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PERMIT APPLICATION REVIEW
GREENHOUSE GAS (GHG) EMISSIONS REDUCTION PLAN (ERP)
Covered Source Permit (CSP) NO. 0243-01-C
Application for Significant Permit Modification No. 0243-07

Submitter:	Hamakua Energy, LLC
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Proposed Project

The Standard Industrial Classification (SIC) Code is 4911 - Electric Services

Hamakua Energy, LLC (Hamakua Energy) submitted an application for a significant modification to CSP No. 0243-01-C for the HEP to incorporate GHG emission caps established in its GHG emission reduction plan. In summary, the Hamakua Energy's GHG ERP is proposing to:

1. Establish a total combined cap on carbon dioxide equivalent (CO_2e) emissions emitted by the HEP and partnering facilities of 6,371,392 metric tons (7,023,258 short tons) per calendar year;
2. Establish an individual facility-wide cap on CO_2e emissions from the HEP of 139,433 metric tons (153,699 short tons) per calendar year; and

3. Add provisions that enable the transfer of GHG emissions allowances between partnering facilities, and vice versa that will allow individual facility-wide caps on CO_2e emissions to be exceeded as long as the total combined cap among partnering facilities is met.

Department of Health's (DOH) approval:

Implementation of Hamakua Energy's GHG ERP in accordance with HAR §11-60.1-204 and §11-60.1-205, respectively, requires the DOH's approval for the following proposals:

1. Establish "*facility-wide GHG emissions cap"*[1] and associated provisions pursuant to HAR §11-60.1-204(b) and §11-60.1-205; and
2. Establish a control strategy involving partnering with other facilities pursuant to HAR §11-60.1-204(d)(6)(A) and §11-60.1-205(b)(5)(D)(iii).

[1]**Facility-wide GHG emissions cap is defined in HAR §11-60.1-202 as a permit emissions limitation, applicable to a covered source. It may also be defined as an approved combined GHG emissions cap applicable to multiple covered source permits used as a control strategy to leverage emission reductions among partnering facilities as described in HAR §11-60.1-204(d)(6)(A). The entire source's annual non-biogenic greenhouse gas, and biogenic nitrous oxide and methane emissions will be subject to the permit emissions limitation.**

Permitted Equipment Subject to GHG Emissions Cap:

The following permitted units are subject to GHG emission reductions specified in Subchapter 11 of the Hawaii Administrative Rules (HAR):

Unit No.	Equipment Description
CT1	23 MW General Electric LM2500 Combustion Turbine Generator (247 MMBtu/hr max heat input rate - refer to Hamakua Energy's response letter dated December 27, 2018)
CT2	23 MW General Electric LM2500 Combustion Turbine Generator (247 MMBtu/hr max heat input rate)
----------	1,250 kW (14.3 MMBtu/hr) Cummins Black Start Diesel Engine Generator

Permitted Equipment Not Subject to GHG Emissions Cap:

Unit No.	Equipment Description [a]
----------	Two (2) unfired HRSGs with Two (2) SCR Units
----------	19 MW (nominal) Steam Turbine Generator
----------	Two (2) 120-foot high exhaust stacks servicing CT1 and CT2
Tank Nos. 1 and 3	Two (2) 1.4 Million Gallon External Floating Roof Petroleum Tanks for Storage and Transfer of Naphtha or gasoline
----------	Multi-cell Cooling Tower

[a] **Mandatory GHG reporting pursuant to 40 CFR §98.2(a)(3) applies only to "stationary fuel combustion sources" as defined in 40 CFR §98.30 as devices that combust solid, liquid, or gaseous fuel. This excludes sources of fugitive emissions.**

Background:

The HEP produces electrical power and process steam. The nominal 65 megawatts (MW) of electricity produced is sold to the Hawai'i Electric Light Company, Inc. (HELCO) to supplement the electrical demands for the island of Hawaii. With exception to downtime for maintenance, the plant is fully dispatchable and operates year-round.

Equipment at the facility consists of two (2) 24.3 (gross capacity) MW General Electric LM2500 combustion turbine generators (CT1 and CT2), two HRSGs, and one nominal 19 MW steam turbine generator. The facility was initially operated in simple cycle mode and currently operates in combined cycle mode. In combined cycle mode, the high temperature exhaust from the combustion turbine generators is directed to the HRSG's for extraction of energy to produce steam which then drives the steam turbine generators to produce 19 MW of additional power.

The combustion turbine generators are fired primarily on naphtha, with low sulfur fuel oil No. 2 (LSFO) or gasoline allowed as alternate fuels. In addition, Hamakua Energy has submitted a separate application No. 0243-08 for a minor modification to authorize the combustion of biodiesel and biodiesel blended with LSFO. The combustion turbine generators use water injection to reduce nitrogen oxide (NOx) emissions. Additional NOx reduction is provided by two (2) selective catalytic reduction (SCR) units, each installed as part of the two (2) HRSG's.

For meeting the GHG emission reductions, Hamakua Energy is proposing to partner the HEP with ten (10) Hawaiian Electric Company facilities and two (2) other independent power producers (IPPs) to allow flexibility in dispatching units to generate power.

Permits issued to the Hawaiian Electric Companies will reference GHG emission caps specified in CSP No. 0548-01-C for Campbell Industrial Park Generating Station as the main permit for specifying each individual partnering facility and total combined GHG emissions caps. This will enable the modification of a single permit if the GHG emission caps need to be revised and reduce the burden of modifying all Hawaiian Electric Companies' permits had the caps been incorporated separately into each facility's permit.

The IPPs will be issued a separate permit specifying individual and total combine GHG emission caps established for the partnering facilities. Any GHG emission cap revision will require each IPP to submit a significant permit modification since emission caps will be incorporated separately into each facility's permit.

Air Pollution Controls:

NO_x emissions from the combustion turbines are controlled through the use of water injection and SCR. The NO_x emissions are limited to 15 ppmvd @ 15% O_2.

The HEP uses a continuous emissions monitoring system (CEMS) to measure NO_x and carbon monoxide (CO) emissions. A transmissometer is used to measure visible emission levels.

Applicable Requirements:

Hawaii Administrative Rules (HAR)

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 11-60.1-33	Fugitive Dust
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 8	Standards of Performance for Stationary Sources (NSPS)
Subchapter 9	Hazardous Air Pollutant 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 Greenhouse Gas Emission Reduction Plan

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

   HAR §11-60.1-204(a) is applicable to the HEP because it is a permitted covered source as defined in HAR Subchapter 11 with the potential to emit GHG emissions (biogenic plus non-biogenic) equal to or greater than 100,000 short tons per year (TPY).

2. Baseline Emission Rate and Cap.

   a. DOH's Approval*:*
   Subsequent to public review and comment, the DOH approval is required for the following:

   i. Proposed total combined cap on CO_2e emissions emitted by the HEP and partnering facilities listed in Table 1 pursuant to HAR §11-60.1-204(d)(6)(A); and
   ii. Proposed individual facility-wide cap for the HEP as shown in Table 1.

The combined emissions cap was determined by multiplying the total combined baseline GHG emissions (less any biogenic carbon dioxide (CO_2) emissions) for the partnering facilities by 0.84(i.e. 1.00-0.16).

The total combined GHG baseline and GHG emission caps proposed for the partnering facilities are as follows:

Table 1
GHG ERP Baseline and Proposed CO_2e Facility Emission Caps

Plant	CSP Permit No.	Emissions (Short Tons)				Percent (%) Reduction[c]
		Baseline CO_2e	Baseline Biogenic CO_2	Baseline CO_2e Less Biogenic CO_2	CSP CO_2e Caps	
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	0.0%
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	100.0%
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[b]	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	100.0% Plant closed
MECO Kahului	0232-01-C	230,839	0	230,839	154,633	33.0%
MECO Maalaea[b]	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**	**8,361,022**	**7,023,258**	**16.0%**

[a] **The HECO Honolulu Generating Station is currently deactivated (not operating but could restart if necessary). Refer to Enclosure 1.**

[b] **These facilities had two operating permits that were combined into a single permit. Refer to Enclosure 1.**

[c] **Negative (-) numbers represent an increase instead of a reduction from the baseline emissions.**

Partnering facilities are using calendar year (CY) 2010 as the baseline year to establish their caps, except KPLP is proposing to use CY 2009 as an alternate baseline year.

b. *DOH's Methodology for Conducting Assessment*.
The Tier 1 method described in 40 Code of Federal Regulations (CFR) Part 98, §98.33, is used to illustrate in Enclosure 2, the facility's relative GHG emission levels over a time period that extends beyond the five-year period ending 2010 as prescribed by HAR §11-60.1-204(d)(1). The Tier 1 computation method determines mass emissions from the volume of fuel combusted per year using company records, with the default high heat values (HHV) and emission factors from Tables C-1 and C-2 of 40 CFR Part 98. The Tier 1 method is the least accurate method since it utilizes fuel specific default emission factors and HHV. 40 CFR Part 98, §98.33(b)(1)(i), does not restrict the HEP to a specific Tier for its calculation method, however, relative GHG emissions over a longer time span can be evaluated for trends as shown in Figure 2-2 of Enclosure 2 using the Tier 1 method since fuel consumption data is available. The global warming potentials used to compute CO_2e emissions are based on 40 CFR Part 98, Subpart A, Table A-1 (79 FR 73779, Dec 11, 2014). Biogenic CO_2 emissions (if any) are factored out of the emission calculations. Pursuant to 40 CFR Part 98, Subpart C, the mass emissions of CO_2, methane (CH_4), and nitrous oxide (N_2O) shall be determined for each type of fuel.

c. *Baseline Year*.
Hamakua Energy is proposing to use their calendar year 2010 GHG annual emission rate as their baseline in accordance with HAR §11-60.1-204(d)(1).

d. *Using Tier 2 Methodology to Calculate CY 2010 Baseline Emissions.*
The HEP used the Tier 2 computation method for CYs 2010 through 2017 except the Tier 1 method was used for CY 2016. The Tier 1 computation method results in a GHG annual emission rate that is more than five percent (5%) higher than if computed using the Tier 2 method as determined in Enclosure 2A. The impact if the HEP continues to use the Tier 1 method for GHG reporting in future years is expected to conservatively underestimate the annual GHG emission reductions. 40 CFR Part 98, §98.33, does not restrict the HEP to using the Tier 2 method, however, the HEP plans to continue with using the Tier 2 method in future years as stated in Mr. Dave Cumming's December 25, 2018, email.

3. GHG Control Assessment (Refer to the "Non-Applicable Requirements").

4. Proposed Control Strategy.

   Hamakua Energy has determined that a combined facility-wide GHG emissions reduction of sixteen percent (16%) is achievable by 2020 when partnering with other facilities listed in Enclosure 1 pursuant to HAR §11-60.1-204(d)(6)(A) using a combined GHG emissions rate as a baseline. Therefore, Hamakua Energy is proposing a sixteen percent (16%) combined facility-wide reduction in GHG emissions by partnering to curtail or retire the operations of less efficient source units. A comparison of technically feasible control measures in Table 4, indicates partnering with other facilities is expected to have the least economic and schedule impact, without compromising partnering facilities to effectively meet a sixteen percent (16%) overall facility-wide emissions reduction goal.

Hamakua Energy's GHG ERP includes the following additional control measures for meeting the required GHG emission cap(s) to increase their margin for reasonably unforeseen events that are beyond the control of the HEP, such as the termination of the partnership or acts of god:

a. Fuel switching involving biofuels; and
b. Restrictive operations.

Hamakua Energy considers the use of liquid biofuels at the HEP to be a reasonable alternate control measure for complying with a GHG emissions cap in terms of compatibility with existing infrastructure. Since the HEP is currently capable of receiving, handling, storing, and operating on a variety of distillate fuels, including fuel oil No. 2 (e.g., diesel and Ultralow Sulfur Diesel (ULSD)), the most significant changes may involve a change-out of gasket and flexible tubing to materials that are compatible with biofuels. The combustion turbine generators are capable of operating on biodiesel or blends of biodiesel and LSFO without modification to the units themselves. Accordingly, Hamakua Energy plans to implement the necessary steps to modify the HEP to accommodate biodiesel and has performed the requisite pilot tests, emissions measurements, and acquisition of the technical and operational data needed to support this modification. The HEP has submitted a separate application No. 0243-08 for a minor permit modification to CSP No. 0243-01-C to allow the use of biodiesel and/or blends of biodiesel and LSFO. This control measure becomes viable if the supply of biodiesel becomes available on the island of Hawai'i to reasonably sustain power generation levels. It is also anticipated that the biofuel could be used instead of ULSD for daily startups of the combustion turbine generators.

Restrictive operations would be the least desirable of the top three (3) GHG control measures that may voluntarily be employed if partnering is terminated, adequate supply of biofuel is not available, or other incidences where emergency provisions would not apply or are not defendable. While it is unlikely, if restrictive operation is employed, the cost to produce electric power from this facility would increase because of imposed penalties for failing to dispatch power as obligated by the power purchase agreement (PPA) with HELCO. This could lead to increasing emissions of GHG if less efficient facilities are needed to make up for the short fall in power generation by the HEP. The extreme ramification of a curtailment in power generation from the HEP is a failure to meet customer demand on the Island of Hawai'i thus resulting in power outages.

<u>Federal Requirements</u>

40 CFR Part 60, Standard of Performance for New Stationary Sources (NSPS):

40 CFR Part 60, Subpart GG, Standards of Performance for Stationary Gas Turbines **<u>is applicable</u>** to the combustion turbine generators because the capacity of each unit is greater than 10 MMBtu/hr and the combustion turbine generators were constructed after October 3, 1977. Pursuant to §60.333(b) standards for sulfur dioxide can be met by burning fuel oil with a sulfur content not to exceed 0.8% by weight.

40 CFR Part 60, Subpart Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels **is applicable** to external floating roof storage Tank Nos. 1 and 3 because:

1. These tanks commenced construction, modification, or reconstruction after July 23, 1984;
2. Each tank exceeds the 151 cubic meters (m^3) maximum capacity; and
3. The maximum true vapor pressure of the VOC stored inside these tanks exceeds 3.5 kilopascals (kPa).

Refer to Enclosure 3 for details in determining applicability of Subpart Kb to the facility's storage tanks.

40 CFR Part 63, National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Source Categories (Maximum Achievable Control Technology (MACT)),
Subpart ZZZZ – NESHAP for Stationary Reciprocating Internal Combustion Engines (RICE) **is applicable** to the black start diesel engine generator (DEG). For stationary RICE located at an area source of HAP emissions, a stationary RICE is existing if you commenced construction or reconstruction of the stationary RICE before June 12, 2006. The permittee must have complied with the applicable emission limitations and operating limitations no later than May 3, 2013.

Subpart ZZZZ – NESHAP for RICE **is not applicable** to the emergency stationary RICE (or DEG), such as the diesel fire pump engine, at an area source of HAP that complies with §63.6585(f).

The applicable provisions of Subpart ZZZZ will be reviewed and addressed separately with the renewal of CSP No. 0243-01-C.

40 CFR Part 98, Mandatory Greenhouse Gas Reporting **is applicable** to this facility because:

1. The facility does not meet the requirements of either paragraph (a)(1) or (a)(2) of Subpart A, §98.2;
2. The aggregate maximum rated heat input capacity of the stationary fuel combustion units at the facility is 30 MMBtu/hr or greater; and
3. The total CO_2e emissions from stationary fuel combustion sources at the HEP are greater than 25,000 metric tons per year.

40 CFR Part 68, Chemical Accident Prevention Provisions **is applicable** to the storage and use of ammonia (anhydrous) at the facility because it exceeds the regulated threshold quantity. Pursuant to section 112(r) of the Clean Air Act, the Chemical Accident Prevention Provisions require facilities that produce, handle, process, distribute, or store certain chemicals to develop a Risk Management Program, prepare a Risk Management Plan (RMP), and submit the RMP to EPA. Compliance with the rule was initially required in 1999, and the rule has been amended on several occasions since then, most recently in 2004.

Table 2

Ammonia (anhydrous)				
Ref	Description		Units	Source or Derivation
(a)	Threshold	10,000	(lbs)	40 CFR §68.130
(b)	Wt per gal (@ 60°F)	5.15	(lbs/gallon)	U.S. Dept of Labor - OSHA Properties of ammonia
(c)	Tank Capacity	12,000	(gallon)	Hamakua Energy's GHG emission reduction plan
(d)	Total Wt =	61,800	(lbs)	(b) x (c)
(e)	Exceeds Threshold	Yes		(d)>(a)

Non-Applicable Requirements:

Hawaii Administrative Rules (HAR):

Title 11, Chapter 11-60.1 Air Pollution Control
- Subchapter 3 Open Burning
- Subchapter 4 Noncovered Sources
- Subchapter 7 Prevention of Significant Deterioration Review
- Subchapter 9 Hazardous Air Pollutants Sources
- HAR 11-60.1-180 National Emission Standards for Hazardous Air Pollutants
  - Subchapter 11
  - HAR 11-60.1-204(d)(2)
  - HAR 11-60.1-204(d)(3)
  - HAR 11-60.1-204(d)(4)
  - HAR 11-60.1-204(d)(5)

GHG Control Assessment.

Hamakua Energy is proposing to combine their facility-wide GHG emissions cap among partnering facilities and meet a combined GHG emissions cap and sixteen percent (16%) GHG emissions reduction. Hamakua Energy is also proposing an individual facility-wide GHG emissions cap and sixteen percent (16%) GHG emissions reduction, however, the HEP may exceed their individual cap provided the combined facility-wide GHG emissions cap is met. 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).

Hamakua Energy is not required to conduct a GHG control assessment, however, an assessment was included in Hamakua Energy's GHG emissions reduction plan as follows:

1. Identify all available control measures and eliminate all technically infeasible options.

   Pursuant to HAR §11-60.1-204(d)(3) and §11-60.1-204(d)(4), respectively, all available control measures applicable to HEP are listed in Table 3 and each available control measure evaluated to determine whether it is technically infeasible.

Table 3
Assessment of All Control Measures

GHG Control Option	Feasibility and Benefit
Carbon Capture and Storage (CCS)	Not technically feasible since not currently commercially available for combustion turbine exhaust treatment.
Fuel Switching or Co-Fired Fuels	Fuel switching or co-firing with biodiesel is determined to be technically feasible.
Energy Efficiency Upgrades and Combustion Improvements	HEP is a combined cycle plant that recovers waste heat from CT1 and CT2 to produce steam in the HRSGs. There is limited opportunity for energy efficiency upgrades or operational improvements that would result in meaningful reductions in GHG emissions.
Restrictive Operations or Equipment Retirement	Restrictive operation is technically feasible, however, consideration for efficiency while operating the HEP in combined cycle should dictate the curtailment of other less efficient plants first relative to overall GHG emissions and cost per kilowatt-hour.
Planned Upgrades, Overhaul, or Retirement of Equipment	Hamakua Energy is pursuing the option to fire or co-fire CT1 and CT2 with biodiesel or a blend of biodiesel with LSFO.
Outstanding regulatory mandates, emission standards, and binding agreements	No outstanding regulatory mandates, emissions standards, or binding agreements.
Other GHG reduction initiatives that may affect the facility's GHG emissions	Hamakua Energy is proposing a combined facility-wide GHG emissions cap to leverage emission reductions among partnering facilities as a control strategy. Otherwise, Hamakua Energy has not been able to identify any other GHG reduction initiatives that would apply.

2. List technically feasible control measures and identify the cost effectiveness of each.

   Pursuant to HAR §11-60.1-204(d)(5), Hamakua Energy's evaluation of technically feasible control measures are listed and summarized in Table 4. The three (3) technically feasible measures in order of priority are: (1) Partnering with other power producers in Hawai'i, (2) Fuel switching to include biogenic fuels, and (3) Restrictive operations. Hamakua Energy is working with other facilities to develop a GHG partnering agreement, which is the primary control measure for achieving GHG compliance. Secondly, Hamakua Energy is committed on qualifying the HEP to operate on biodiesel and/or a blend of biodiesel and LSFO. Thirdly, if and only if there are no alternatives to meet the GHG permit conditions of its CSP, restrictive operation would be implemented.

Table 4
Effectiveness and Cost of Control Measures

Available Control Measure→	Partnering	Fuel Switching or Co-Fire w/ 16% Biofuel	Restrictive Operation
Fuel Type→	Naphtha	Biodiesel or a Blend with ULSD	Naphtha
Control Effectiveness*	Combined 16%	As high as 100%	16%
Required Implementation Schedule	End of CY 2019	CY 2019	Immediate if no alternatives available
Cost or level of effort required for implementation	$0	Replace rubber seals and hose & conduct qualification	Higher operating cost and potential penalties
Cost per metric ton of CO_2e removed ($/MT)	$0	None provided	None provided

* **Percent (%) reduction from baseline GHG level**

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 PSD determination from the previous permit application review is still valid and additional PSD review **is not required** because this 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 emission 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.

Compliance Assurance Monitoring (CAM), 40 CFR Part 64:

CAM was not previously addressed in the 2009 CSP renewal application review. The purpose of CAM is to provide a reasonable assurance that compliance is being achieved with large emissions 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 one-hundred percent (100%) of the major source level; and (5) not otherwise be exempt from CAM. This source **is not subject to CAM.** Although the combustion turbine generators rely on SCR and a water injection system to achieve compliance with the NO_X emission limit and have potential pre-control emissions greater than the major source level for NO_X, CAM is not applicable because a continuous emission monitoring system (CEMS) is used to determine compliance with the NO_X emissions standard. As such, the combustion turbine generators **are exempt from CAM**.

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 Table 6-7 titled “Total Facility Emissions and Threshold” from the Project Emissions section. Since the facility-wide emission levels of one or more air pollutant(s) still exceeds the reporting threshold(s), the AERR (previously referred to as “CERR” in the 2009 CSP renewal application review) and DOH in-house Annual Emissions Reporting requirements **remain unchanged** from the previous permit application review and annual emissions reporting for the facility **is still required** for in-house recordkeeping purposes.

Insignificant Activities:

The equipment listed in Table 5 are insignificant activities.

Table 5

Unit Number	Tank Contents	Capacity (Unit)	Justification
7	ULSD storage and transfer	359,000 (gal)	HAR §11-60.1-82(f)(7) [0.11 tpy VOC emissions]
---------	Day tank	10,000 (gal)	HAR §11-60.1-82(f)(1)
	Fire pump engine[a]	10.4 (gal/hr)	HAR §11-60.1-82(g)(6)
	One (1) multi-cell cooling tower	----------	HAR §11-60.1-82(f)(7) [0.04 tpy emissions of particulate matter (PM)]

[a]40 CFR §98.30 excludes emergency generators and equipment as defined in 40 CFR §98.6 from mandatory GHG reporting.

Alternate Operating Scenarios:

The application for a significant modification did not propose any alternate operating scenarios.

Project Emissions:

The modification to incorporate GHG emissions caps will not cause an increase in maximum potential emissions from the existing permit limits. The emission rates, equipment, and design operating parameters used in determining the maximum potential emissions have not changed.

Table 6-1 compares current emission estimates with estimates from the prior review of CSP renewal application No. 0243-03 and the impact of the change in emissions are discussed as follows:

1. Emission estimates for application No. 0243-07 in Table 6-1 are based on mass emission rates of permitted combustion sources in renewal application No. 0243-06 dated July 11, 2013, unless specified otherwise. A breakdown of emission estimates for application No. 0243-07 are included in Table 6-2. Fugitive emission estimates are not included.

2. Pursuant to EPA's memorandum dated September 6, 1995, emissions from the fire pump engine were determined using a 500 hour per year default assumption to further evaluate prevention of significant deterioration (PSD) and major source applicability determinations (please refer to Table 6-1). Based on this expected worst-case operating assumption, net increases in emissions from the fire pump engine were found to be lower than BACT emission thresholds. Emissions that are below these thresholds do not require PSD review. Also, estimated emissions in the ambient air quality impact report dated March 31, 1998 are above major source thresholds for NO_X, SO_2, and CO. Since emissions are already above major source thresholds, the fire pump engine will not affect this facility's status as a major source. Additional emissions from the fire pump engine do not cause the facility to become a major source for HAPs.
3. Fugitive PM and VOC emissions from the cooling towers and storage tanks are shown in Tables 6-3 and 6-4 respectively. Fugitive emissions from these sources are not included in the evaluation and therefore the emissions from these sources will have no impact on major source thresholds shown in Table 6-7. See HAR Subchapter 7, Major Source definitions.
4. Assessment of GHG emissions are summarized in Table 6-5. Maximum potential GHG emissions were not included in prior permit application reviews since GHGs were not previously subject to regulation. The combustion turbine generators (CTG) at the HEP will be subject to an individual facility's GHG emissions cap, however, these individual caps may be exceeded provided the combined cap of all partnering facilities are met. Therefore, the GHG emission estimates are based on the facility's *potential annual heat input*, i.e. the maximum rated heat input capacity times the maximum expected hours of operation. Each CTG is rated at 247 MMBtu/hr and potentially is able to operate 8,760 hours annually. The black start DEG has a maximum design fuel consumption rate of 103.6 gal/hr based on a telephone discussion between Mr. Dave Cummings of the HEP and Mr. Dale Hamamoto of the Clean Air Branch. Using the default high heat value of 0.138 MMMBtu/gal from 40 CFR Part 98, Subpart C, Table C-1 for fuel oil No. 2, the maximum rated heat input of the black start DEG is estimated to be 14.3 MMBtu/hr. GHG emissions from the fire water pump diesel engine and fuel storage tanks are not included since 40 CFR Part 98, Subpart A, §98.2(a)(3), states that reporting of GHG emissions must be from *stationary fuel combustion sources* only. 40 CFR Part 98, Subpart C, §98.30 further defines *stationary fuel combustion sources* as devices that combust fuel for producing useful energy but specifically excludes emergency equipment. The CO_2e emissions in Table 6-5 are computed by multiplying the mass-based emissions in Enclosure 5 by each associated global warming potential (GWP) from 40 CFR Part 98, Table A-1.
5. There are no significant changes in emissions of HAPs. Table 6-6 compares the current estimates with previous estimates in CSP review of renewal application No. 0243-03. Emissions of nickel remains as the single highest HAP with a slight reduction in 2019 estimates. Total emissions of HAPs also reduced slightly, which is primarily attributable to eliminating emissions of sulfuric acid mist from the 2019 estimates, despite an increase in xylene isomers. As clarified in Mr. David Cummings' email dated January 23, 2019, any sulfuric acid mist and hydrogen fluoride would react with ammonia resulting in ammonium sulfate, which is included with particulate matter. This explains why both pollutants were not included in the CSP renewal application No. 0243-06. HAP emissions from the HEP will not impact major source thresholds shown in Table 6-7.

Table 6-1
Changes in Annual Emissions

Application →	No. 0243-03		No. 0243-07			
Description→	Two (2) CTGs and a Black Start DEG [a]		Two (2) CTGs and a Black Start DEG	Fire Water Pump Engine	Net Increase	Total
Ref →	(a)		(b)	(c)	(d)	(e)
Source →	Footnote [b]		Table 6-2	Table 6-3	(a)-(e)	(b)+(c)
Pollutant ↓ Units→	(tpy)		(tpy)	(tpy)	(tpy)	(tpy)
NO_x	104.5		103.3	1.6	0.3	104.8
SO_2	131.4		131.4	6.31E-03	0.0	131.4
CO	245.4		245.3	3.35E-01	0.3	245.7
VOCs	25.1		17.5	1.02E-02	-7.6	17.5
PM	41.3[c]		41.2	1.14E-01	0.0	41.3
Pb	1.10E-01		1.17E-01	0.00E+00	0.0	1.17E-01
HAP (Single Highest)	2.5[d]		2.4	4.17E-04	-0.1	2.4
HAP (Total)	14.04[d]		13.5	1.06E-03	-0.6	13.5

[a] **Annual estimated emissions are based on two CTG's operating 8,760 hour per year, and on the black start DEG operating 52 hours per year.**

[b] **Permit renewal application review No. 0243-03.**

[c] **Particulate matter based either TSP or PM_{10}.**

[d] **HAP emissions determined in the 2009 review of CSP renewal application No. 0243-03 are from CTG's only; black start DEG emissions were determined to be negligible.**

Table 6-2
Emissions from Permitted Combustion Sources

Description→	CTG No. 1 (West)		CTG No. 2 (East)		Black Start DEG		Total Emissions
Hours of Operation→	8760 hrs/yr		8760 hrs/yr		52 hrs/yr limit		
Source or Derivation→	Note[a]	(a)*8760 / 2000	Note[a]	(c)*8760 / 2000	Table 4-2, Enclosure 4		(b)+(d)+(f)
Units→	(lbs/hr)	(tpy)	(lbs/hr)	(tpy)	(lbs/hr)	(tpy)	(tpy)
Pollutant↓ Ref→	(a)	(b)	(c)	(d)	(e)	(f)	
NO_x	11.7	51.2	11.7	51.2	29.85	0.776	103.3
SO_2	15	65.7	15	65.7	0.15	0.004	131.4
CO	28	122.6	28	122.6	2.66	0.069	245.3
VOC	2	8.8	2	8.8	0.49	0.013	17.5
PM	4.7	20.6	4.7	20.6	0.20	0.01	41.2
Lead (Pb)	1.34E-02	5.87E-02	1.34E-02	5.87E-02			1.17E-01
HAP (Highest)							2.4
HAP (Total)							13.5

[a] **Annual emission rates in application No. 0243-07 are from renewal application No. 0243-06.**

Table 6-3
Emissions from Permitted Cooling Tower and Diesel Fire Pump Engine

Description→	Cooling Tower		Diesel Fire Pump Engine[b]	
Hours of Operation→	8760 hrs/yr		500 hrs/yr	
Source or Derivation→	Note[a]		Table 4-1, Enclosure 4	
Type of Source→	Permitted (Fugitive)		Insignificant (Combustion)	
Pollutant↓ Units→	(lbs/hr)	(tpy)	(lbs/hr)	(tpy)
NO_x		0.00	6.2	1.6
SO_2		0.00	2.52E-02	6.31E-03
CO		0.00	1.3	3.35E-01
VOC		0.00	4.07E-02	1.02E-02
PM	1.451	6.147	4.56E-01	1.14E-01
Lead (Pb)		0.000	0	0.000
HAP (Highest)				4.17E-04
HAP (Total)				1.06E-03

[a] **Refer to Enclosure 7 for detailed calculation of annual emissions from the cooling tower.**

[b] **Fire pump engine will be removed when processing the permit renewal application.**

Table 6-4
VOC Emissions from Permitted Floating Roof Tanks and Nonpermitted ULSD Tank

Description→	Floating Roof Tank (East)		Floating Roof Tank (East)		ULSD Tank	
Hours of Operation→	8760 hrs per year		8760 hrs per year		8760 hrs per year	
Fuel Types↓ Units→	(lbs/hr)	(tpy)	(lbs/hr)	(tpy)	(lbs/hr)	(tpy)
Naphtha	0.54	2.37	0.54	2.37		0.00
Gasoline	0.58	2.54	0.58	2.54		0.00
Fuel Oil No. 2	0.009	0.04	0.009	0.04	0.01	0.11
Worst Case		2.54		2.54		0.11

Table 6-5
GHG Emissions

Description →	GHG Mass-Based Emissions [a]	GWP	CO_2e Based Emissions	
Source or Derivation →	**Enclosure 5**	**40CFRS98 Table A-1**	**(a)*(b)**	**(c)*0.90718474[b]**
Unit of Measure →	**(tpy)**	**None**	**(tpy)**	**(metric tons/yr)**
GHG Pollutant ↓ Ref→	**(a)**	**(b)**	**(c)**	**(d)**
Carbon Dioxide (CO_2)	363,153	1	363,153	329,447
Methane (CH_4)	15	25	375	340
Nitrous Oxide (N_2O)	3	298	894	811
CO_2e Emissions =			364,422	330,598

[a] **Refer to Enclosure 5 for detailed calculations of the GHG mass-based emissions.**
[b] **One (1) short ton is equivalent to 0.90718474 metric tons.**

Table 6-6
Comparison of HAPs Emissions

Source or Derivation →	Renewal Application No.0243-03	Application No.0243-07[a]
Pollutant ↓ Units →	**(tpy)**	**(tpy)**
Acenaphthene		1.03E-06
Acenaphthylene		2.12E-05
Acetaldehyde (1)	1.60	1.55
Acrolein (6)	1.80E-01	1.87E-01
Antimony (172)	4.40E-02	4.44E-02
Anthracene		1.36E-06
Arsenic (173)[c]	9.60E-03	1.06E-02
Benzene (15)	2.00	1.98
Benzo(a)anthracene		7.18E-08
Benzo(b)fluoranthene		1.12E-07
Benzo(k)fluoranthene		3.54E-07
Benzo(g,h,l)perylene		1.36E-07
Benzo(a)pyrene		2.83E-05
Beryllium (174) [c]	6.60E-04	6.67E-04
1,3 Butadiene (23)		2.83E-05
Cadmium (175)	8.30E-03	8.48E-03
Chromium (176)	9.60E-02	9.46E-02
Chrysene		2.56E-07
Cobalt (177)	1.80E-02	1.84E-02
Dibenz(a,h)anthracene		4.23E-07
Fluoranthene		5.52E-06
Fluorene		2.12E-05
Formaldehyde (86)	2.40	2.38
Indeno(1,2,3-cd)pyrene		2.72E-07
Lead (181)		1.17E-01
Manganese (182)	7.00E-01	6.87E-01
Mercury (183)	1.80E-03	1.84E-03
Naphthalene		6.15E-05
Nickel (185)	2.50	2.43
Phenanthrene		2.13E-05
Phosphorous (133)	6.10E-01	6.06E-01
Pyrene		3.46E-06
Selenium (188)	1.10E-02	1.07E-02
Toluene (151)	8.30E-01	8.26E-01
Xylene isomers (168)	0.57	2.18
PAH	3.40E-01	3.39E-01
Fluorides	1.70E-02	
Sulfuric Acid Mist	2.1	
HAP (Single Highest)	**2.50**	**2.43**
HAP (Total)	**14.04**	**13.5**

[a] **Emission rates are from CSP Renewal Application No. 0243-06, except as noted.**

Table 6-7
Total Facility Emissions Relative to Control Thresholds (TPY)

Pollutant	Total Emissions (tpy) [a]	AERR		Major Source		DOH (In-House) Reporting	
		Thresholds (Type B Sources)	Applies	Threshold	Applies	Threshold	Applies
NO_x	104.8	100	Yes	100	Yes	25	Yes
SO_2	131.4	100	Yes	100	Yes	25	Yes
CO	245.7	1,000	No	100	Yes	250	No
VOC	17.5	100	No	100	No	25	No
PM_{10}	41.3	100	No		NA	25	Yes
Pb (Actual)	1.17E-01	0.5	No	100	No	5	No
HAPs (Single)	2.4		NA	10	No	5	No
HAP (Total)	13.5		NA	25	No		NA

[a] **Excludes fugitive emissions**

Hamakua Energy is proposing an individual CO_2e emissions cap of 153,699 short tons (139,433 metric tons) per year for the HEP. 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 level by the start of 2020.

Ambient Air Quality Impact Assessment (AAQIA):

An ambient air quality assessment was not required for the significant modification to incorporate the GHG emission caps because there are no increases in emission rates from previously modeled levels.

Significant Permit Conditions:

1. Each partnering facility shall not emit or cause to be emitted carbon dioxide equivalent (CO_2e) emissions in excess of the following individual caps except as specified in Attachment II – GHG Special Condition No. C.1.d.iv of CSP No. 0243-01-C for Hamakua Energy Plant. This CO_2e emissions limit will be specified in Attachment II – GHG, Special Condition No. C.1.a of CSP No. 0243-01-C for Hamakua Energy Plant.

Generating Station	CSP Permit No.	CO_2e Emission Cap	
		Metric Tons per Calendar Year [a]	Short Tons per Calendar Year
AES Coal-Fired Cogeneration Plant	0087-02-C	1,534,598	1,691,605
Hamakua Energy, LLC Cogeneration Plant	0243-01-C	139,433	153,699
Kalaeloa Partners, L.P. Cogeneration Plant	0214-01-C	993,198	1,094,813
HECO Campbell Industrial Park Generating Station	0548-01-C	48,752	53,740
HECO Honolulu Generating Station	0238-01-C	0	0
HECO Kahe Generating Station	0240-01-C	1,935,707	2,133,752
HECO Waiau Generating Station	0239-01-C	733,265	808,286
HELCO Kanoelehua-Hill Generating Station	0234-01-C	156,449	172,456
HELCO Keahole Generating Station	0007-01-C	219,727	242,208
HELCO Puna Generating Station	0235-01-C	28,800	31,747
MECO Kahului Generating Station	0232-01-C	140,281	154,633
MECO Maalaea Generating Station	0067-01-C	417,182	459,864
MECO Palaau Generating Station	0031-04-C	23,999	26,454

[a] **One (1) metric tons = (0.90718474) x (Short Tons)**

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 CO_2e emissions in excess of 6,371,392 metric-tons (7,023,258 short tons) per calendar year. This total combined CO_2e emissions limit will be specified in Attachment II – GHG Special Condition No. C.1.b of CSP No. 0243-01-C for Hamakua Energy Plant.

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

3. In the event that partnering is terminated or becomes unavailable, the permittee shall not exceed an individual GHG emissions cap of 139,433 metric tons (153,699 short tons) per calendar year and Attachment II – GHG, Special Condition Nos. C.1.b, C.1.d.iv, C.1.d.v, and D.1.f, and items 2 and 3 of the **Monitoring Report Form: GHG Emissions** do not apply. This CO_2e emissions limit will be specified in Attachment II – GHG, Special Condition No. C.1.c for Hamakua Energy Plant.

4. For purposes of the CO_2e emission limits in Attachment II – GHG Special Condition Nos. C.1.a, C.1.b, and C.1.c:

   a. The CO_2e 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 (CO_2) emissions will not be included when determining compliance with the emissions limit;
   c. The permittee shall be in compliance with the emissions limits by the end of 2019 and each calendar year thereafter;
   d. Except as specified in Attachment II – GHG, Special Condition No. C.1.c, 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. Except as specified in Attachment II – GHG, Special Condition No. C.1.c, 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 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 shall be sixteen percent (16%) below the-total combined baseline emission level less biogenic CO_2 emissions.

A = Actual GHG emissions from the affected facility.

C = GHG emissions cap for the affected facility.

$\sum_{Ai>ci}(Ai - Ci)$ = 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, §11-60.1-90, §11-60.1-204.

5. By **August 29, 2019**, and **within sixty (60) days** following the end of each semi-annual calendar period (January 1 – June 30 and July 1 – December 31) thereafter**,** the Hamakua Energy Plant shall submit written reports to the Department for monitoring CO_2e 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.d.v; and
   b. The total combined GHG emissions cap and allocating excess emissions pursuant to Attachment II – GHG Special Condition No. C.1.d.v.

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

Conclusion and Recommendation:

Hamakua Energy applied for a significant modification to CSP No. 0243-01-C for the HEP to incorporate GHG emission caps and significant permit conditions. These permit additions are required for implementing GHG reduction measures proposed in HEP's GHG ERP pursuant to HAR §11-60.1-204.

Hamakua Energy is proposing to partner the HEP with facilities listed in Enclosure 1 as the primary control measure to achieve a combined sixteen percent (16%) reduction below the total combined CO_2e baseline emissions by:

1. Establishing a total combined limit of 6,371,392 metric tons (7,023,258 short tons) of CO_2e emissions per CY; and
2. Establishing a facility wide individual GHG emissions cap of 139,433 metric tons (153,699 short tons) per CY.

As a secondary control measure, in the event the partnering agreement is terminated or otherwise becomes unavailable, Hamakua Energy is proposing the use of biodiesel or a blend of biodiesel and ULSD (subject to the DOH approval) to meet the HEP's GHG emissions cap. As a tertiary control measure, Hamakua Energy is proposing to employ restricted operations if both the primary and secondary control measures are not available, is determined not to be cost effective, or other incidences where emergency provisions would not apply or are not defendable.

Hamakua Energy's GHG emissions reduction plan was reviewed and determined to comply with HAR §11-60.1-204. Hamakua Energy's proposed baseline emission rate and emission caps were evaluated using the HEP's past fuel consumption data and determined to be reasonably representative. The Tier 2 computation method was used to calculate HEP's CY 2010 baseline, which will conservatively impact future assessments by understating emission reductions if the Tier 1 computation method is used for future reporting of GHG emissions. As such, the HEP plans to continue with using Tier 2 for future GHG reporting, thus negating the impact of using different computation methods for determining their facility-wide GHG emissions. Further review shows the HEP's fuel usage and GHG emission rates have been in a steady decline since CY 2005 and is already forty eight percent (48%) below their 2010 GHG baseline emissions as of the end of CY 2016. However, Hamakua Energy has expressed concerns that unexpected events can easily disrupt this trend, such as the recent volcanic activities. Hamakua Energy has also expressed a concern with the impact of complying with the cap if the partnering agreement fails as the primary control measure. Hamakua Energy has mitigated these concerns by proposing secondary and tertiary control measures in its GHG ERP control strategy, which provides alternate means for meeting their individual cap.

As specified in HAR §11-60.1-204(g), once a facility-wide GHG emission cap is established and incorporated in the covered source permit, the GHG ERP shall become part of the permit application process for renewals and any required modifications.

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

Review By: Dale Hamamoto
March 18, 2019

ENCLOSURE 1 GHG PARTNERING FACILITIES

Generating Station	CSP Permit No.	CO_2e Emission Caps	
		Metric Tons per Calendar Year [a]	Short Tons per Calendar Year
AES Coal-Fired Cogeneration Plant	0087-02-C	1,534,598	1,691,605
Hamakua Energy, LLC Cogeneration Plant	0243-01-C	139,433	153,699
Kalaeloa Partners, L.P. Cogeneration Plant	0214-01-C	993,198	1,094,813
HECO Campbell Industrial Park Generating Station	0548-01-C	48,752	53,740
HECO Honolulu Generating Station[b]	0238-01-C	0	0
HECO Kahe Generating Station	0240-01-C	1,935,707	2,133,752
HECO Waiau Generating Station	0239-01-C	733,265	808,286
HELCO Kanoelehua-Hill Generating Station	0234-01-C	156,449	172,456
HELCO Keahole Generating Station[c]	0007-01-C	219,727	242,208
HELCO Puna Generating Station	0235-01-C	28,800	31,747
MECO Kahului Generating Station	0232-01-C	140,281	154,633
MECO Maalaea Generating Station[c]	0067-01-C	417,182	459,864
MECO Palaau Generating Station	0031-04-C	23,999	26,454
Partnership Total[d]		6,371,392	7,023,258

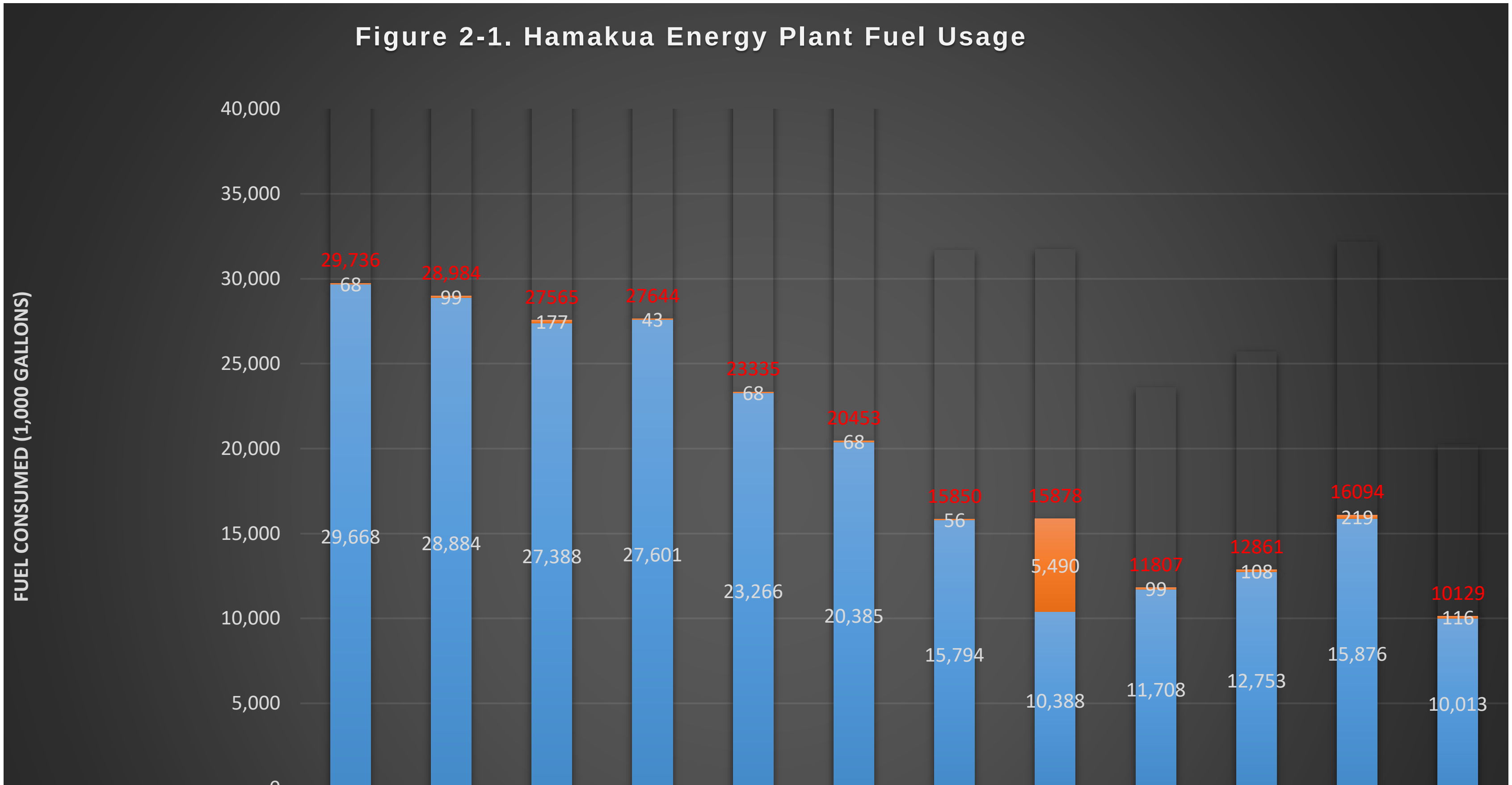
[a] **One (1) metric tons = (0.90718474) x (Short Tons)**

[b] **The HECO Honolulu Generating Station is currently deactivated (not operating but could restart if necessary).**

[c] **These facilities previously had two operating permits that were combined into a single permit.**

[d] **CSP No. 0236-01-C is not included as a partnering facility since its permit is closed, however, it's 2010 baseline emissions are included in calculating the partnership total baseline and emissions cap pursuant with HAR§11-60.1-204(d)(1).**

ENCLOSURE 2



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total	29,736	28,984	27565	27644	23335	20453	15850	15878	11807	12861	16094	10129
Diesel Fuel No. 2 (1000 gal)	68	99	177	43	68	68	56	5,490	99	108	219	116
Naphtha (1000 gal)	29,668	28,884	27,388	27,601	23,266	20,385	15,794	10,388	11,708	12,753	15,876	10,013

ENCLOSURE 2 (Continued)

Table 2-1

COMPILE FUEL USAGE DATA														
Ref	Source or Derivation	Calendar Year→	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(a)	See Data Source	Naphtha (1000 gal)	29,668	28,884	27,388	27,601	23,266	20,384.846	15,794	10,388	11,708	12,753	15,876	10,013
(b)	See Data Source	Diesel Fuel No. 2 (1000 gal)	68	99	177	43	68	67.955	56	5,490	99	108	219	116
	(a)+(b)	**Total**	**29,736**	**28,984**	**27565**	**27644**	**23335**	**20452.801**	**15850**	**15878**	**11807**	**12861**	**16094**	**10129**
		DATASOURCE→	Annual Emissions Report Forms (AERF)						SLEIS	AERF	SLEIS	SLEIS	SLEIS	SLEIS
COMPILE FACTORS FOR DETERMINING CO_2e EMISSIONS														
(c)	40CFRS98 Table C-1 [Emission Factors]	Heat Value Naphtha (mmBtu/gal)	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
(d)		Heat 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
(e)		CO_2 EF Naphtha (Kg/mmBtu)	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	69.02	70.02
(f)		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
(g)	40CFRS98 Table C-2 [Emission Factors]	CH_4 EF (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
(h)		N_2O EF (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
(i)	40CFRS98 Table A-1 [Global Warming Potential]	GWP CO_2	1	1	1	1	1	1	1	1	1	1	1	1
(j)		GWP CH_4	25	25	25	25	25	25	25	25	25	25	25	25
(k)		GWP N_2O	298	298	298	298	298	298	298	298	298	298	298	298
CALCULATE FUEL USAGE IN MMBTU														
(l)	$(a)*(c)*10^3$	Naphtha Consumed (MMBtu)	3,708,462	3,610,550	3,423,500	3,450,076	2,908,308	2,548,106	1,974,278	1,298,549	1,463,542	1,594,114	1,984,473	1,251,625
(m)	$(b)*(d)*10^3$	Diesel Fuel No. 2 Consumed (MMBtu)	9,407	13,713	24,441	5,978	9,431	9,378	7,754	757,566	13,681	14,923	30,170	16,031
(n)	(l)+(m)	Total (MMBtu)	3,717,870	3,624,262	3,447,941	3,456,054	2,917,739	2,557,483	1,982,031	2,056,115	1,477,223	1,609,037	2,014,643	1,267,656
CALCULATE MASS BASED EMISSIONS (TIER 1 METHOD)														
(o)	(e)*(l) + (f)*(m)	CO_2 Mass Emissions (Kg)	252,945,374	246,603,777	234,674,113	235,116,293	198,520,604	174,015,730	134,863,838	144,356,857	100,561,980	109,535,357	139,199,673	88,824,469
(p)	(g)*(n)*(j)	CH_4 Mass Emissions (Kg)	11,154	10,873	10,344	10,368	8,753	7,672	5,946	6,168	4,432	4,827	6,044	3,803
(q)	(h)*(n)*(k)	N_2O Mass Emissions (Kg)	2,231	2,175	2,069	2,074	1,751	1,534	1,189	1,234	886	965	1,209	761
CALCULATE CO_2e EMISSIONS (TIER 1 METHOD)														
(r)	(l)*(i) + (p)*(j) + (q)*(k)	CO_2e Emissions (Kg)	253,888,969	247,523,614	235,549,201	235,993,439	199,261,127	174,664,819	135,366,878	144,878,699	100,936,899	109,943,730	139,710,990	89,146,200
(s)	$(r)/10^3$ **(see note a)**	CO_2e Emissions (MT)	253,889	247,524	235,549	235,993	199,261	174,665	135,367	144,879	100,937	109,944	139,711	89,146
(t)	(s)*1.10231131[b]	**CO_2e Emissions (tpy)**	**279,865**	**272,848**	**259,649**	**260,138**	**219,648**	**192,535**	**149,216**	**159,701**	**111,264**	**121,192**	**154,005**	**98,267**

[a] **One (1) metric-ton=1000 Kg**

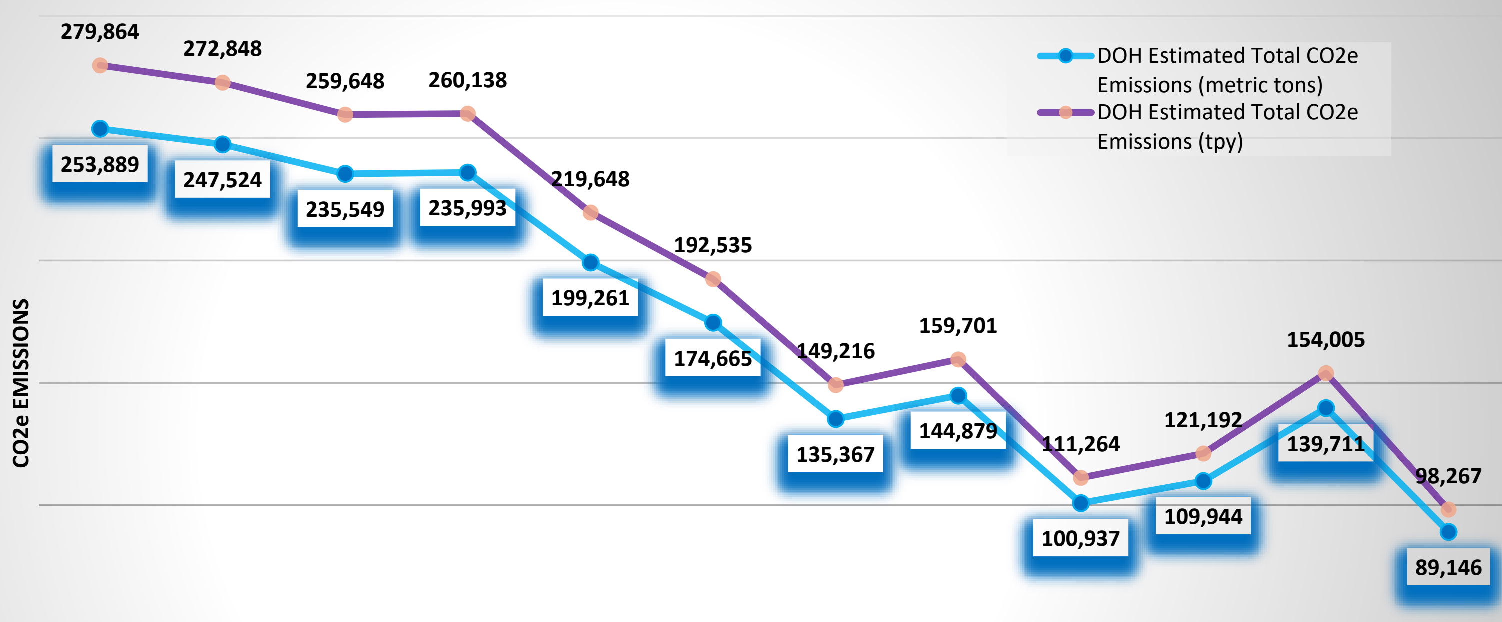
[b] **One (1) short-ton = 1.10231131 * metric tons, as derived from 1 metric ton = 0.90718474 * short ton**

ENCLOSURE 2 (Continued)

GHG EMISSION ESTIMATES AND OVERVIEW

Data Source: DOH estimates based on reported fuel consumption

Figure 2-2. Total Hamakua Energy Plant CO_2e Emissions



Calendar Year	2010	2011	2012	2013	2014	2015	2016
CO_2e Emission Reductions from 2010 (tpy)	0	-43,319	-32,834	-81,271	-71,343	-38,530	-94,268
CO_2e Emission Reductions from 2010 (%)	0.00%	-22.50%	-17.05%	-42.21%	-37.05%	-20.01%	-48.96%

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
DOH Estimated Total CO2e Emissions (metric tons)	253,889	247,524	235,549	235,993	199,261	174,665	135,367	144,879	100,937	109,944	139,711	89,146
DOH Estimated Total CO2e Emissions (tpy)	279,864	272,848	259,648	260,138	219,648	192,535	149,216	159,701	111,264	121,192	154,005	98,267

ENCLOSURE 2 (Continued)

Table 2-2

METHOD	TOTAL COMBINED CO_2e FACILITY-WIDE EMISSIONS														
	Ref	Source or Derivation	Calendar Year→ Description ↓	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TIER 1 [c]	(a)	Line (s) Chart Fuel Usage	DOH Estimated Total CO_2e Emissions (Tier 1, metric tons)	253,889	247,524	235,549	235,993	199,261	174,665	135,367	144,879	100,937	109,944	139,711	89,146
TIER 1 [c]	(b)	(a)/0.90718474 [a]	DOH Estimated Total CO_2e Emissions (tpy)	279,865	272,848	259,649	260,138	219,648	192,535	149,216	159,701	111,264	121,192	154,005	98,267
TIER 1 [c]	(c)	FLIGHT	Biogenic Emissions			0		0	0	0	0	0	0	0	
TIER 1 [c]	(d)	(b)-(c)	DOH Estimated Non-biogenic Emissions (Tier 1, tpy)						192,535						
HEP PROPOSAL	(e)	Table 1, Main Text	Hamakua Energy Proposed Baseline Emissions (Tier 2, tpy)						182,975						
HEP PROPOSAL	(f)	(e)*0.90718474	Hamakua Energy Plant Proposed Baseline Emissions (Tier 2, metric tons)						165,992						
HEP PROPOSAL	(g)	FLIGHT	Hamakua Energy Plant Baseline Biogenic Emissions (tpy)						0						
HEP PROPOSAL	(h)	Table 1, Main Text	Hamakua Energy Plant Proposed CO_2e Emissions Cap (Tier 2, tpy)						153,699						
HEP PROPOSAL	(i)	(h)*0.90718474	Hamakua Energy Plant Proposed CO_2e Emissions Cap (Tier 2, Metric Tons)						139,433						
HEP PROPOSAL	(j)	(e)-(h)	Hamakua Energy Plant Proposed Reduction in CO_2e Emissions (tpy)						29,276						
HEP PROPOSAL	(k)	Line (c) of Table 2A-2 in Enclosure 2A	DOH Estimated 2020 Minimum CO_2e Baseline Emissions Cap (Tier 2, tpy) [b]						153,142						
HEP PROPOSAL	(l)	(i)-(k)	Amount Hamakua Energy Plant Proposed Cap is Lower or (Higher) than DOH estimates (tpy)						(557.4)						
HEP PROPOSAL	(m)	(l)/(k)	Percent Hamakua Energy Plant Proposed Cap is Lower or Higher(-) than DOH estimates (%)						-0.364%						
COMBINED PARTNERS	(n)	HECO GHG ERP	Proposed Total Combined Baseline Emissions (tpy)						8,361,022						
COMBINED PARTNERS	(o)	(1.00-0.16)*(N)	Calculated Total Combined Emissions Limit (tpy)						7,023,258						
COMBINED PARTNERS	(p)	HECO GHG ERP	Proposed Total Combined Emissions Limit (tpy)						7,023,258						
COMBINED PARTNERS	(q)	(p)*0.90718474	Partnering Facilities Proposed Total Combined Emissions Limit Recalculated to Metric Tons						6,371,392						

FOOTNOTES

[a] 1 metric-ton = 0.90718474 * short tons

[b] Minimum Facility-Wide GHG Emissions Cap pursuant to HAR §11-60.1-204(c)

[c] Tier 1 method is used to illustrate and compare the emissions level of the proposed baseline year relative to emission levels of other calendar years.

ENCLOSURE 2A COMPARISON OF TIER 2 TO TIER 1

Purpose: This enclosure contains the details for calculating the HEP's CY 2010 baseline GHG emissions using both the Tier 1 and Tier 2 methods. The results from the detailed computations of this enclosure is used to examine the potential impact when using a baseline GHG emissions rate developed from using the Tier 2 method as a benchmark for gaging future GHG emissions developed from using the Tier 1 method.

Background: Hamakua Energy is proposing to use CY 2010 as the baseline GHG emissions rate, computed using the Tier 2 method in accordance with 40 CFR §98.33. The HEP may use either the Tier 1, Tier 2, or Tier 3 methods for future reporting, however, the Tier 1 method is the simplest but least accurate method in 40 CFR §98.33. The Tier 1 method utilizes fuel specific default emission factors and HHV, whereas both the Tier 2 and Tier 3 methods requires fuel sampling to determine the annual average HHV and carbon content respectively. From CY 2010 to 2017, the HEP reported to the EPA's Facility Level Information on Greenhouse Gases (GHG) Tool (FLIGHT) GHG emission rates that were computed using the Tier 2 method with exception to CY 2016 where the Tier 1 method was used. The HEP is not required to use the Tier 4 method because the maximum rated heat input capacity of each combustion turbine generator unit is less than 250 MMBtu/hr.

Calculations: CY 2010 mass-based emissions are computed using Tier 2 method in Table 2A-1.

ENCLOSURE 2A (Continued)

Table 2A-1

DOH Mass-Based Emission Estimates for CY 2010 Using Tier 2

Pollutant →			Carbon Dioxide (CO_2)[a]		Methane[b] (CH_4)		Nitrous Oxide[b] (N_2O)	
Fuel Type	Fuel Usage[c] (gal)	HHV[d]	EF (kg/MMBtu)	Mass-Based Emissions (tpy)	EF (kg/MMBtu)	Mass-Based Emissions (tpy)	EF (kg/MMBtu)	Mass-Based Emissions (tpy)
Naphtha	20,384,846	0.118341	68.02	180,877	0.003	8.0	0.0006	1.6
Diesel	67,955	0.136625	73.96	757	0.003	3.07E-02	0.0006	6.14E-03
Subtotal Mass-Based Emissions				**181,634**		**8**		**2**

[a] **CO_2 mass-based emissions computed with the Tier 2 method, equation C-2a from 40 CFR Subpart C, §98.33(a)(2) modified as follows:**

$$CO_2 = 1 \times 10^{-3} \times Fuel \times HHV \times EF \times 1.10231131$$

Where,

CO_2	=			**Annual CO_2 mass emissions for a specific fuel type (equation modified to convert emission unit from metric tons to short tons).**
Fuel	=			**Annual volume of fuel combusted (gallons/yr) during the year, from company records as defined in §98.6 (expressed in gallons).**
HHV	=	**See Footnote[d]**	=	**Annual average high heat value of the fuel (mmBtu per per gallon). The average HHV is calculated to the requirements of paragraph (a)(2) (ii) of §98.33.**
1 x 10-3	=	**0.001**	=	**Conversion factor from kg to metric tons.**
EF	=			**Fuel specific default emission factor for CO2 from Table C-1 of this subpart (kg CO2 per mmBtu).**
1.10231131	=			**Conversion factor to change emission units from metric tons to short tons.**

[b] **CH_4 and N_2O mass-based emissions are computed from using equation C-9a of 40 CFR SUBPART C, §98.33(c) modified as follows:**

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} \times Fuel \times HHV \times EF \times 1.10231131$$

Where,

CH_4 or N_2O	=			**Annual CH_4 or N_2O emissions from the combustion of a particular type of fuel (equation modified to convert emissions unit from metric tons to short tons).**
Fuel	=			**Volume of the fuel combusted during the reporting year (gallons).**
HHV	=	**See Footnote[d]**	=	**High heat value of the fuel, averaged for all valid measurements for the reporting year (mmBtu per gallon).**
EF	=			**Fuel specific default emission factor for CH4 or N2O, from Table C-2 of 40 CFR Subpart C of Part 98 (kg CH4 or N2O per mmBtu).**
1 x 10-3	=	**0.001**	=	**Conversion factor from kilograms to metric tons.**
1.10231131	=		=	**Conversion factor to change emissions unit from metric tons to short tons.**

[c] **Refer to Enclosure 2, Table 2-1 for CY 2010 fuel usage rate.**

ENCLOSURE 2A (Continued)

[d] **The annual average HHV is computed on a weighted average basis using Eq C.2b (expressed below) in 40CFR§98.33 as follows:**

$$(HHV)_{annual} = \frac{\sum_{i=1}^{n} (HHV)_i \times (Fuel)_i}{\sum_{i=1}^{n} (Fuel)_i} \qquad \text{(Eq C.2b)}$$

Where,

$(HHV)_{annual}$	=	**Weighted annual average high heat value of the fuel (mmBtu per mass or volume).**
$(HHV)_i$	=	**Measured high heat value of the fuel, for month "i" (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (mmBtu per mass or volume).**
$(Fuel)_i$	=	**Mass or volume of the fuel combusted during month "i" from company records (express volume in gallons for liquid fuel).**

ENCLOSURE 2A (Continued)

Table 2A-1.1						
HHV Weighted Annual Average *(Source: Mr. David Cummings Email dtd 12/14/18)*						
Year: 2010	**Diesel Fuel**			**Naphtha**		
Month	**HHV (MMBtu/gal)**	**Is average HHV measured or substituted ?**	**Fuel Use (gal)**	**HHV (MMBtu/gal)**	**Is average HHV measured or substituted ?**	**Fuel Use (gal)**
January	0.135667	m	6,217	0.117929	m	2,394,312
February	0.135667	m	10,412	0.118128	m	1,996,866
March	0.137178	m	8,195	0.118876	m	1,545,645
April	0.136648	m	4,929	0.119160	m	1,466,069
May	0.134832	m	3,100	0.119342	m	1,462,364
June	0.137500	m	5,074	0.118742	m	1,610,917
July	0.137500	m	4,658	0.118441	m	1,565,912
August	0.134392	m	4,241	0.118503	m	1,662,709
September	0.137500	m	4,554	0.117975	m	1,879,563
October	0.137500	m	4,779	0.118481	m	1,720,256
November	0.137500	m	4,138	0.117658	m	1,356,040
December	0.137500	m	6,868	0.117309	m	1,725,063
$(HHV)_{annual}$	**0.136625**		**67,164**	**0.118341**		**20,385,716**

Calculations: (continued) CY 2010 CO_2e baseline emissions are computed in Table 2A-2 and a comparison made between Tier 1 and Tier 2 methods.

ENCLOSURE 2A (Continued)

Table 2A-2
DOH CO2e (GHG) Emission Estimates for CY 2010 Using Tier 2

Ref	Source or Derivation ↓	Description→	ΣGHG Mass-Based Emissions	Global Warming Potential (GWP)	CO_2e Emissions	
		→	**Table 2A-1**	**40CFRS98 Table A-1**	**(a)*(b)**	**(c)/1.10231131**
		Units→	**(tpy)**	**None**	**(tpy)**	**(metric tons/yr)**
		GHG↓ Ref→	**(a)**	**(b)**	**(c)**	**(d)**
(1)	**Table 2A-1**	CO_2	181,634	1	181,634	164,776
(2)		CH_4	8	25	200	182
(3)		N_2O	2	298	477	433
(4)	**(1)+(2)+(3)**	DOH CO_2e Emission Estimate (Tier 2) =			**182,311**	165,390
(5)	**0.16*(4)**	Sixteen Percent CO_2e Emissions Reductions			**29,170**	
(6)	**(4)-(5)**	DOH Estimated 2020 CO2e Emissions Cap			**153,142**	
(7)	**Enclosure 2, Table 2-2, Ref (d)**	DOH CO_2e Emission Estimate (Tier 1) =			**192,535**	
(8)	**(4)-(7)**	Lower (Higher) than DOH Tier 2 Estimate (tpy)			**(10,224)**	
(9)	**(8)*100/(4)**	Lower (Higher) than DOH Tier 2 Estimate (%)			**-5.61%**	

Evaluation: Table 2A-2 shows the results of the DOH's detailed computations of the HEP's CO_2e baseline emissions for CY 2010 using the Tier 2 method and compares this value with the DOH's computed baseline CO_2e emissions using the Tier 1 method. Baseline emission rates computed using Tier 1 method results in a baseline emissions rate that is 5.61% higher than emission rates computed using the Tier 2 methods. Therefore, switching to Tier 1 method for future GHG reports would overstate reported GHG emissions thus understating the reduction in GHG emissions when using CY 2010 baseline computed using the Tier 2 method.

ENCLOSURE 3 STORAGE VESSELS

Table 3-1
40 CFR, Part 60, Subpart Kb Storage Vessels

Tank No.	Tank Description	Tank Content	Tank Capacity (gallons)	Tank Capacity[a] (m^3)	Max P_{VA}[b] of fuel (psi)	40CFR Subpart Kb, §60.110b Applicability[c]					
						≥ July 23, 1985	Capacity ≥ 75 m^3	Capacity < 151 m^3	Max $P_{VA} \geq$ 2.18[d] psi	Max $P_{VA} \geq$ 0.508[d] psi	Subpart Kb Applies
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
1	External Floating Roof (34,350 bbls)	Naphtha or Gasoline	1,442,700	5461	11.1	Yes	Yes	No	NA	Yes	Yes
3	External Floating Roof (34,350 bbls)	Naphtha or Gasoline	1,442,700	5461	11.1	Yes	Yes	No	NA	Yes	Yes
	Storage & Transfer (8,950 bbls)	ULSD	375,900	1423	0.022	Yes	Yes	No	NA	No	No
	Day Tank	ULSD	10,000	38	0.022	Yes	No	NA	NA	NA	No
	Storage	ammonia (anhydrous)	12,000	45	198	Yes	No	NA	NA	NA	No

Footnotes:

[a] **AP-42 Appendix A (9/85 Reformatted 1/95), MISCELLANEOUS DATA AND CONVERSION FACTORS, used as reference for the following conversions:**

1 gallon	**=**	**0.0037854**	**m^3**						
1 bbl (petroleum)	**=**	**42**	**gal**	**therefore,**	**34,350**	**bbls**	**=**	**1,442,700**	**gal**
1 bbl (petroleum)	**=**	**42**	**gal**	**therefore,**	**8,950**	**bbls**	**=**	**375,900**	**gal**

[b] **Max P_{VA} = Maximum true vapor pressure as defined in 40 CFR Kb §60.111b and determined from AP42 Section 7.1 (11/06).**

1. **For the external floating tanks, the permit limit of 11.1 psia or (76.6 kPa) is specified.**
2. **For tanks that store ULSD, a worst-case vapor pressure of 0.022 PSI at 100°F is specified based on data in Table 7.1-2 of AP 42 Section 7.1.**
3. **For the tank that store ammonia, a worst-case vapor pressure of 198 PSI at 100°F is specified based on data from the U.S. Department of Labor - OSHA Properties of Ammonia.**

Footnotes: (continued)

[c] **40CFR Subpart Kb, §60.110b Applicability:**

(a) Subpart Kb applies to each storage vessel with a capacity greater than or equal to 75 cubic meters (m^3) that is used to store volatile organic liquids (VOL) for which construction, reconstruction, or modification is commenced after July 23, 1984. The equipment date is December 1995.

(b) Subpart Kb does not apply to storage vessels with:

(1) a capacity greater than or equal to 151 m^3 storing a liquid with a maximum true vapor pressure less than 3.5 kilopascals (kPa); or

(2) a capacity greater than or equal to 75 m^3 but less than 151 m^3 storing a liquid with a maximum true vapor pressure less than 15.0 kPa.

[d] **The equivalent maximum true vapor pressures when converting the units from kPa to psi are shown below:**

1 kilo Pascal (kPa) = 0.145038 (psi)

	kPa	psi
40CFR Kb, §60.110b(b)(1)	3.5	0.508
40CFR Kb, §60.110b(b)(2)	15	2.18

ENCLOSURE 4 DEG

DEG EMISSIONS

Table 4-1
Fire Water Pump Engine (Fired with LSFO)

Pollutant	Emission Rate (ER) [a]	Annual Emissions [c]	Annual Emissions
	(lbs/hr)	**(lbs/yr)**	**(tpy)**
	(a)	**(c)=500*(a)**	**(d)=(c)/2000**
CO	1.19	595	0.298
NO_x	2.10	1050	0.525
PM [d]	0.115	57	0.029
PM_{10}	0.110	55	0.028
$PM_{2.5}$ [d]	0.103	52	0.026
SO_2	7.00E-02	35	0.018
Pb	0.00	0	0.000
VOC	5.20E-01	260	0.130
HAP (Highest)	Refer to Table 4-1.1		4.17E-04
HAP (Total)			1.39E-03

ENCLOSURE 4 (Continued)

Table 4-1.1
Speciated Organic Compounds of HAPS
Fire Water Pump Engine (Fired with LSFO)

Organic Compound	Emission Factor[a] (Fuel Input)	Emission Rate [b]	Annual Emissions [c]	Annual Emissions
	(lb/MMBtu)	(lbs/hr)	(lbs/yr)	(tpy)
	(a)	(b)=1.412*(a)	(c)=500*(b)	(d)=(c)/2000
Acenaphthene	1.42E-06	2.01E-06	0.001	5.01E-07
Acenaphthylene	2.92E-05	4.12E-05	0.021	1.03E-05
Acetaldehyde	7.67E-04	1.08E-03	0.542	2.71E-04
Acrolein	9.25E-05	1.31E-04	0.065	3.27E-05
Anthracene	1.87E-06	2.64E-06	0.001	6.60E-07
Benzene	9.33E-04	1.32E-03	0.659	3.29E-04
Benzo(a)anthracene	1.68E-06	2.37E-06	0.001	5.93E-07
Benzo(b)fluoranthene	9.91E-08	1.40E-07	0.000	3.50E-08
Benzo(k)fluoranthene	1.55E-07	2.19E-07	0.000	5.47E-08
Benzo(g,h,l)perylene	4.89E-07	6.91E-07	0.000	1.73E-07
Benzo(a)pyrene	1.88E-07	2.66E-07	0.000	6.64E-08
1,3 Butadiene	3.91E-05	5.52E-05	0.028	1.38E-05
Chrysene	3.53E-07	4.99E-07	0.000	1.25E-07
Dibenz(a,h)anthracene	5.83E-07	8.23E-07	0.000	2.06E-07
Fluoranthene	7.61E-06	1.07E-05	0.005	2.69E-06
Fluorene	2.92E-05	4.12E-05	0.021	1.03E-05
Formanldehyde	1.18E-03	1.67E-03	0.833	4.17E-04
Indeno(1,2,3-cd)pyrene	3.75E-07	5.30E-07	0.000	1.32E-07
Naphthalene	8.48E-05	1.20E-04	0.060	2.99E-05
Phenanthrene	2.94E-05	4.15E-05	0.021	1.04E-05
Pyrene	4.78E-06	6.75E-06	0.003	1.69E-06
Toluene	4.09E-04	5.78E-04	0.289	1.44E-04
Xylenes	2.85E-04	4.03E-04	0.201	1.01E-04
HAP (Single Highest)				**4.17E-04**
HAP (Total)				**1.39E-03**

FOOTNOTES TO TABLES 4-1 AND 4-1.1:

[a] **Emission rates for criteria pollutants are from CSP Renewal Application No. 0243-06. Emission factors for HAPs are from AP-42 Section 3.3, Table 3.3-2 (10/96) for diesel fuel.**

[b] **Maximum heat input rate is based on the fire water pump diesel engine fuel consumption rate of 10.4 gal/hr and a heating value is 0.1358 MMBtu/gal provided from Mr. Dave Cummings of Hamakua Energy by telephone discussion with Mr. D. Hamamoto of DOH-CAB. The maximum heat input rate is calculated as follows:**

Max Heat Input Rate (MMBtu/hr) = 10.4 (gal/hr) x 0.1358 (MMBtu/gal) = 1.412

[c] **The 500 maximum annual operating hours is the default assumption used in calculating the potential to emit (PTE) for emergency generators.**
[Source: EPA's guidance memorandum dated September 6, 1995.]

[d] **It is assumed that 96% and 90% of the total particulate is PM_{10} and $PM_{2.5}$ respectively, based on AP-42 Appendix B.2, Table B.2-2 (9/90 reformatted 1/95) for gasoline and diesel fired internal combustion engines.**

$$PM = PM_{10} \div (0.96) = 0.114583 \text{ (lbs/MMBtu)}$$

$$PM_{2.5} = PM \times (0.90) = 0.103125 \text{ (lbs/MMBtu)}$$

ENCLOSURE 4 (Continued)

Table 4-2
1,250 KW (14.3 MMBtu/hr) Black Start DEG (Fired with LSFO)

Pollutant	Emission Rate (ER)[a] per Stack	Total Emission Rate [b]	Annual Emissions [c]	Annual Emissions
	(lbs/hr)	**(lbs/hr)**	**(lbs/yr)**	**(tpy)**
	(a)	**(b)=(a)*2**	**(c)=52*(b)**	**(d)=(c)/2000**
CO	1.33	2.66	138	0.069
NO_x	14.93	29.86	1553	0.776
PM [d]	0.10	0.21	11	0.005
PM_{10}	0.10	0.20	10	0.005
$PM_{2.5}$ [d]	0.09	0.19	10	0.005
SO_2	0.25	0.50	26.00	0.013
Pb	0.00	0.00	0	0.000
VOC	0.25	0.50	26.00	0.013
HAP (Highest)	Refer to Table 4-2.1			4.39E-04
HAP (Total)				1.46E-03

ENCLOSURE 4 (Continued)

Table 4-2.1
Speciated Organic Compounds of HAPs
1,250 KW (14.3 MMBtu/hr) Black Start DEG (Fired with LSFO)

Organic Compound	Emission Factor[a] (Fuel Input)	Emission Rate [b]	Annual Emissions [c]	Annual Emissions
	(lb/MMBtu)	(lbs/hr)	(lbs/yr)	(tpy)
	(a)	(b)=14.3*(a)	(c)=52*(b)	(d)=(c)/2000
Acenaphthene	1.42E-06	2.03E-05	0.001	5.28E-07
Acenaphthylene	2.92E-05	4.18E-04	0.022	1.09E-05
Acetaldehyde	7.67E-04	1.10E-02	0.570	2.85E-04
Acrolein	9.25E-05	1.32E-03	0.069	3.44E-05
Anthracene	1.87E-06	2.67E-05	0.001	6.95E-07
Benzene	9.33E-04	1.33E-02	0.694	3.47E-04
Benzo(a)anthracene	1.68E-06	2.40E-05	0.001	6.25E-07
Benzo(b)fluoranthene	9.91E-08	1.42E-06	0.000	3.68E-08
Benzo(k)fluoranthene	1.55E-07	2.22E-06	0.000	5.76E-08
Benzo(g,h,l)perylene	4.89E-07	6.99E-06	0.000	1.82E-07
Benzo(a)pyrene	1.88E-07	2.69E-06	0.000	6.99E-08
1,3 Butadiene	3.91E-05	5.59E-04	0.029	1.45E-05
Chrysene	3.53E-07	5.05E-06	0.000	1.31E-07
Dibenz(a,h)anthracene	5.83E-07	8.34E-06	0.000	2.17E-07
Fluoranthene	7.61E-06	1.09E-04	0.006	2.83E-06
Fluorene	2.92E-05	4.18E-04	0.022	1.09E-05
Formaldehyde	1.18E-03	1.69E-02	0.877	4.39E-04
Indeno(1,2,3-cd)pyrene	3.75E-07	5.36E-06	0.000	1.39E-07
Naphthalene	8.48E-05	1.21E-03	0.063	3.15E-05
Phenanthrene	2.94E-05	4.20E-04	0.022	1.09E-05
Pyrene	4.78E-06	6.84E-05	0.004	1.78E-06
Toluene	4.09E-04	5.85E-03	0.304	1.52E-04
Xylenes	2.85E-04	4.08E-03	0.212	1.06E-04
HAP (Highest)				**4.39E-04**
HAP (Total)				**1.46E-03**

FOOTNOTES TO TABLES 4-2 AND 4-2.1

[a] **Emission rates for criteria pollutants are from CSP Renewal Application No. 0243-06. Emission factors for HAPs are from AP-42 Section 3.3, Table 3.3-2 (10/96) for diesel fuel.**

[b] **Black start DEG has two (2) stacks**

[c] **The maximum operating hours of the black start diesel engine generator shall each not exceed fifty-two (52) hours per rolling 12-month period.**

[d] **It is assumed that 96% and 90% of the total particulate is PM_{10} and $PM_{2.5}$ respectively, based on AP-42 Appendix B.2, Table B.2-2 (9/90 reformatted 1/95) for gasoline and diesel fired internal combustion engines.**

$$PM = PM_{10} \div (0.96) = 0.104167 \quad \text{(lb/hp-hr)}$$

$$PM_{2.5} = PM \times (0.90) = 0.09375 \quad \text{(lb/hp-hr)}$$

ENCLOSURE 5 GHG

Table 5-1

Mass-Based Greenhouse Gas Emissions

Source Unit	Fuel	Maximum Design Heat Input per Unit [a] (MMBtu/hr)	Hours of Operation per year	Maximum Heat Input per year (MMBtu/yr)	Carbon Dioxide (CO_2)		Methane (CH_4)		Nitrous Oxide (N_2O)	
					EF [c] (kg/MMBtu)	Mass-Based Emissions [d] (tpy)	EF [c] (kg/MMBtu)	Mass-Based Emissions [d] (tpy)	EF [c] (kg/MMBtu)	Mass-Based Emissions [d] (tpy)
CT 1	Naphtha	247	8,760	2,163,720	68.02	162,234	0.003	7.16	0.0006	1.43
	FO No. 2	247	8,760	2,163,720	73.96	176,401	0.003	7.16	0.0006	1.43
CT 2	Naphtha	247	8,760	2,163,720	68.02	162,234	0.003	7.16	0.0006	1.43
	FO No. 2	247	8,760	2,163,720	73.96	176,401	0.003	7.16	0.0006	1.43
CT Total Emissions (worst case by fuel type)[b]						**352,803**		**14.3**		**2.9**
1275 kW Blackstart DEG	FO No. 2	14.3	8,760	125,268	74.96	10,351	0.003	0.41	0.0006	0.08
Subtotals of Mass-Based GHG Emissions						**363,153**		**15**		**3**

FOOTNOTES TO TABLE 5-1

a **GHG emissions estimate is based on a specified maximum design heat input of 247 MMBtu/hr per CT. A maximum design fuel consumption rate of 103.6 gal/hr is specified in the manufacturer's specification for the 1275kW black start DEG. This equates to a maximum design heat input calculated using a default high heat value of 0.138 MMBtu/gal from 40CFR§98 Table C-1 for Fuel Oil No. 2 as follows:**

Heat Input of Black Start DEG = 103.6 (gal/hr) x 0.138 (MMBtu/gal) = 14.3 (MMBtu/hr)

b **Maximum potential emission are based on a worst case operating basis using the fuel type that produces the higher emission rate.**

c **As demonstrated in Enclosure 2A, the Tier 1 computation method is used as a conservative estimate since 40 CFR §98.33 allows the HEP Facility to use either Tier 1 or Tier 2. Default emission factors (EF) and HHV are from 40CFR§98 Table C-1 for CO2 and Table C-2 for CH4 and N2O.**

ENCLOSURE 5 (Continued)

FOOTNOTES TO TABLE 5-1 (Continued)

[d] **Mass-based emissions are calculated by multiplying the [maximum heat input per year] x [applicable emissions factors from 40 CFR §98, Tables C-1 or C-2] x [conversion factor of 1.10231131 (tpy/metric tons)] x [0.001(metric tons/kg)].**

Maximum Heat Input (MMBtu/yr)	x	EF (kg/MMBtu)	x	1.10231131 (tons/metric tons)	x	0.001 (metric tons/kg)	=	1.10E-03	x Maximum Heat Input x EF (tpy)

[e] **Storage tanks and emergency DEGs are not included because the HEP facility meets the condition of 40 CFR §98.2 paragraph (a)(3) and these units are not stationary fuel combustion sources as defined in 40 CFR §98.30.**

ENCLOSURE 6 HAPS

HAPs Emissions for Application No. 0243-07

Description →	CT (East)	CT (West)	CTGs	Fire Pump	Black Start DEG	2019 Totals
Source or Derivation →	**Note[a]**	**Note[a]**	**((a)+(b))*8760 / 2000**	**Table 4-1.1, Enclosure 4**	**Table 4-2.1, Enclosure 4**	**(c)+(d)+(e)**
Ref →	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(g)**
Pollutant ↓ Units →	**(lbs/hr)**	**(lbs/hr)**	**(tpy)**	**(tpy)**	**(tpy)**	**(tpy)**
Acenaphthene			Note[b]	5.01E-07	5.28E-07	1.03E-06
Acenaphthylene			Note[b]	1.03E-05	1.09E-05	2.12E-05
Acetaldehyde (1)	1.77E-01	1.77E-01	1.55	2.71E-04	2.85E-04	1.55
Acrolein (6)	2.13E-02	2.13E-02	1.87E-01	3.27E-05	3.44E-05	1.87E-01
Antimony (172)	5.07E-03	5.07E-03	4.44E-02			4.44E-02
Anthracene			Note[b]	6.60E-07	6.95E-07	1.36E-06
Arsenic (173)[c]	1.13E-03	1.13E-03	9.9E-03	3.29E-04	3.47E-04	1.06E-02
Benzene (15)	2.26E-01	2.26E-01	1.98	5.93E-07	6.25E-07	1.98
Benzo(a)anthracene			Note[b]	3.50E-08	3.68E-08	7.18E-08
Benzo(b)fluoranthene			Note[b]	5.47E-08	5.76E-08	1.12E-07
Benzo(k)fluoranthene			Note[b]	1.73E-07	1.82E-07	3.54E-07
Benzo(g,h,I)perylene			Note[b]	6.64E-08	6.99E-08	1.36E-07
Benzo(a)pyrene			Note[b]	1.38E-05	1.45E-05	2.83E-05
Beryllium (174) [c]	7.61E-05	7.61E-05	6.7E-04			6.67E-04
1,3 Butadiene (23)				1.38E-05	1.45E-05	2.83E-05
Cadmium (175)	9.68E-04	9.68E-04	8.48E-03			8.48E-03
Chromium (176)	1.08E-02	1.08E-02	9.46E-02			9.46E-02
Chrysene			Note[b]	1.25E-07	1.31E-07	2.56E-07
Cobalt (177)	2.10E-03	2.10E-03	1.84E-02			1.84E-02
Dibenz(a,h)anthracene			Note[b]	2.06E-07	2.17E-07	4.23E-07
Fluoranthene			Note[b]	2.69E-06	2.83E-06	5.52E-06
Fluorene			Note[b]	1.03E-05	1.09E-05	2.12E-05
Formaldehyde (86)	2.72E-01	2.72E-01	2.38	4.17E-04	4.39E-04	2.38
Indeno(1,2,3-cd)pyrene			Note[b]	1.32E-07	1.39E-07	2.72E-07
Lead (181)	1.34E-02	1.34E-02	1.17E-01			1.17E-01

ENCLOSURE 6 (Continued)

Description →	CT (East)	CT (West)	CTGs	Fire Pump	Black Start DEG	2019 Totals
Source or Derivation →	**Note[a]**	**Note[a]**	**((a)+(b))*8760 / 2000**	**Table 4-1.1, Enclosure 4**	**Table 4-2.1, Enclosure 4**	**(c)+(d)+(e)**
Ref →	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(g)**
Pollutant ↓ Units →	**(lbs/hr)**	**(lbs/hr)**	**(tpy)**	**(tpy)**	**(tpy)**	**(tpy)**
Manganese (182)	7.84E-02	7.84E-02	6.87E-01			6.87E-01
Mercury (183)	2.10E-04	2.10E-04	1.84E-03			1.84E-03
Naphthalene			Note[b]	2.99E-05	3.15E-05	6.15E-05
Nickel (185)	2.77E-01	2.77E-01	2.43			2.43
Phenanthrene			Note[b]	1.04E-05	1.09E-05	2.13E-05
Phosphorous (133)	6.92E-02	6.92E-02	6.06E-01			6.06E-01
Pyrene			Note[b]	1.69E-06	1.78E-06	3.46E-06
Selenium (188)	1.22E-03	1.22E-03	1.07E-02			1.07E-02
Toluene (151)	9.43E-02	9.43E-02	8.26E-01	1.44E-04	1.52E-04	8.26E-01
Xylene isomers (168)	2.49E-01	2.49E-01	2.18	1.01E-04	1.06E-04	2.18
PAH	3.87E-02	3.87E-02	3.39E-01			3.39E-01
Fluorides	0	0	0			0
Sulfuric Acid Mist	0	0	0			0
HAP (Single Highest)			2.4	4.17E-04	4.39E-04	2.4
HAP (Total)			13.5	1.39E-03	1.46E-03	13.5

[a] **Emission rates are from CSP Renewal Application No. 0243-06, except as noted.**

[b] **Grouped as polycyclic aromatic hydrocarbons (PAH).**

ENCLOSURE 7 COOLING TOWERS

PM_{10} emissions for the cooling tower are computed based on past recommendations from Mr. Ron Myers at the EPA, Research Triangle Park as follows:

PM_{10} emissions = DE X TDS X CW (lbs/hr-cell)

Where,	**DE[a] =**	**Drift Eliminator Factor =**		**0.002%**	**Efficiency**	
	TDS[b] =	**Total Dissolved Solids =**		**0.0021**	**Weight fraction**	
	CW[c]=	**Circulating Water Vol =**		**11,516,100**	**(lbs/hr-cell)**	

PM_{10} (lbs/hr-cell) =	**0.002%**	**X**	**0.0021**	**X**	**11,516,100**	**=**	**0.4836762**
Total PM_{10} (lbs/hr)[d] =	**0.4836762**	**X**	**3**	**=**	**1.451**		
Total PM10 (tpy) =	**1.451**	**X**	**8760**	**÷**	**2000**	**=**	**6.147**

Footnotes:

[a] **DE is restricted from exceeding a 0.002% total drift loss.**

[b] **Total concentration of dissolved solids is restricted from exceeding 2,100 mg/l where 1 mg/L = 1 ppm and its maximum equivalent weight fraction computed as follows:**

Maximum weight fraction of	**TDS**	**=**	**2,100**	**(ppmwt)**	**X**	**1.00E-06**	**=**	**0.0021**

[c] **The design circulating flow rate is restricted from exceeding 23,000 gallons per minute and its maximum flow rate by weight per hour per cell is computed as follows:**

CW_{VOL} =	**23,000**	**(gpm)**	**X**	**60**	**(min/hr)**	**=**	**1,380,000**
CW_{WT} =	**1,380,000**	**(gal/hr-cell)**	**X**	**8.345**	**(lbs/gal)**	**=**	**11,516,100**

[d] **Three (3) cells confirmed with Mr. Dave Cummings by telecon on 2/15/19.**