

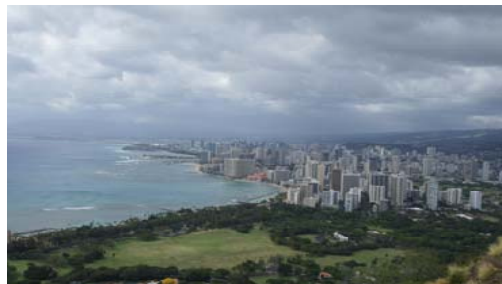


Hawaii GHG Emissions Reduction Modeling

Prepared for:

Hawaii Greenhouse Gas Emissions Reduction Task Force

June 16, 2009



Hawaii GHG Emissions Reduction Task Force

Agenda:

1. Status Update and Plan for Completing Project
2. Review of ENERGY 2020 & REMI models
3. Modeling Inputs and Assumptions
4. Historic Pattern of Hawaii GHG emissions
5. Review of Potential Policies
6. Questions and Discussion

Work Plan for Project Completion:

- Built updated model for Hawaii – incorporating updates relating to Cap-and-Trade options and data from the GHG Inventory completed by ICF.
- ICF obtained a copy of DBEDT’s version of the REMI macro-economic model and adjusted it to align with DBEDT 2035 Series forecast.
- Now incorporating Hawaii policies and utility plans per IRP3.

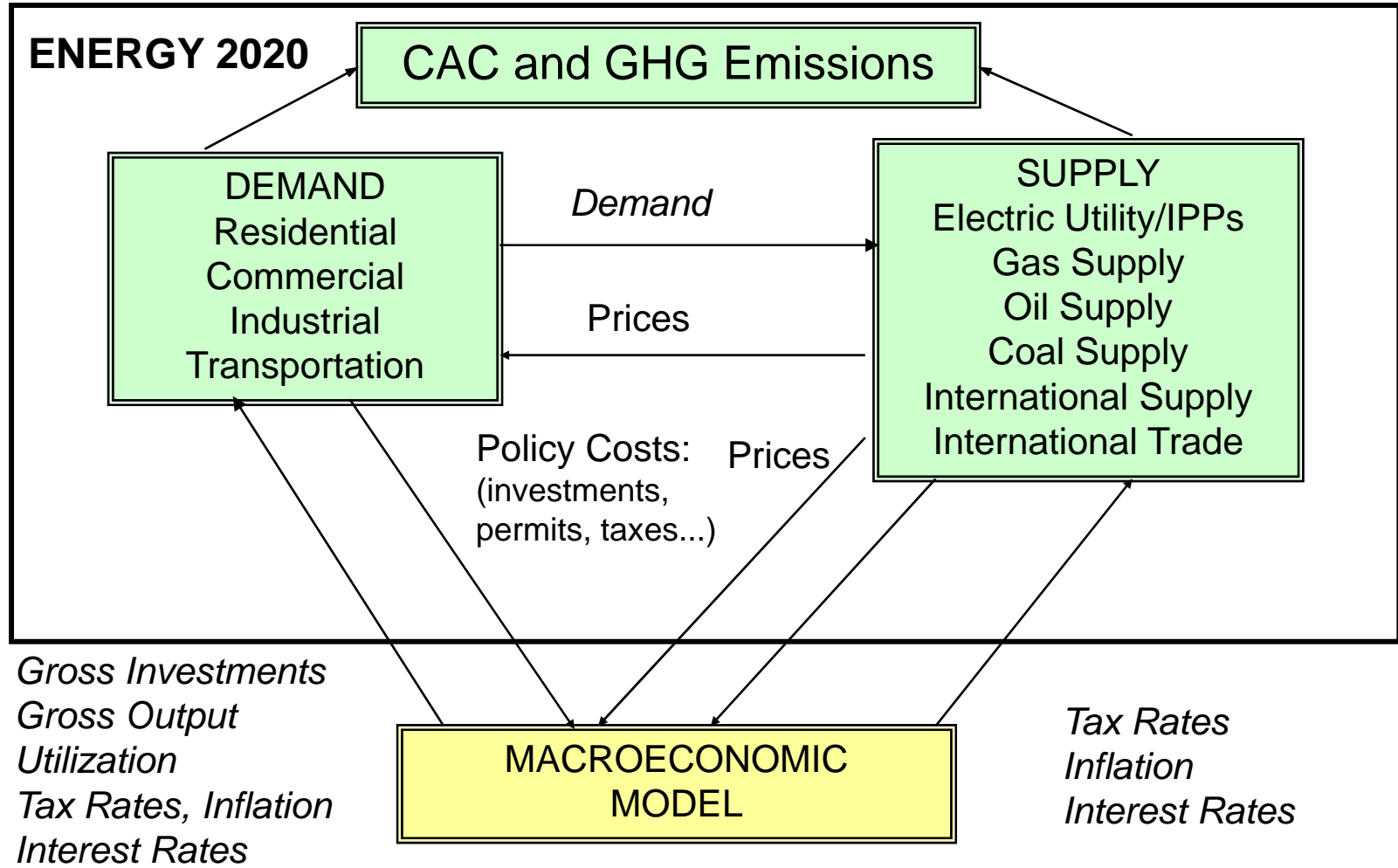
Deliverable	Proposed Delivery Date
1 st draft of the Reference Case	June 22, 2009
Final report on the Reference Case	July 13, 2009
1 st drafts of the work plans and impact analysis	July 28, 2009
2 nd drafts of the work plans and impact analysis	September 15, 2009
Final Work Plans and Impact Analysis Reports	September 30, 2009

ENERGY 2020 Model Overview

Overview of ENERGY 2020

- Integrated North American multi-fuel, multi-sector economy, energy and emissions model.
- Energy demand end-use sector disaggregation.
- Energy supply for electricity, oil, gas, coal, other.
- Each type of air emission modeled separately:
 - Greenhouse Gas (CO₂, N₂O, CH₄, SF₆, HFC, PFC)
 - Outputs convert to CO₂ equivalent terms (CO₂e)
- Modeling 4 counties for Hawaii to the year 2020.

Model Structure & Relationships



What make ENERGY 2020 Different?

- Not Optimization or classical econometrics
- Decisions are endogenous to the model
- Capable of flexible policy scenario analysis
- Uses Qualitative Choice Theory
 - ❖ Recognizes price & non-price elements of decisions, market imperfections, time delays, etc.
 - ❖ Maximize utility within constraints of imperfect market
 - ❖ Simulates actual as opposed to assumed responses
 - ❖ *e.g. choice of vehicle considers non-price factors of style, comfort, space, safety, affordability, and reliability in addition to vehicle efficiency or lowest operating cost.*

Value of Modeling

- Build Reference Case projection. Compare policy effects to Reference. Reference Case provides framework on which to analyze proposed policies.
- Supports analysis of multiple, interacting policies and influences.
- Experience indicates that emission reductions from policies combined in an Action Plan will be less than sum estimated reductions from stand-alone policies.
- Linking ENERGY 2020 and REMI enables analysis of interactions of proposed policies with broader economy – and evaluation of economic impacts.

Modeling Inputs & Assumptions

Modeling Inputs

- Data inputs required in five areas:
 - ❖ Demographic and economic
 - ❖ Fuel prices
 - ❖ Energy use and consumption
 - ❖ Emissions and air regulations
 - ❖ Electricity generation capacity and operation
- Both historic data and future projected levels are required for the first two areas.
- Historic data are required for the last 3 areas.

Demographic & Economic Data

- Demographic data and economic forecast based on **DBEDT 2035 Series**. (Population and Economic Projections for the State of Hawaii to 2035. Research and Economic Analysis Division; Department of Business, Economic Development and Tourism. January 2008)
- Historic energy use based on:
 - State of Hawaii Data Books (2000 to 2007) and information supplied directly by DBEDT (*Note – some information confidential*)
 - US EIA State Energy Data System (SEDS) and Energy Consumption Surveys.
 - IRP reports on Energy Efficiency Potential were used to allocate electricity use by sector and end use.

Energy Price Data

- ENERGY 2020 uses projected energy prices for oil, coal and other fuels (i.e., world oil price).
- Agreed with DBEDT to use price projections for crude oil and coal based on US Annual Energy Outlook 2009.
- Changes in delivered prices are calculated in model.
- Historic energy prices based on US DOE SEDS and Hawaii Data Book. Some information supplied directly by DBEDT.
- Electricity prices are calculated endogenously based on generation costs and dispatch.

Historic GHG Emissions

- Historic GHG emissions based on GHG emissions inventory prepared by ICF.^[1]
- ENERGY 2020 is calibrated for each GHG gas:
 - ❖ Carbon dioxide (CO₂),
 - ❖ Nitrous oxide (N₂O),
 - ❖ Methane (CH₄),
 - ❖ Sulfur hexafluoride (SF₆),
 - ❖ Hydrofluorocarbons (HFCs) and
 - ❖ Perfluorocarbons (PFCs).

^[1] *Hawaii Greenhouse Gas Inventory: 1990 and 2007, Prepared by ICF International for the Hawaii Department of Business, Economic Development & Tourism, December 2008*

Electricity Generation Data

- Model contains information on each generating unit in county/state.
- Tracks and uses the following variables for each unit:
 - ❖ Historic Peak Capacity (MW);
 - ❖ Historic generation levels (GWh);
 - ❖ Type of fuel used;
 - ❖ Heat rate;
 - ❖ Historic annual fuel use (PJ);
 - ❖ Emissions by pollutant type;
 - ❖ O&M costs;
 - ❖ Capacity factors;
 - ❖ Emission rates;
 - ❖ Outage rates;
 - ❖ Location (county);
 - ❖ Ownership information;
 - ❖ Plant type (Hydraulic, Coal, Combined Cycle Turbine, etc.)
- Data for operating and committed units for Hawaii from:
 - ❖ EIA data (Form 860)
 - ❖ Hawaii Public Utilities Commission Integrated Resource Planning process (IRP3).

Electricity Data

- Planned Generation Changes
 - ❖ Generation planned as part of IRP3 included in Reference Case.
 - ❖ List of planned/committed plants included as Appendix C of Assumptions Book.
- New Generation Characteristics
 - ❖ New generation costs based on data in IRP3 reports.
- Industrial and Co-generation
 - ❖ Generation used primarily to supply industrial or other sector loads is normally included in the source sector.
 - ❖ Historic levels of industrial and co-generation based on EIA data (form EIA 860) as well as data from IRP documents and DBEDT.
 - ❖ List of known CHP and Distributed Generation sites shown in Appendix F of Assumptions Book.

Transportation

- Vehicle and modal efficiencies are based on the US DOE ‘Transportation Energy Data Book’
- Supplemented by data from State of Hawaii Data Books and information supplied by DBEDT.
- More detailed information provided in “Assumptions Book” (example below).

Input	Sources Used/Available
<i>All tables below are from Transportation Energy Data Book (Edition 26, 2007)¹ published by the US Department of Energy’s Oak Ridge National Laboratory.</i>	
Average fuel economy	Tables 4.17 and 4.18
New Vehicle Efficiency	Tables 4.7 and 4.8
Scrap/Survival Rates	Tables 3.8, 3.9 and 3.10
Freight Truck Fuel Economy	Tables 5.1 and 5.2
Bus Efficiency	Table 2.13
Rail Efficiency – Passenger	Table 9.10 and 9.11
Rail Efficiency - Freight	Table 9.8
Marine – Freight	Table 9.5
Air Travel	Table 9.2

Reference Case Programs & Policies

- ❖ **US Energy Independence and Security Act** (EISA or Energy Act 2007)
 - includes changes to CAFE standard, biofuels mandate and lighting, equipment and appliance standards
- ❖ **US Emergency Economic Stabilization Act of 2008**
 - changes to energy tax incentives
- ❖ **Hawaii Renewable and Energy Efficiency Portfolio Standards**
- ❖ **Hawaii Net Energy Metering (NEM)**
- ❖ **Hawaii Public Benefits Fund (PBF)**
- ❖ **Hawaii ethanol content requirement**
- ❖ **Hawaii Lead by Example Initiatives for State Facilities**
- ❖ **Hawaii Solar Water Heating System Requirements**

Reference Case Programs & Policies

Potential Policy Changes:

➤ **New proposed federal vehicle efficiency standards**

- ❖ EISA included CAFÉ standards for light vehicles (35 mpg by 2020)
- ❖ On May 19, 2009, U.S. government announced intention to increase vehicle efficiency requirements (35.5 mpg by 2016).
- ❖ Which level should be assumed for Reference Case?

➤ **Treatment of biofuel requirements in EISA**

- ❖ EISA sets out required production levels for biofuels.
- ❖ EIA has questioned whether these targets are achievable.
- ❖ AEO 2009 projects a lower level of biofuel use than EISA for 2020.
- ❖ Which level should be assumed for Reference Case?

Policy Screening/Evaluation Criteria

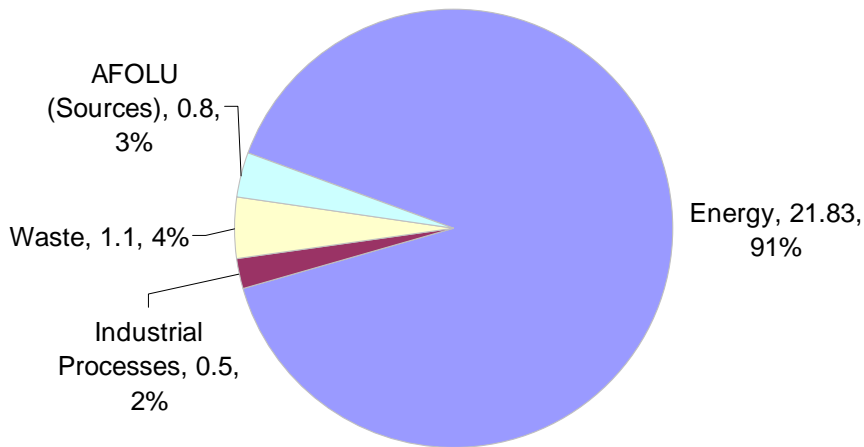
(per contract)

- Cost effectiveness.
- Ability to meet goals when combined in Action Plan – including long term reductions.
- Addresses key sources.
- Size of affected sources.
- Ability to monitor and verify.
- Maximizes environmental benefits for Hawaii
 - Co-benefits for CAC's and toxic air emissions.
 - Prevents any increase in emissions of toxic air contaminants or pollutants.
- Compatibility with other programs
- Minimizes leakage
- Potential adverse effects on small business

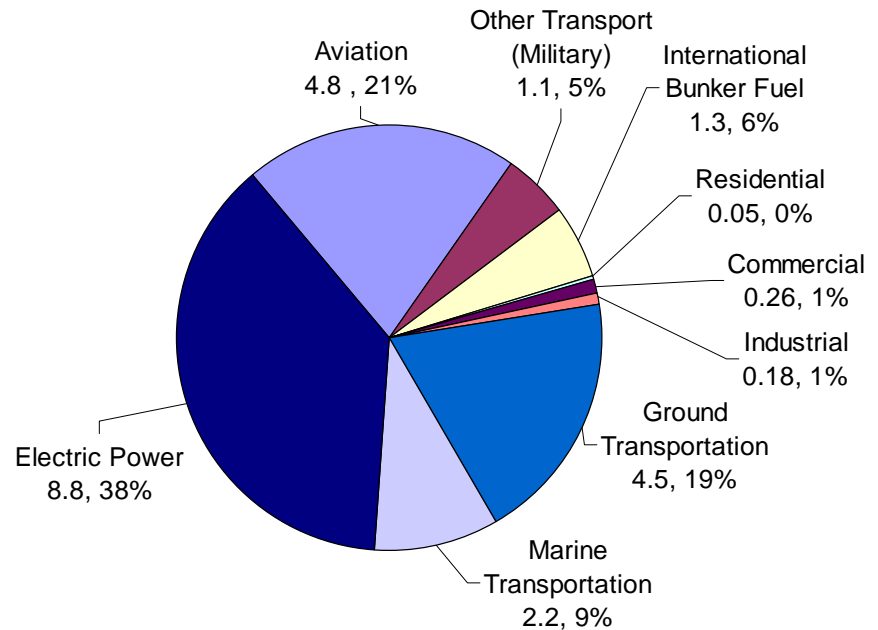
Hawaii's GHG Emissions

Hawaii GHG Emission Sources

2007 Hawaii Emissions by Sector
(Mt and %)



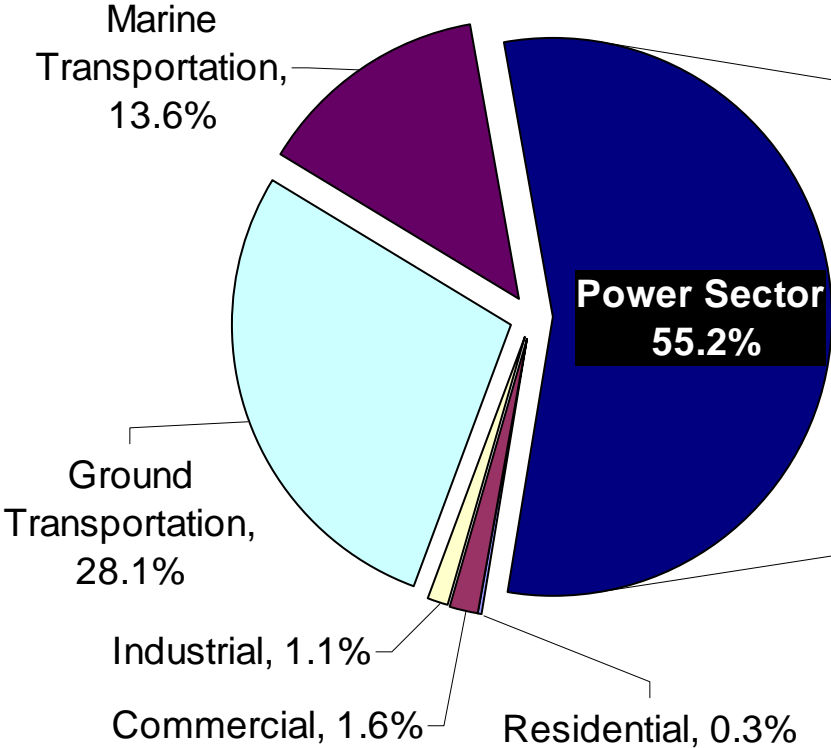
Hawaii Energy Related GHG Emissions
(Mt, % of Total)



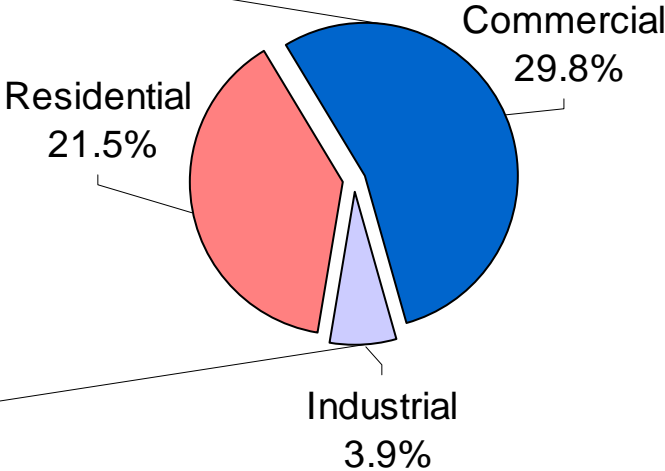
Transportation & Power Sector = 98%

Hawaii GHG Emissions Included in Target Contribution by Sector

Emissions by Sector



Electricity Use by Sector

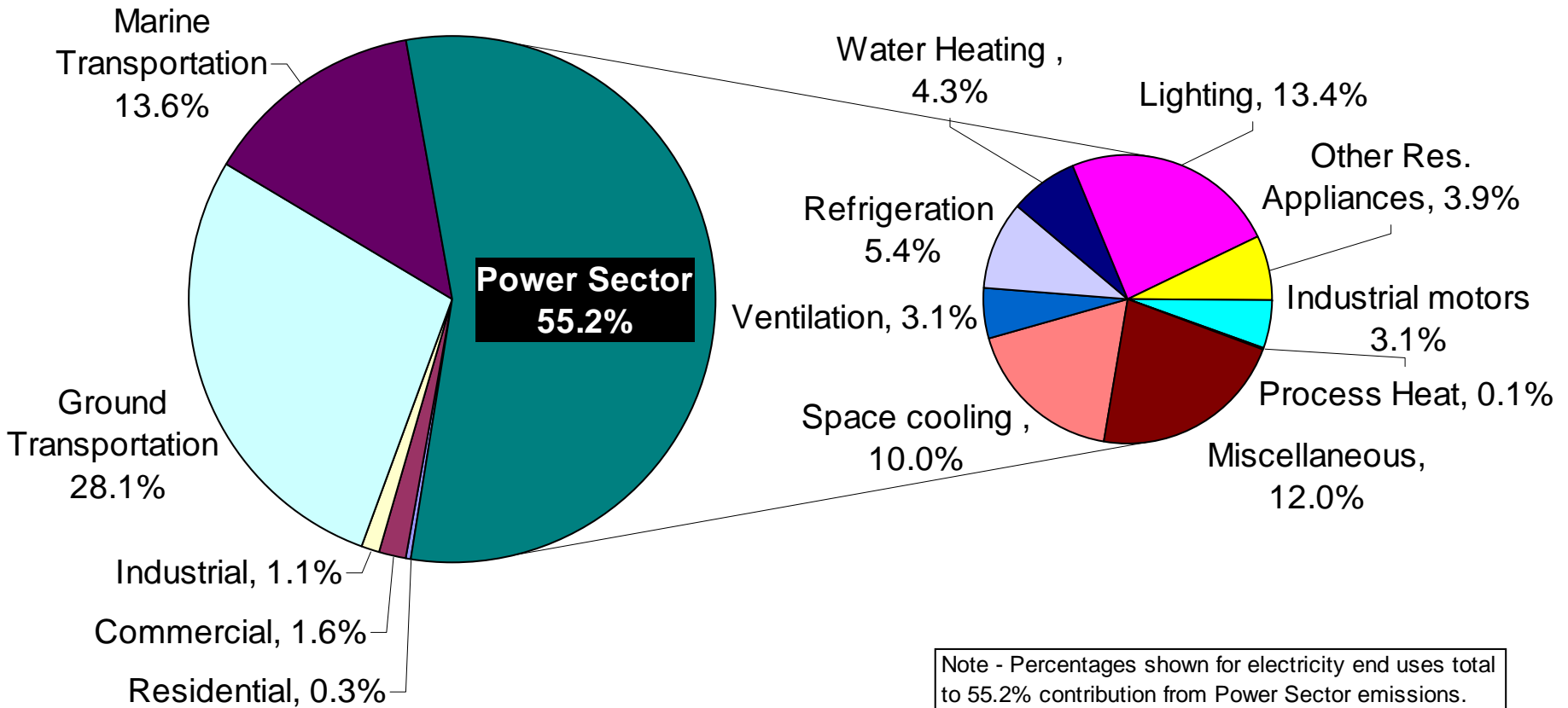


Note - Percentages shown for electricity end uses total to 55.2% contribution from Power Sector emissions.

Hawaii GHG Emissions Included in State Target by Sector and Electricity End Use

Transportation – 44.8%

Electricity Use x End Use



Note - Percentages shown for electricity end uses total to 55.2% contribution from Power Sector emissions.

Preliminary Review of Potential GHG Reduction Policies

Potential GHG Reduction Policies

- Reviewing Potential Policies
- Target – 1990 emissions excluding aviation, international bunker and military transportation fuels.
- Considering key sources/size of sources; recognizing existing/approved initiatives, prior analyses and experience:
 - ❖ Hawaii Clean Energy Initiative.
 - ❖ Prior reports to Task Force.
 - ❖ DBEDT Reports.
 - ❖ IRP process.
- Following list represents preliminary and still incomplete list of potential areas of focus and policies.

Potential GHG Reduction Policies

- Cross cutting policies:
 - ❖ Carbon tax
 - ❖ Cap & Trade – state level, regional or national.
 - ❖ Energy Efficiency Portfolio standard (EEPS) – state or national.
 - ❖ Public Benefits Agency to promote energy efficiency.
 - ❖ Aggregate Purchasing – to support/develop markets.
 - ❖ Incentives:
 - Monetary – direct incentives, tax treatment, etc.
 - Non-monetary – influence non-price decision making.
 - ❖ Information and education – both broad and targeted.
 - ❖ Fuel and energy prices (i.e. barrel tax).

Potential GHG Reduction Policies

- Electricity consumption and generation
 - ❖ Decoupling utility revenues from sales.
 - ❖ Energy Efficiency Portfolio Standard – state or national, electricity or all regulated fuels. *(Passed in May 2009)*
 - ❖ Require all economic DSM to be pursued before new supply.
 - ❖ Building codes and standards (lighting, equipment, & appliances)
 - ❖ Renewable Portfolio Standard (RPS) – state/national.
 - ❖ Increase use of non-electric renewables – solar water heating, biomass, sea water cooling, etc. *(Current Hawaii law requires solar for new construction post 2010, provides incentives, etc.)*
 - ❖ Increase efficiency of generation, T&D – including co-generation, distributed generation, etc. *(IRP's include pursuit of CHP)*
 - ❖ Net metering and feed-in tariff.

Potential GHG Reduction Policies

- Transportation policies: Vehicles
 - ❖ Require increase in vehicle efficiency.
 - ❖ Encourage purchase of more efficient vehicles within existing selection.
 - ❖ Promote increased operational efficiency of existing vehicles.
 - ❖ Encourage more rapid turnover of older vehicle stock.
 - ❖ Promote higher occupancy vehicle usage (car/van pooling)
 - ❖ Promote early adoption of Plug-in Hybrid Electric Vehicles (PHEV's)
 - ❖ Renewable Fuel Standard.
 - ❖ Low Carbon Fuel Standard.

Potential GHG Reduction Policies

- Transportation policies: Vehicles
 - ❖ Shift to lower emission modes – mass transit, biking, walking
(include effects of high capacity transit system)
 - ❖ Land Use Planning to encourage higher density, mixed communities, etc. (i.e., Smart Growth).
 - ❖ Promote appropriately sized vehicles for freight and commercial applications.

Potential GHG Reduction Policies

Transportation policies:

➤ Marine:

- ❖ Promote fuel switching to lower emission fuels
- ❖ Biofuels
- ❖ Increase engine and operational efficiency
- ❖ On-shore supply of power

Potential GHG Reduction Policies

Built Environment policies:

- Building Code improvements (i.e., Green and Net zero buildings) – new and renovations.
- Promote processes to involve all stakeholders in new building design.
- Support development of deep water cooling for high density commercial areas.
- Equipment and appliance standards.
- Existing buildings – re-commissioning, operator training, best practice standards and operating procedures for facilities staff, hotels, etc..

Potential GHG Reduction Policies

Industry policies:

- Promote improved process design and operational efficiencies.
- Fuel switching and increased use of non-emitting energy sources.
- Review opportunities for reducing industrial process emission (*0.5Mt in 2007 inventory*).

Questions and Discussion?

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Mahalo!