



Hawaii GHG Emissions Reduction Modeling

Prepared for:

Hawaii Greenhouse Gas Emissions Reduction Task Force

September 3, 2009



Passion. Expertise. Results.

Hawaii GHG Emissions Reduction Task Force

Agenda:

1. Summary of Results
2. Project Overview
3. Reference Projection
4. Work Plans & Impact Analysis
5. Questions and Discussion

Note – “~” used to represent “approximately” in following slides.

Summary of Results

- Act 234 Target – Reduce Hawaii’s GHG Emissions to 1990 levels by 2020 (*excluding aviation, international bunker*).
- Existing and approved policies/legislation modeled in Reference Projection achieve State goal.
- HCEI Initiative plus recommended policies further reduce emissions to about 40% below 1990 levels by 2020.
- State-level carbon tax modeled results in only small change in GHG emissions but provides potential revenue source to fund programs.
- Federal Cap-and-Trade system would not drive any significant additional GHG reductions. Effects on economy remain unclear; depend on federal decisions.

Project Overview

➤ Target

- ❖ Reduce GHG emissions in 2020 to the level of 1990 emissions
- ❖ Excludes aviation and international bunker, includes sinks.
- ❖ Based on GHG Inventory Target = 13.66 Mt by 2020.

➤ Scope:

- ❖ Develop three Work Plans to achieve State GHG Reduction Target – using screening criteria outlined by Act 234 and specified by DBEDT.

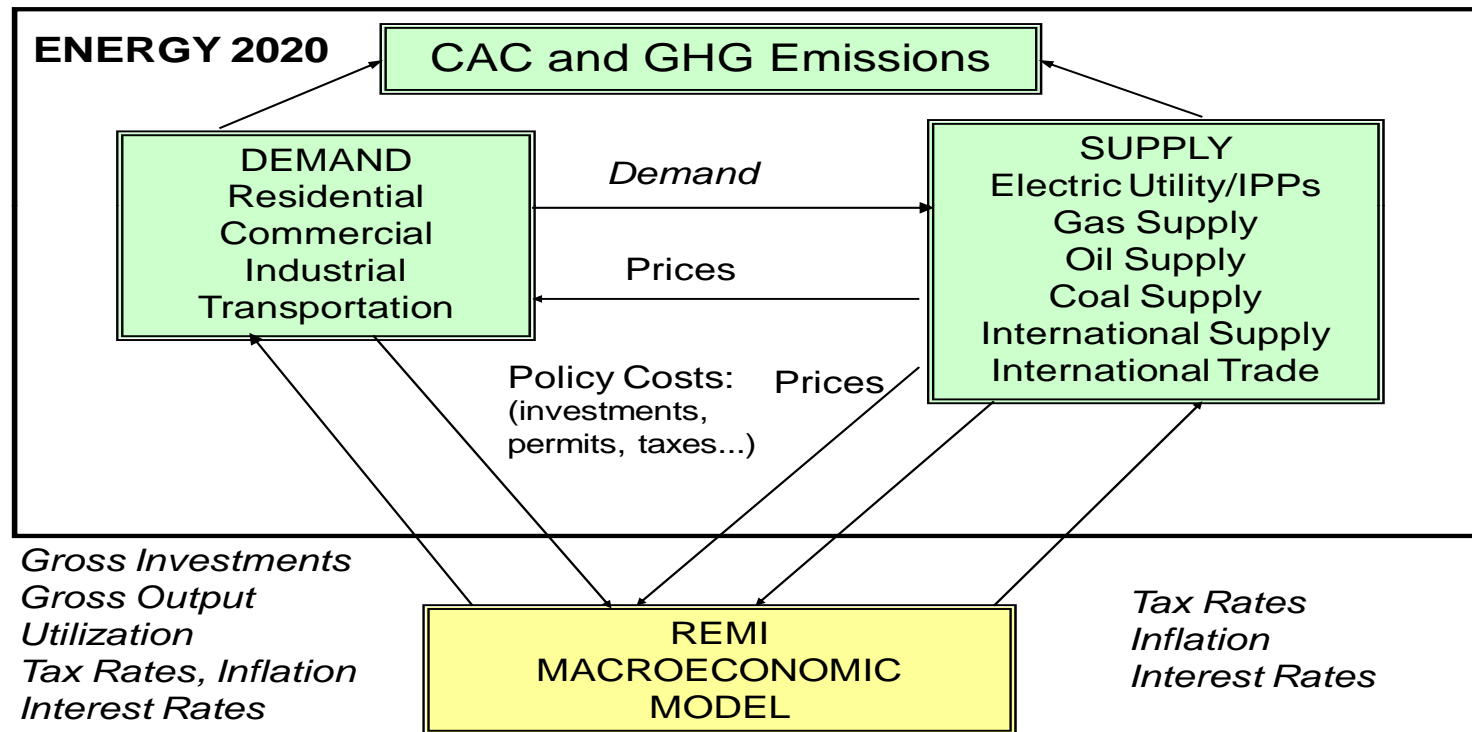
➤ Key Assumptions:

- ❖ energy prices based on AEO 2009 Reference Case projections.
- ❖ economic & demographic forecast - DBEDT 2035 Series.

➤ Used ENERGY 2020 to model state energy use and emissions and REMI to model economic impacts.

Project Overview - Models Used

Model Structure & Relationships



Reference Projection - Summary

- Population growth ~1.1% per year
- Economy increase ~2.3% per year (Gross Regional Product or GRP)
- Secondary energy use projected to rise by only 0.3% per year and electricity use by 0.6% per year.
- Lower energy use per household and per \$ output due to increased efficiency driven by State & federal policies.
- GHG emissions decline slightly (0.8% per year) as a result of energy efficiency and increased renewable use.
- Emissions from highway transportation and power sector decline as a share of total emissions.

Reference Projection - Emissions

GHG Emissions (kt)	1990	2007	2010	2015	2020	Avg. Annual Growth Rate 2007-2020	Absolute Change 1990-2020
Residential	30	66	63	64	66	0.0%	36
Commercial	380	329	329	327	315	-0.4%	(65)
Industrial	880	637	650	649	635	0.0%	(245)
Passenger - Residents	3,230	2,918	2,534	2,185	1,819	-3.6%	(1,200)
Passenger - Visitors	n/a	453	331	271	211	-5.7%	^
Marine	1,650	2,173	2,182	2,184	2,135	-0.1%	485
Aviation	6,800	4,839	5,075	5,180	5,167	0.5%	(1,633)
Freight	1,530	1,402	1,298	1,240	1,204	-1.2%	(326)
Power Sector	6,790	8,745	7,957	7,545	7,684	-1.0%	894
Waste	850	1,032	1,143	1,209	1,320	1.9%	470
Agriculture & Forestry	(1,690)	(2,267)	(2,267)	(2,266)	(2,266)	0.0%	(576)
Total	20,450	20,326	19,294	18,588	18,289	-0.8%	(2,161)
Targetted Emissions	13,660	15,487	14,219	13,408	13,123	-1.3%	(527)

- ❖ Emissions included in target - 13.66 Mt CO₂e in 1990.
- ❖ Under Reference Projection emissions included in target fall to 13.1 Mt CO₂e by 2020 – or 4% below 1990 levels.
- ❖ ***State reduction target is met in Reference Projection.***

GHG Reduction Policies Included in Work Plans

Work Plans – Summary

Work Plan:

- 1 Hawaii Clean Energy Initiative plus additional recommended policies.
- 2 State-level Carbon Tax (*plus Work Plan 1*).
- 3 Federal Cap-and-Trade System (*plus Work Plan 1*).

➤ Note

1. Policies included in Reference Projection result in total State emissions declining by ~10% from 2007 levels by 2020 (*emissions included in target drop by ~15% by 2020*).
2. Act 234 goals are met in Reference Projection.
3. All three plans assume the policies in the Hawaii Clean Energy Initiative are implemented in accordance with the HCEI Agreement between HECO and the State.

Work Plans – Key Assumptions/Caveats

- Assumes that legislated targets for RPS, EEPS, and AFS are met. (*Appendix B of Work Plan lists specific policy assumptions*).
- Achieving these aggressive targets will not be easy:
 - EEPS target of 20% reduction in electricity use by 2020 implies very aggressive and sustained DSM initiatives.
 - Achieving RPS target of 25% renewables by 2020 assumes substantial expansion of wind and other renewable capacity.
 - Higher HCEI targets assume major infrastructure initiatives, including inter-island undersea cable .
- Biodiesel/palm oil prices are assumed to decline below the price of diesel during the period. Future biofuel prices are uncertain; could remain above fossil prices.
- Assumes in-state production of biofuels and ethanol. Dependent on new capacity additions.

Work Plan 1: HCEI + Additional Policies

➤ Work Plan 1 includes the following policies:

Code*	Policy	Description	Approx. CO2e Reduction in 2020 (when implemented in isolation)
B	Renewable Portfolio Standard (RPS)	25% of electricity sales by 2020 (5% above Reference Projection)	244 kt
C	Energy Efficiency Portfolio Standard (EEPS)	20% reduction by 2020	1,580 kt
D	Additional Renewable Generation and use of Biodiesel to Fuel Power Plants	per HCEI Energy Agreement	4,490 kt
E	Sea Water Cooling	2 projects – Waikiki/Honolulu	126 kt
F	Alternative Fuel Standard (AFS)	20% of highway fuels by 2020	192 kt
G	Increased Vehicle Efficiency	Average new vehicle efficiency rise from 35.5 mpg in 2016 to 42.4 by 2020.	27 kt
H	Plug In Hybrid Electric Vehicles (PHEV's)	2010 start – reaching 2% of new vehicles by 2020	56 kt
I	Building Codes	2010 - 30% over current 2014 - 50% over current then 5% every 3 years.	715 kt

Note – Freight options (J) and Land Use Planning (K) recommended but not included in modeling.

* Code refers to part of section 5 of Work Plan Report which describes the policy.

Work Plan 1: HCEI + Additional Policies

- *Reductions shown for each policy provided only as an approximation of relative contribution – estimates do not take interactions between policies into account.*
- Bulk of reductions to 2020 come from power sector as a result of EEPS and HCEI Agreement initiatives – complemented by improved building codes.
- HCEI Agreement modeled based on initiatives described in HCEI Agreement – understood to be a work in progress.
- Additional reductions due to RPS, AFS, and vehicle standard enhancements relatively small – bulk of reduction from these initiatives achieved in Reference Projection.
- Effects of building codes, PHEV's, Urban Form/Smart Growth limited when only looking out to 2020 but important to longer term goals.

Work Plan 2: State Carbon Tax (Plus HCEI Policies)

- Modeled Carbon Tax applied at State level
- Effectiveness of Carbon Tax in reducing GHG emissions depends on level of tax and relative levels of energy efficiency in Hawaiian economy.
- Assumed to start at \$10/tonne in 2010 and increase to \$40 per tonne CO₂e by 2020.
 - ❖ Covers all sectors
 - ❖ Applied to all fossil fuels based on carbon content of each fuel.
 - ❖ Does not cover non-energy emissions or feedstocks.
 - ❖ Provides price certainty not compliance certainty; subject to same market imperfections as any other price signal.
 - ❖ Level selected to be comparable to anticipated cost of permits under proposed federal C&T program.

Work Plan 2: State Carbon Tax (Plus HCEI Policies)

- Impact on emissions relatively small (<50kt CO₂e reduction) compared to WP1 (4,800 kt CO₂e reduction)
- Revenues raised – about \$200 million in 2010 rising to ~\$870 million per year by 2020.
- Recommend majority of revenues (~90%) be returned via tax system.
- Portion could be used to finance HCEI initiatives, energy efficiency or efforts to adapt to the impacts of climate change on Hawaii's infrastructure and environment.
- Recommend that a portion be used to target assistance to groups most affected by tax (i.e. low income households) – contributing to reduction goals while reducing negative impacts.

Work Plan 3: Cap & Trade (Plus HCEI Policies)

- Federal Cap-and-Trade (C&T) policy modeled on American Clean Energy and Security (ACES) Act *(also referred to as Waxman-Markey)*
- Requires 17% reduction from covered sectors by 2020
- Coverage:
 - ❖ 2012 - Electricity sector and Petroleum Refining
 - ❖ 2014 - Other industrial sectors
 - ❖ 2016 - Gas LDC's.
- Electricity/Refineries equal ~90% of Hawaiian emissions.
- Permit prices based on EIA modeling *(assumed to start at \$20 per tonne in 2012 rising to \$35 per tonne by 2020).*

Work Plan 3: Cap & Trade (Plus HCEI Policies)

- Permits – auction 17.5% in 2016 rising to 72% by 2030.
- Assumed allocation based on WRI/Georgetown analysis
- Extent to which funds from “allowance-funded” federal programs will benefit Hawaii is unknown as programs & rules are not yet defined (“programs” includes R&D, low-income consumer assistance, adaptation, and assistance for ‘trade-vulnerable’ industries) .
- Modeling conservatively assumed relatively high prices for permits and no portion of allowance-funded programs returned to Hawaii.

Work Plan 3 – Modeling Results

- Cap-and-Trade results in minor change in energy use and emissions relative to HCEI (~ 20kt CO₂e reduction from C&T vs. 4,800 kt CO₂e reduction from Work Plan 1/HCEI).
- Emissions & number of permits required projected to fall from ~18 Mt in 2012 to ~14 Mt CO₂e by 2020.
- Hawaii projected to receive about 8.8 Mt of free permits plus ~0.2 Mt of permits for the refineries & coal plant.
- Difference equals potential cost to Hawaiian economy.
- Estimated net cost of purchasing permits from federal system as ~\$212 million in 2012, falling to ~\$154 million in 2020 as emissions decline.
- Represents about 0.2% of projected GRP in 2020.

Work Plans – Modeling Results

Summary of Work Plan Impacts <i>(changes all from Reference Projection)</i>	Work Plan 1 (HCEI +)	Work Plan 2 (State Carbon Tax)	Work Plan 3 (Federal Cap-and-Trade)
2020 GHG Emissions included in Target (in kt CO ₂ e) <i>Reference – 13,419 kt</i> <i>1990 Level – 13,660 kt</i>	8,569	8,527	8,550
Change from Reference	4,850	4,892	4869
Increase in Electricity Prices	22-24%	25-28%	21-23%
Change in average Residential Bill	~20% decrease	~20% decrease	~20% decrease
Change in other energy prices	No change	5-6% Increase	7-8% increase

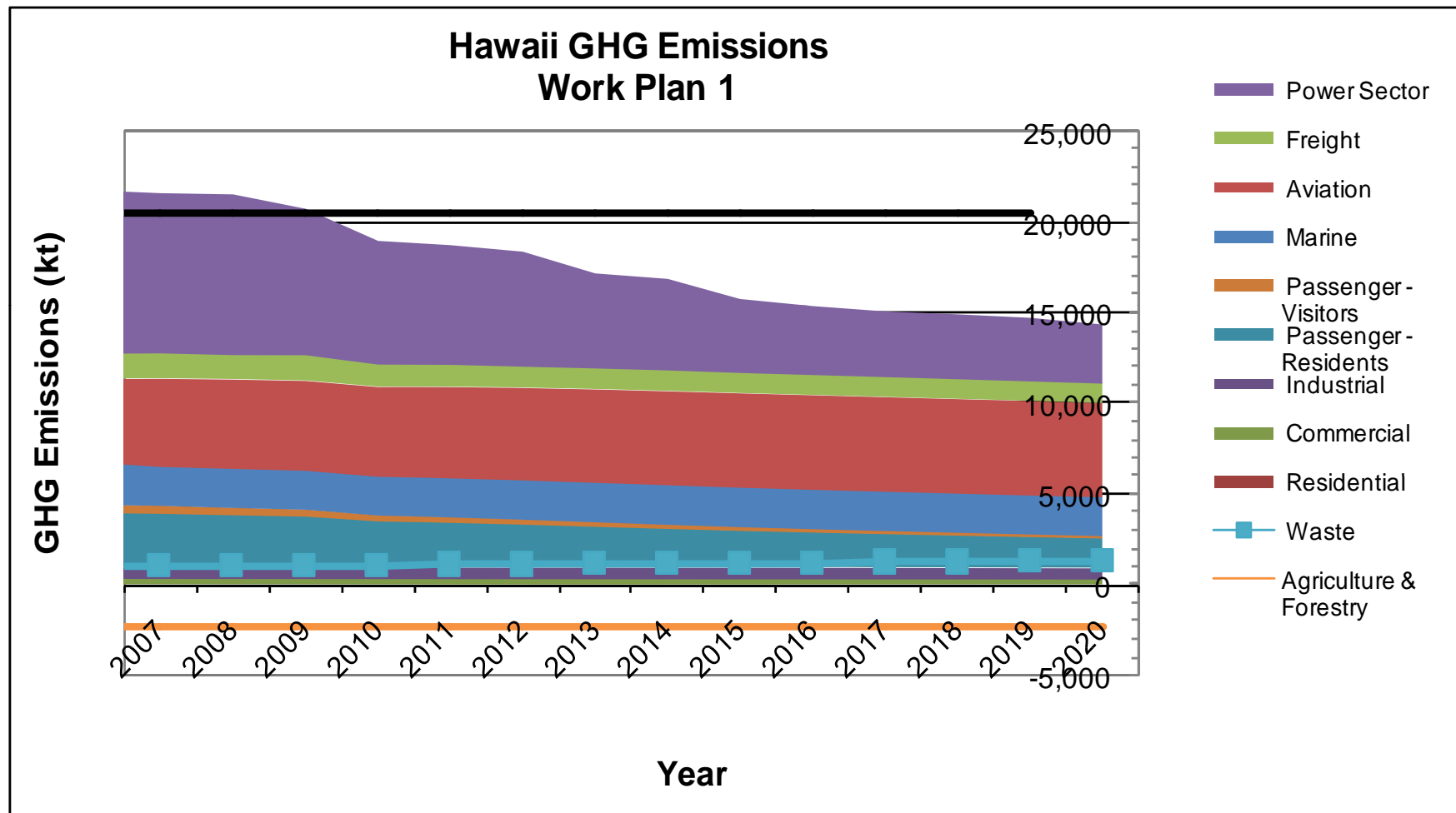
➤ Note that while electricity prices rise, actual costs for consumers decline as efficiency gains reduce average consumption.

Work Plan 1 – Modeling Results

GHG Emissions (kt)	1990	2007	2010	2015	2020	Avg. Annual Growth Rate 2007-2020	Abs. Change from Ref @ 2020	% Change from Ref @ 2020
Residential	30	66.0	61.8	61.1	62.2	-0.4%	(3.9)	-5.9%
Commercial	380	329.4	319.9	313.9	298.3	-0.8%	(16.2)	-5.2%
Industrial	880	637.1	644.3	645.8	630.5	-0.1%	(4.5)	-0.7%
Passenger - Residents	3,230	2,917.6	2,502.8	1,980.8	1,591.9	-4.6%	(226.6)	-12.5%
Passenger - Visitors	n/a	452.6	348.8	246.5	185.0	-6.6%	(26.1)	-12.3%
Marine	1,650	2,172.6	2,153.1	2,183.9	2,135.2	-0.1%	-	0.0%
Aviation	6,800	4,839.4	4,929.2	5,179.8	5,166.9	0.5%	-	0.0%
Freight	1,530	1,401.9	1,249.8	1,136.3	1,096.1	-1.9%	(107.8)	-9.0%
Power Sector	6,790	8,745.1	6,751.4	4,039.4	3,230.7	-7.4%	(4,452.9)	-58.0%
Waste	850	1,031.6	1,098.2	1,209.3	1,320.4	1.9%	-	0.0%
Agriculture & Forestry	(1,690)	(2,267.0)	(2,266.8)	(2,266.3)	(2,265.8)	0.0%	-	0.0%
Total	20,450	20,326.2	17,792.7	14,730.4	13,451.4	-3.1%	(4,838.0)	-26.5%

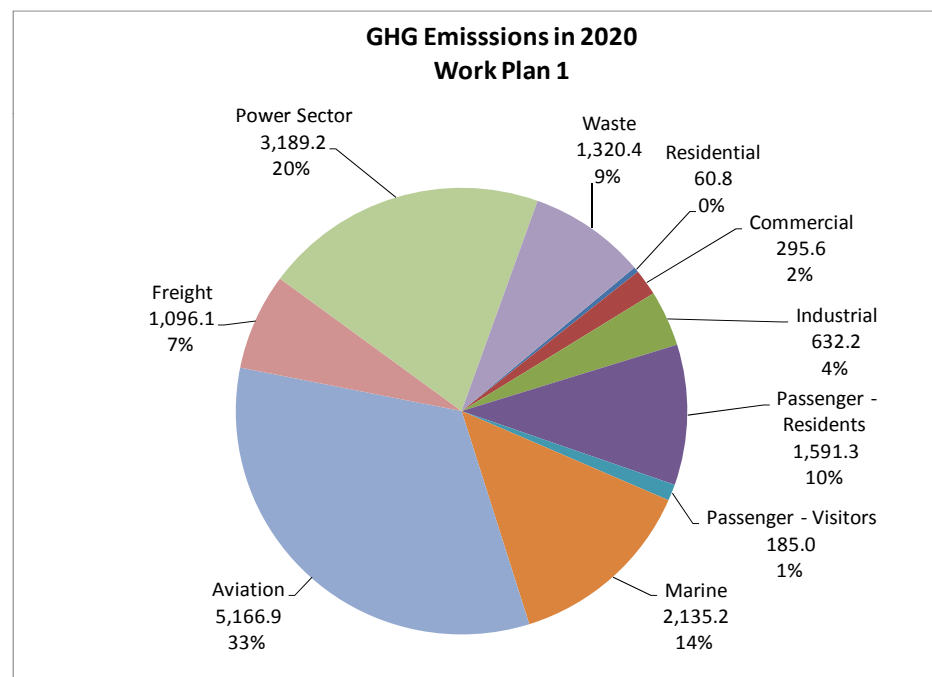
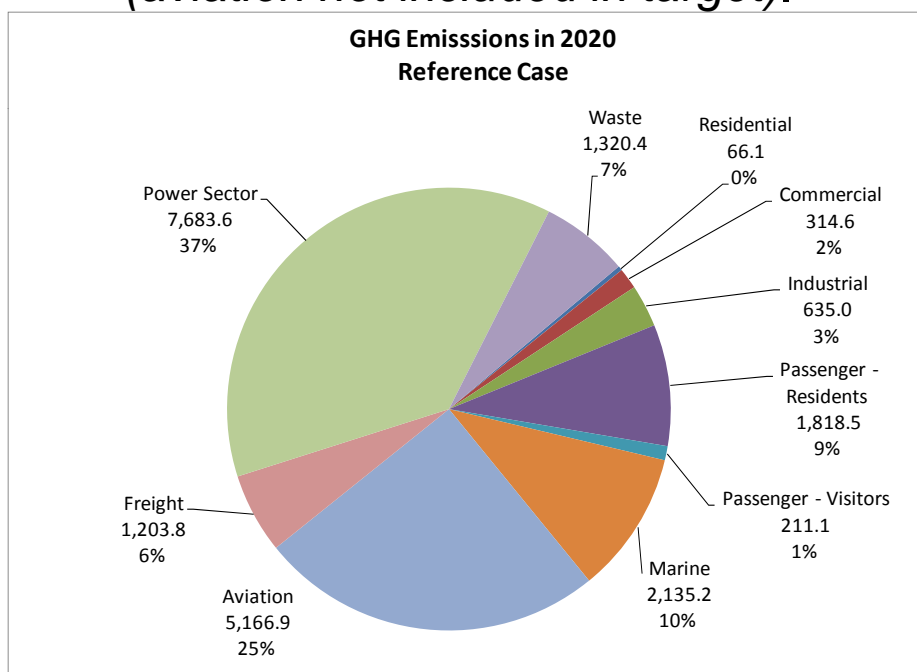
- Residential and Commercial energy use and electricity sales fall by roughly 30%; passenger transportation by about 4% vs. Reference.
- Decrease in electricity sales a combination of energy efficiency and increased use of solar PV/net metering.
- Combined with increased use of renewables these reductions drive emissions to 26% below Reference Projection levels by 2020.

Work Plan 1 – State GHG Emissions



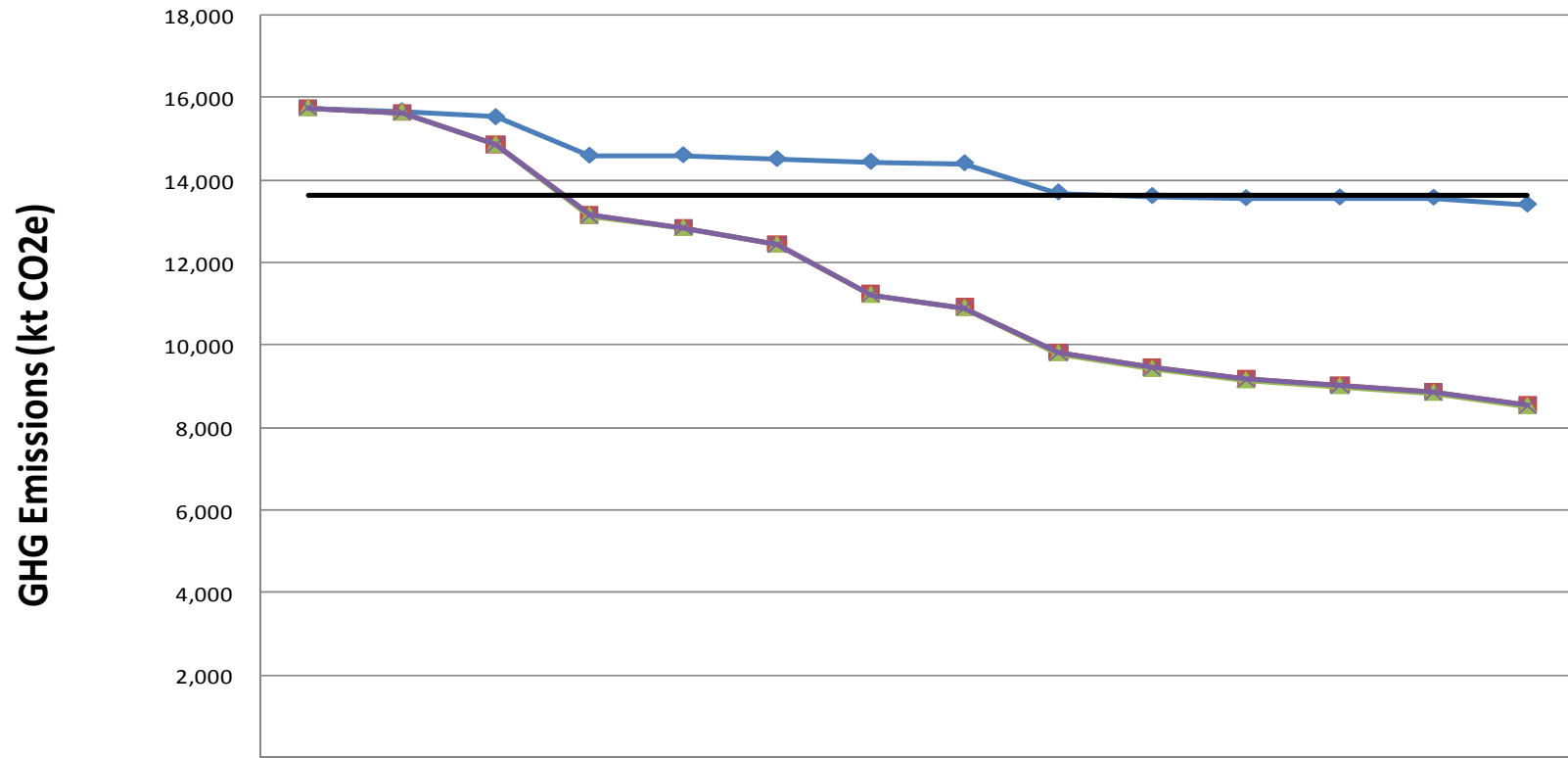
Work Plan 1 – State GHG Emissions

- Composition of emissions shifts as key sources reduced through policy initiatives.
- Aviation, marine and freight become larger share of remaining emissions (*aviation not included in target*).



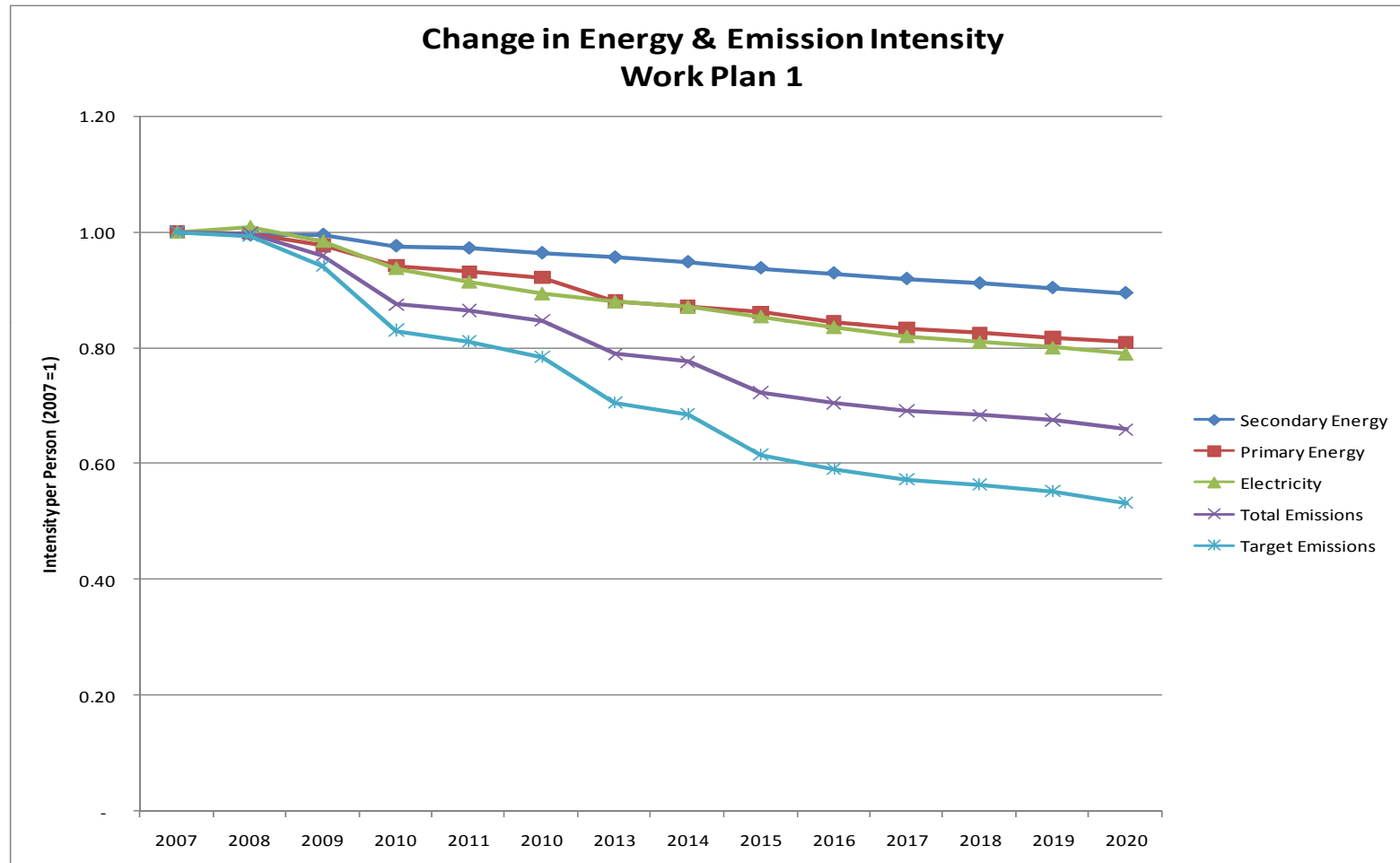
Note: Data labels show emissions in kt CO2e and % of total

Hawaii's Targetted GHG Emissions Under Work Plans



Note – Graph includes all emissions. All plans meet Act 234 target.

Work Plan 1 – Energy/Emission Intensity



Work Plans – Summary of Results

- GHG Reductions under different plans do not vary significantly.
- Bulk of GHG reduction comes from Work Plan 1
- Work Plan 2 and 3 differ from Work Plan 1 in terms of impacts on energy costs and Hawaiian economy.
- Work Plan 2 (Carbon Tax) provides an enhanced prices signal and a source of funds for State.
- Work Plan 3 (C&T) results in some potential flow of funds out of Hawaii to federal system. Net impact depends on extent to which State can attract a share of “permit funded” program spending.

Questions and Discussion?

Glen Wood

Senior Manager

ICF International

gwood@icfi.com

Susan Asam

Manager

ICF International

sasam@icfi.com

Jeff Amlin

President

Systematic Solutions, Inc.

JeffAmlin@ENERGY2020.com

Mahalo!