30-day) public review and comment period in accordance with HAR §11-60.1-205, forty-five day (45-day) EPA review period, and incorporation of the significant permit conditions.

Mike Madsen
February 26, 2019

MECO Kahului Fuel Consumption



Total	21,895	21,996	19,953	19,562	19,881	18,535	16,977	15,781	11,899	12,477	10,035	12,399
Propane (1,000 gal)	0	0	0	2	2	2	2	2	2	2	2	3
Specification Used Oil (1,000 gal)	66	117	103	92	88	80	98	71	105	102	58	69
Diesel Fuel No. 2 (1,000 gal)	0	199	123	0	0	67	140	0	0	0	0	0
Fuel Oil No. 6 (1,000 gal)	21,829	21,681	19,726	19,468	19,790	18,386	16,736	15,708	11,792	12,373	9,975	12,327

Enclosure 1: Bar chart showing fuel consumption for Kahului Generating Station from 2005 to 2016. Fuel consumption data is provided in spreadsheet from Enclosure 2. The facility burns fuel oil No. 6, shown in black, as the primary fuel. Numbers in red provide the total combined fuel consumption in units of 1,000 gallons.

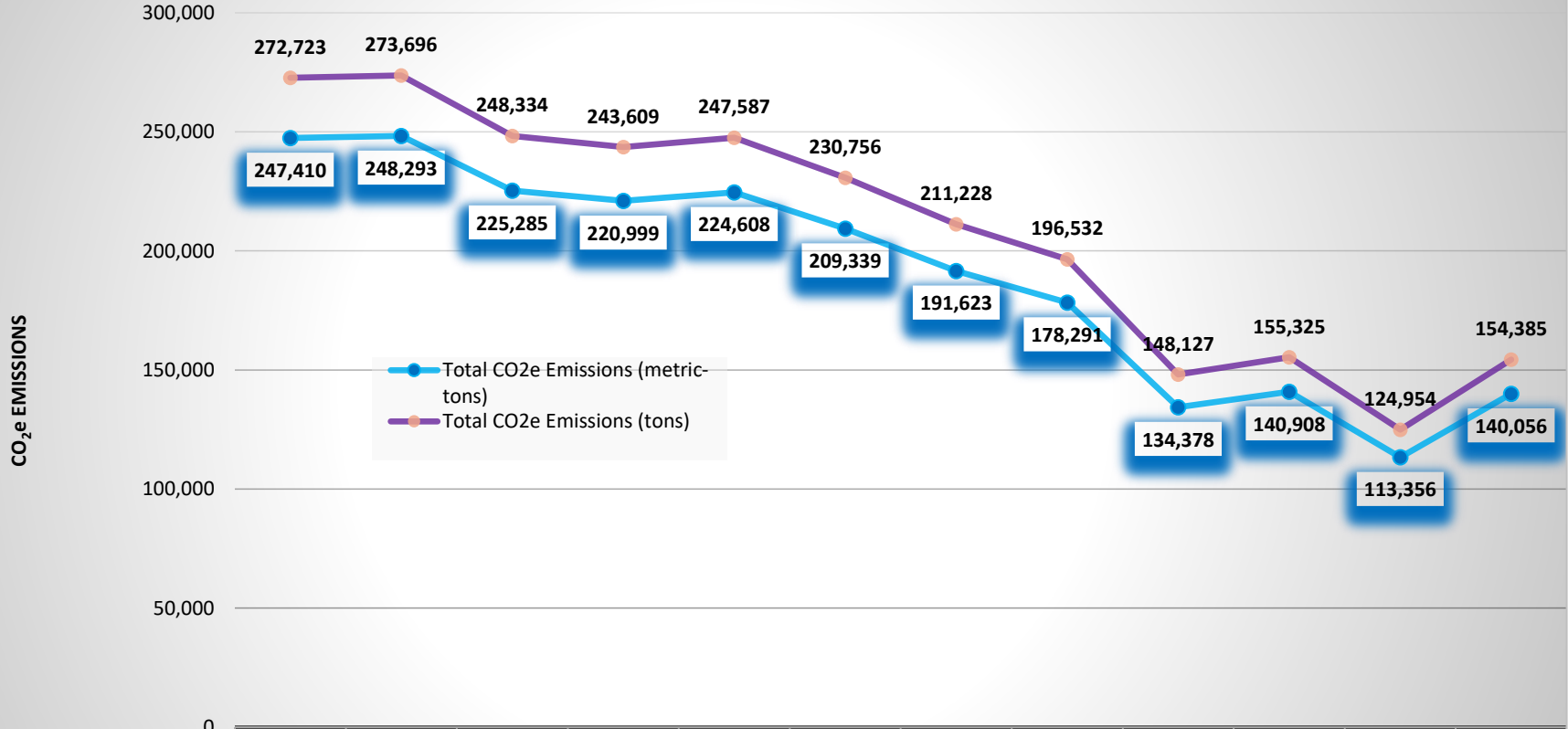
MECO KAHULUI															
FUEL CONSUMPTION DATA															
Ref	Source or Derivation	Calendar Year→	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
(a)	See Data Source	Fuel Oil No. 6 (1,000 gal)	21,829	21,681	19,726	19,468	19,790	18,386	16,736	15,708	11,792	12,373	9,975	12,327	
(b)	See Data Source	Diesel Fuel No. 2 (1,000 gal)	0	199	123	0	0	67	140	0	0	0	0	0	
(c)	See Data Source	Specification Used Oil (1,000 gal)	66	117	103	92	88	80	98	71	105	102	58	69	
(d)	See Data Source	Propane (1,000 gal)	0	0	0	2	2	2	2	2	2	2	2	3	
	(a) + (b) + (c) + (d)	Total	21,895	21,996	19,953	19,562	19,881	18,535	16,977	15,781	11,899	12,477	10,035	12,399	
DATA SOURCE→			Emission Inventory Fuel Consumption Data					SLEIS							
PARAMETERS FOR DETERMINING CO ₂ e EMISSIONS															
(e)	40CFR98 Table C-1 [Emission Factors]	Heating Value FO#6 (MMBtu/gal)	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	
(f)		Heating Value FO#2 (MMBtu/gal)	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	
(g)		Heating Value Specification Used Oil (MMBtu/gal)	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	0.138	
(h)		Heating Value Propane (MMBtu/gal)	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	
(i)		CO ₂ EF FO#6 (kg/MMBtu)	75.10	75.10	75.10	75.10	75.10	75.10	75.10	75.10	75.10	75.10	75.10	75.10	
(j)		CO ₂ EF FO#2 (kg/MMBtu)	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	
(k)		CO ₂ EF Specification Used Oil (kg/MMBtu)	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	74.00	
(l)		CO ₂ EF Propane (kg/MMBtu)	62.87	62.87	62.87	62.87	62.87	62.87	62.87	62.87	62.87	62.87	62.87	62.87	
(m)		40CFR98 Table C-2 [Emission Factors]	CH ₄ EF FO#6 (kg/MMBtu)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
(n)			CH ₄ EF FO#2 (kg/MMBtu)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
(o)	CH ₄ EF Specification Use Oil (kg/MMBtu)		0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	
(p)	CH ₄ EF Propane (kg/MMBtu)		0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	
(q)	N ₂ O EF FO#6 (kg/MMBtu)		0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	
(r)	N ₂ O EF FO#2 (kg/MMBtu)		0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	
(s)	N ₂ O EF Specification Used Oil (kg/MMBtu)		0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	
(t)	N ₂ O EF Propane (kg/MMBtu)		0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	
(u)	40CFR98 Table A-1 [Global Warming Potential]		GWP CO ₂	1	1	1	1	1	1	1	1	1	1	1	1
(v)			GWP CH ₄	25	25	25	25	25	25	25	25	25	25	25	25
(w)		GWP N ₂ O	298	298	298	298	298	298	298	298	298	298	298	298	
CALCULATE FUEL CONSUMPTION IN MMBTU															
(x)	(a)*(e)*10 ³	FO#6 (MMBtu)	3,274,388	3,252,091	2,958,954	2,920,152	2,968,517	2,757,951	2,510,458	2,356,250	1,768,848	1,855,940	1,496,303	1,849,096	
(y)	(b)*(f)*10 ³	FO#2 (MMBtu)	0	27,486	17,008	0	0	9,285	19,364	0	0	0	0	0	
(z)	(c)*(g)*10 ³	Specification Used Oil (MMBtu)	9,062	16,105	14,205	12,681	12,182	11,001	13,480	9,794	14,512	14,103	8,018	9,491	
(aa)	(d)*(h)*10 ³	Propane (MMBtu)	0	0	0	198	226	167	198	187	180	142	143	229	
(bb)	(x)+(y)+(z)+(aa)	Total (MMBtu)	3,283,449	3,295,682	2,990,167	2,933,031	2,980,925	2,778,403	2,543,500	2,366,231	1,783,539	1,870,184	1,504,464	1,858,815	
CALCULATE MASS EMISSIONS															
(cc)	[(i)*(x) + (j)*(y) + (k)*(z) + (l)*(aa)]	CO ₂ Mass Emissions (kg)	246,577,062	247,456,664	224,526,528	220,254,265	223,851,269	208,633,368	190,977,528	177,690,906	133,925,626	140,433,600	112,974,664	139,583,796	
(dd)	[(m)*(x) + (n)*(y) + (o)*(z) + (p)*(aa)]	CH ₄ Mass Emissions (kg)	9,850	9,887	8,971	8,799	8,943	8,335	7,631	7,099	5,351	5,611	4,513	5,576	
(ee)	[(q)*(x) + (r)*(y) + (s)*(z) + (t)*(aa)]	N ₂ O Mass Emissions (kg)	1,970	1,977	1,794	1,760	1,789	1,667	1,526	1,420	1,070	1,122	903	1,115	
CALCULATE CO ₂ e EMISSIONS AND COMPARE WITH BASELINE IN GHG REDUCTION PLAN															
(ff)	(u)*(cc) + (v)*(dd) + (w)*(ee)	CO ₂ e Emissions (kg)	247,410,401	248,293,108	225,285,432	220,998,668	224,607,828	209,338,527	191,623,068	178,291,455	134,378,288	140,908,253	113,356,496	140,055,563	
(gg)	(ff)/10 ²	CO ₂ e Emissions (metric-tons)	2,474,104	2,482,931	2,252,854	2,209,987	2,246,079	2,093,385	1,916,231	1,782,915	1,343,783	1,409,083	1,133,565	1,400,556	
(hh)	Kahului GHG Plan	Kahului CO ₂ e Baseline Emissions (metric-tons)						209,414							
(ii)		Deviation Lower (-) or Higher than CAB Estimate						0.036%							
(jj)	(gg)*1.10231	CO ₂ e Emissions (tpy)	2,727,233	2,736,966	2,483,334	2,436,009	2,475,587	2,307,566	2,112,288	1,965,532	1,481,277	1,553,325	1,249,954	1,543,885	
CALCULATE CO ₂ e CAP AND COMPARE WITH INDIVIDUAL CAP IN GHG REDUCTION PLAN															
(kk)		Biogenic CO ₂ e Emissions (metric-tons)	0	0	0	0	0	0	0	0	0	0	0	0	
(ll)	(kk)*1.10231	Biogenic CO ₂ e Emissions (tons)	0	0	0	0	0	0	0	0	0	0	0	0	
(mm)	(1.00-0.33)*(jj)-(ll)	2020 CO ₂ e Emissions Cap (tons)	182,724	183,376	166,384	163,218	165,884	154,606	141,523	131,677	99,245	104,067	83,719	103,438	
(nn)	Kahului GHG Plan	Kahului CO ₂ e Emissions CAP (tons)						154,633							
	(mm)-(nn)	Lower (-) or Higher than CAB Estimate (tons)						27							

1 metric-ton=1.10231 tons
1 metric-ton=1000 Kg

Enclosure 2: Fuel consumption data for bar chart shown in Enclosure 1 and spreadsheet calculations of GHG emissions for Kahului Generating Station between years 2005 and 2016. This data was used to prepare GHG emission curves in Enclosure 3.

Data Source: CAB estimates based on reported fuel consumption

Total MECO Kahului CO₂e Emissions

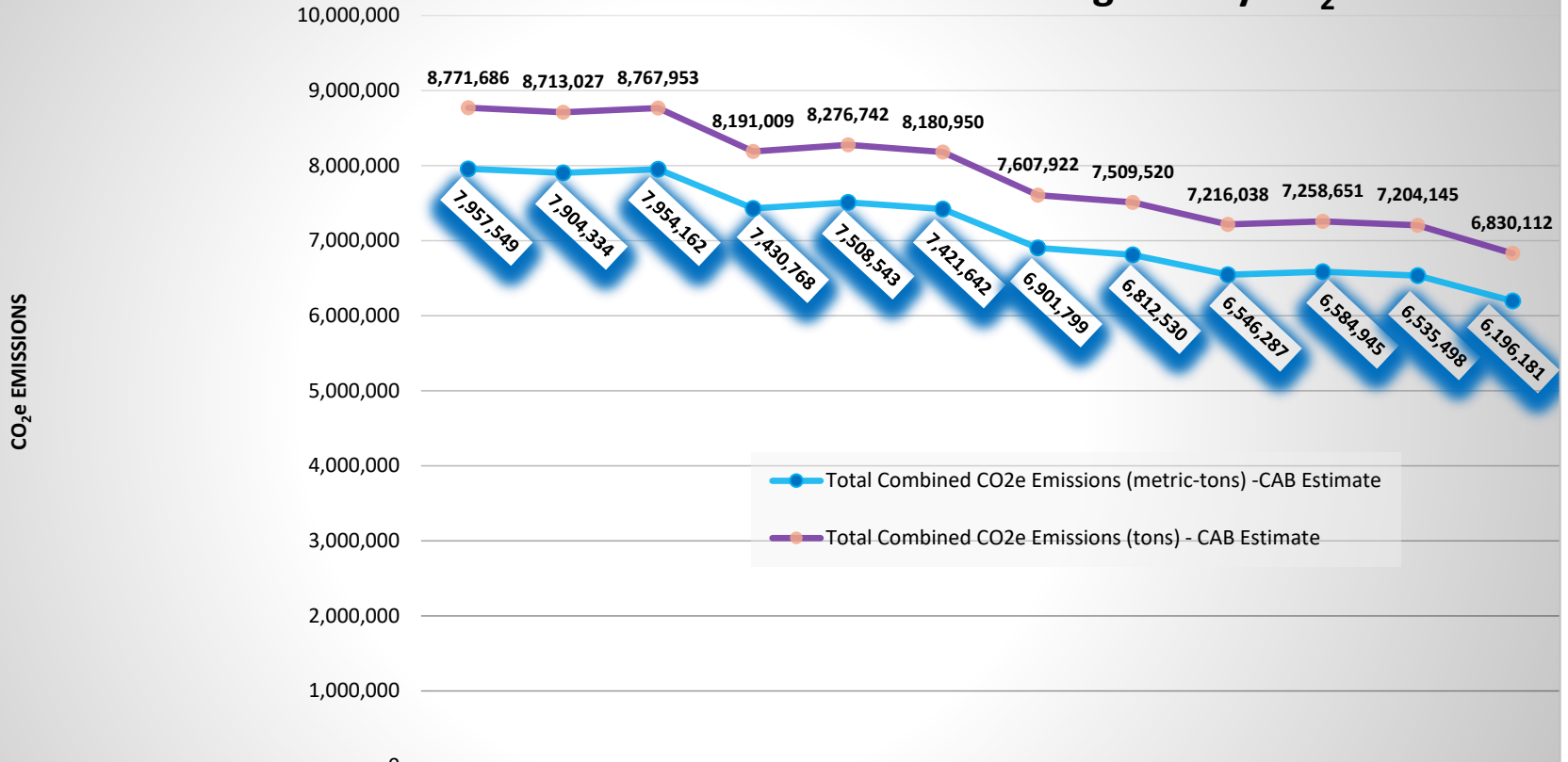


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total CO ₂ e Emissions (metric-tons)	247,410	248,293	225,285	220,999	224,608	209,339	191,623	178,291	134,378	140,908	113,356	140,056
Total CO ₂ e Emissions (tons)	272,723	273,696	248,334	243,609	247,587	230,756	211,228	196,532	148,127	155,325	124,954	154,385

Enclosure 3: Curves showing GHG emissions for Kahului Generating Station between years 2005 and 2016. Blue curve provides emissions in metric tons with numbers that are highlighted in blue. Purple curve shows GHG emissions in short tons with numbers that are not highlighted. The GHG emissions are based on a Tier 1 calculation methodology.

Data Source: CAB estimates based on reported fuel consumption

Total Combined Partnering Facility CO₂e Emissions



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Combined CO ₂ e Emissions (metric-tons) -CAB Estimate	7,957,549	7,904,334	7,954,162	7,430,768	7,508,543	7,421,642	6,901,799	6,812,530	6,546,287	6,584,945	6,535,498	6,196,181
Total Combined CO ₂ e Emissions (tons) - CAB Estimate	8,771,686	8,713,027	8,767,953	8,191,009	8,276,742	8,180,950	7,607,922	7,509,520	7,216,038	7,258,651	7,204,145	6,830,112

Enclosure 4: Curves showing total combined GHG emissions from Shipman Generating Station and all partnering facilities that include three (3) IPPs and ten (10) other facilities operated by the Hawaiian Electric Companies. Blue curve shows GHG emissions with numbers in metric tons are outlined in blue. Purple curve shows GHG emissions with numbers in short tons that are not highlighted. The GHG emissions are based on a Tier 1 calculation methodology.

Maximum Potential Greenhouse Gas Emissions						
CIP Generating Station GHG Emissions						
Unit	Heat Input (MMBtu/hr)	Fuel	GHG	GHG Mass-Based Emissions (TPY) ^a	GWP	GHG CO ₂ e Based Emissions (TPY)
K-1 see note b	94	fuel oil No. 6	CO ₂	68,167	1	68,167
			CH ₄	2.723	25	68
			N ₂ O	0.545	298	162
K-2 see note b	94	fuel oil No. 6	CO ₂	68,167	1	68,167
			CH ₄	2.723	25	68
			N ₂ O	0.545	298	162
K-3 see note b	172	fuel oil No. 6	CO ₂	124,730	1	124,730
			CH ₄	4.983	25	125
			N ₂ O	0.997	298	297
K-4 see note b	181	fuel oil No. 6	CO ₂	131,257	1	131,257
			CH ₄	5.243	25	131
			N ₂ O	1.049	298	312
Total ----->						393,646
a: Emission Factors are from 40 CFR Part 98, Mandatory Reporting of Greenhouse Gases.						
b: Emissions are based on 8,760 hours per year of operation.						

Enclosure 5: Spreadsheet calculations of maximum potential GHG emissions from Kahului Generating Station.