

# Methodology and Status of the Greenhouse Gas Emissions Inventory for the University of Hawai'i at Manoa

Greenhouse Gas Emissions Reduction Task Force

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# UHM Meeting the Challenges

- Systematic/Organizational Challenge
  - How do we implement a system to collect a new set of metrics that stem from arguably all departments and operations?
- Hawai'i Emission Factor Challenge
  - How do we ensure our metrics are accurate for Hawai'i?

# Motivation for Work

## American College & University Presidents' Climate Commitment (ACUPCC)

- “A **high-visibility effort** to make campuses **more sustainable** and address global warming by garnering institutional commitments to **reduce and ultimately neutralize greenhouse gas emissions on campus**. The effort is modeled after the U.S. Mayors Climate Protection Agreement.”
- 487 signatories to date

- I. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
  - I.1. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.
  - I.2. Within one year of signing this document, **complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.**
  - I.3. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:
    - I.3.1. A target date for achieving climate neutrality as soon as possible.
    - I.3.2. Interim targets for goals and actions that will lead to climate neutrality.
    - I.3.3. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
    - I.3.4. Actions to expand research or other efforts necessary to achieve climate neutrality.
    - I.3.5. Mechanisms for tracking progress on goals and actions.

2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.
  - 2.2. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
  - 2.3. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.
  - 2.4. Establish a policy of **offsetting all greenhouse gas emissions generated by air travel paid for by our institution.**
  - 2.5. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.
  - 2.6. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.
3. **Make the action plan, inventory, and periodic progress reports publicly available** by providing them to the Association for the Advancement of Sustainability in Higher Education(AASHE) for posting and dissemination.

# ACUPCC: IMPLEMENTATION SCHEDULE

- Create or designate institutional structures to guide the development and implementation of a comprehensive climate action plan by November 15, 2007 (i.e. within two months);
- Select at least two of the tangible actions from the Commitment by November 15, 2007 (within two months), and implement them by November 15, 2009 (within two years);
- **Complete a greenhouse gas inventory by September 15, 2008 (i.e. within one year);**
- Develop a climate action plan and initiate two or more of the seven tangible actions described in the Commitment by September 15, 2009 (i.e. within two years).

# Methodology

## Primary Resources

- World Resources Institute and World Business Council for Sustainable Development (WRI/WBCSD)

### The GHG Protocol - 2 Standards

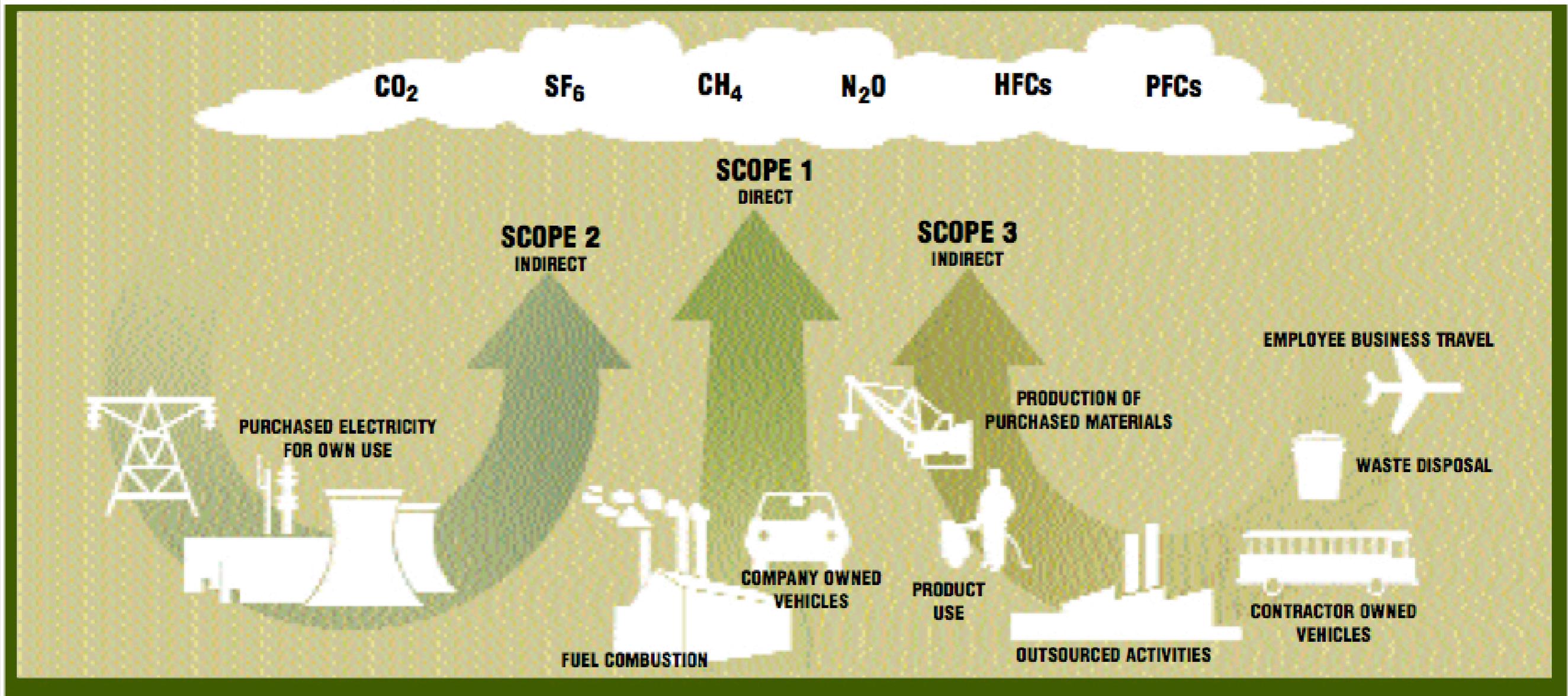
<http://www.ghgprotocol.org/>

- Corporate Accounting and Reporting Standards (Corporate Standard)
  - Project Accounting Protocol and Guidelines
- 
- ACUPCC Implementation Guide and GHG Inventory Brief  
<http://presidentsclimatecommitment.org/html/solutions.php>
- 
- Hawai'i Emission Factors.....?

# Scope

The scope "help[s] delineate direct and indirect emission sources, improve[s] transparency, and provide[s] utility for different types of organizations and different types of climate policies and business goals[.] Three "scopes" ...are defined for GHG accounting and reporting purposes."

**FIGURE 3. Overview of scopes and emissions across a value chain**



*taken from WRI/WBCSD GHG Protocol, revised edition (2004)*

# Scope

Seeking to track and report emissions of the six greenhouse gases covered under the Kyoto Protocol:

GHG	Global Warming Potential (GWP)*
carbon dioxide (CO <sub>2</sub> )	1
methane (CH <sub>4</sub> )	21
nitrous oxide (N <sub>2</sub> O)	310
hydrofluorocarbons (HFCs)	140 - 11,700
perfluorocarbons (PFCs)	5,210 - 8,700
sulphur hexafluoride (SF <sub>6</sub> )	16,300

\*According to the Second Assessment Report of the IPCC

# Potential Sources of GHG for Campuses

- ✓ Purchased Electricity
- Purchased Steam / Chilled Water
- ✓ On Campus Stationary Sources (energy generation)
- ✓ Transportation (commuting, air travel, campus fleet)
- ★ Agriculture (fertilizer use, animal waste)
- Solid Waste (incinerated, landfill)
- Refrigerants and other Chemicals
- ★ Offsets (Renewable Energy Credits purchased, composting, forest preservation, local offset
  - project such as paying for boiler conversion at a local K-12 school, etc.)
- ✓ Included in present inventory
- Assumed negligible (<5% total emissions) which will be supported upon final reporting
- ★ Potentially significant and will be monitored going forward

# Scope

- Operational Boundaries: Manoa Campus
- Time period sought: 1990 - Present
- Direct Emissions (WRI/WBCSD Scope 1)
  - Owned vehicle fleet
  - Diesel Generators
  - Boilers
- Indirect Emissions (WRI/WBCSD Scope 2)
  - Purchased Electricity
- Additional Indirect Emissions (WRI/WBCSD Scope 3)
  - Commuter related emissions (staff, faculty, students)
  - Airline Travel (staff, faculty, students paid for through UHM)

# Conversions: NASA messed this up - so can I (we)!

## Airline Emissions

$$12544 \text{ passengers (P)} \times \frac{158 \text{ g CO}_2}{\text{P} \cdot \text{km}} \times \frac{0.621 \text{ km}}{\text{miles}} \times \frac{1 \text{ mt}}{1\text{E}+06 \text{ g}} \times \frac{250 \text{ miles}}{\text{flights}} \times 2 \text{ flights} = 615 \text{ mt CO}_2$$

## Electricity Emissions

$$88,113,120 \text{ kWh} \times \frac{1.872772 \text{ lbs CO}_2\text{e}}{\text{kWh}} \times \frac{1 \text{ mt}}{2205 \text{ lbs}} = 74837 \text{ mt CO}_2\text{e}$$

Systematic/  
Organizational  
Challenge

## Unleaded Emissions

$$64966 \text{ US gal} \times \frac{0.130204 \text{ GJ}}{\text{gal}} \times \frac{69.25 \text{ kg CO}_2}{\text{GJ}} \times \frac{1 \text{ mt}}{1000 \text{ kg}} = 586 \text{ mt CO}_2$$

Hawai'i Emission  
Factor Challenge

## Diesel Emissions

$$9379 \text{ US gal} \times \frac{0.140424 \text{ GJ}}{\text{gal}} \times \frac{74.01 \text{ kg CO}_2}{\text{GJ}} \times \frac{1 \text{ mt}}{1000 \text{ kg}} = 98 \text{ mt CO}_2$$

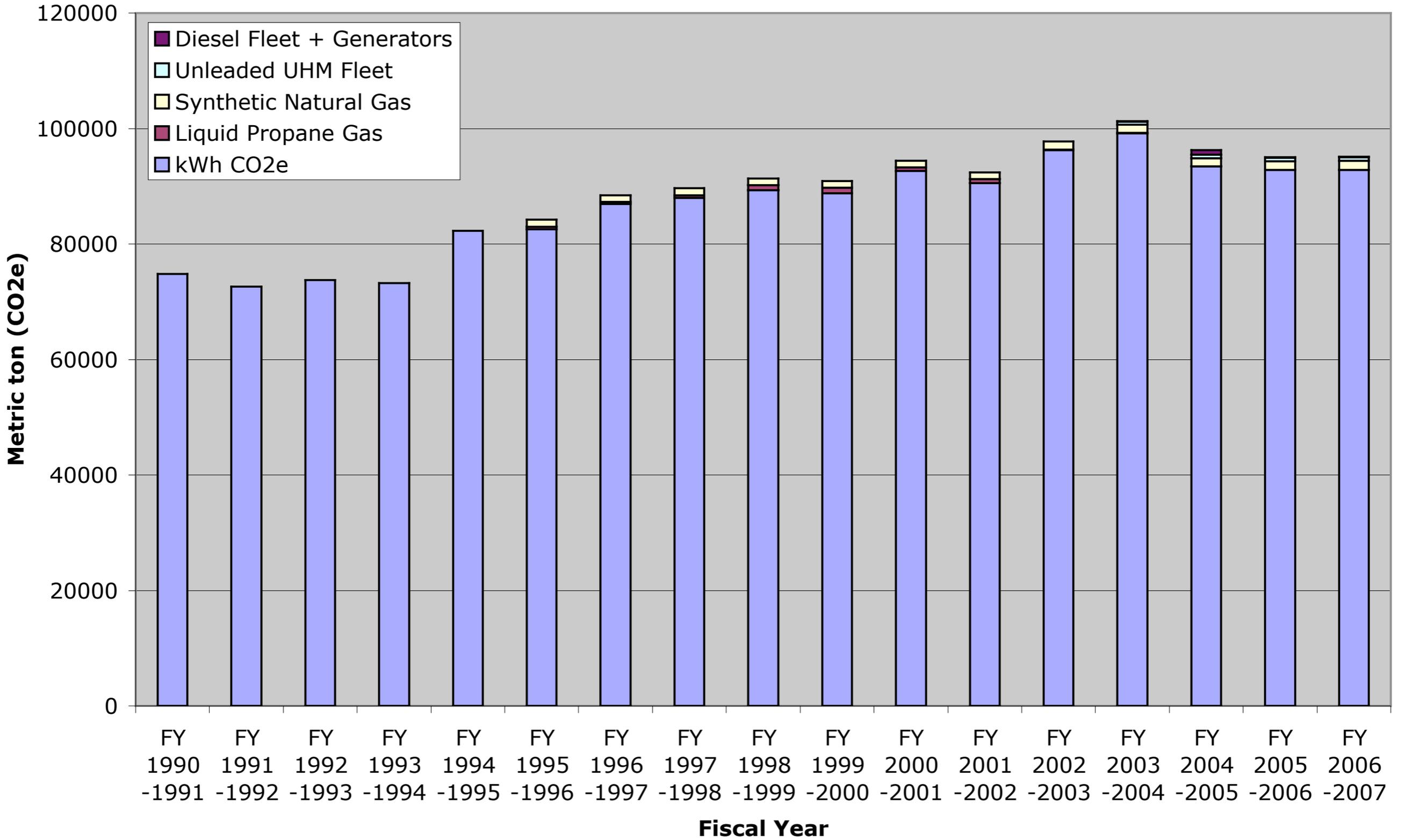
## Synthetic Natural Gas Emissions

$$224,757 \text{ therms} \times \frac{5.43 \text{ kg CO}_2}{\text{therm}} \times \frac{1 \text{ mt}}{1000 \text{ kg}} = 1,220 \text{ mt CO}_2$$

## Liquid Petroleum Gas Emissions

$$31,523 \text{ gal} \times \frac{12.8 \text{ kg CO}_2}{\text{therm}} \times \frac{1 \text{ mt}}{1000 \text{ kg}} = 404 \text{ mt CO}_2$$

# Summary UHM GHG Emissions (SCOPE 1 and 2)



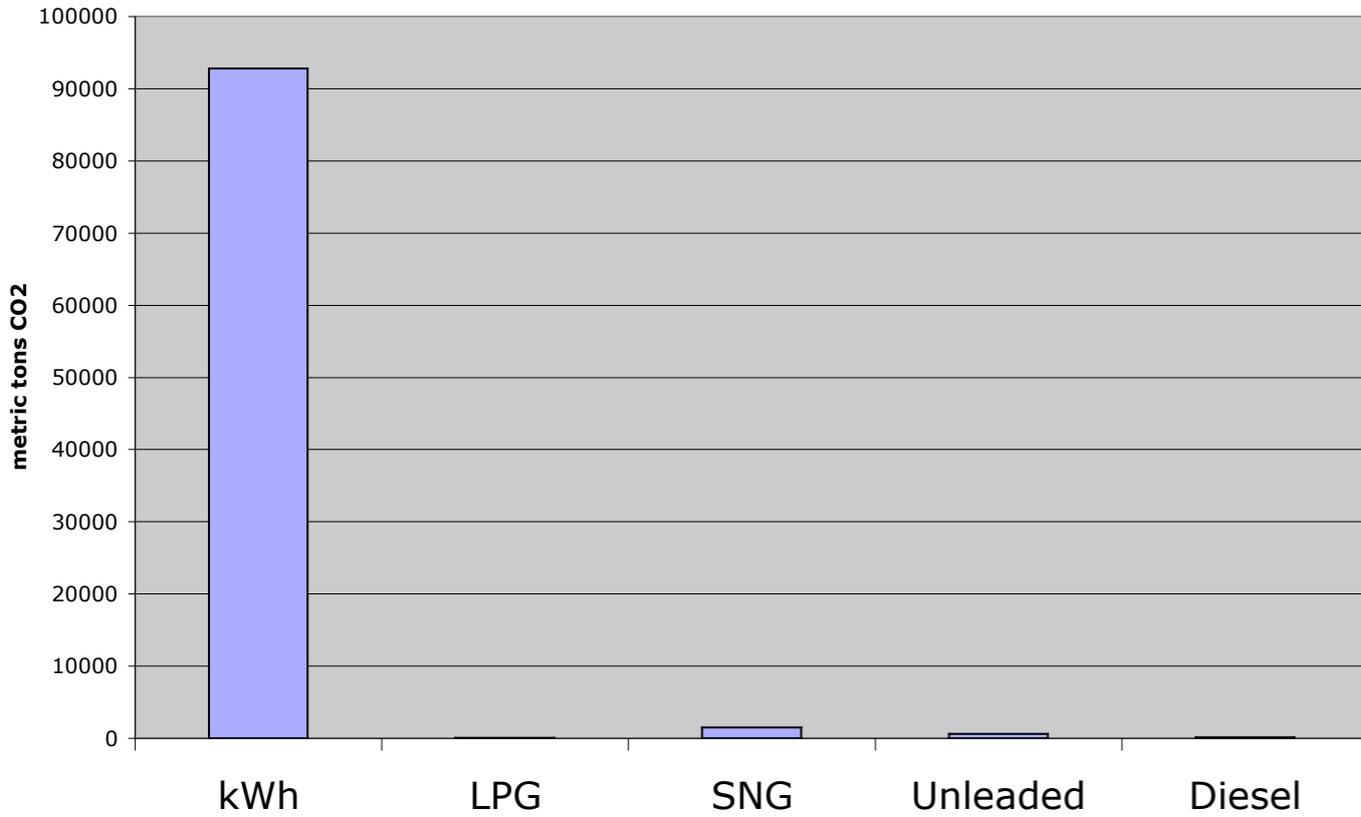
kWh emission factors derived from DBEDT data

SNG, LPG, Diesel and unleaded emission factors are "typical values" from WRI/WBCSD

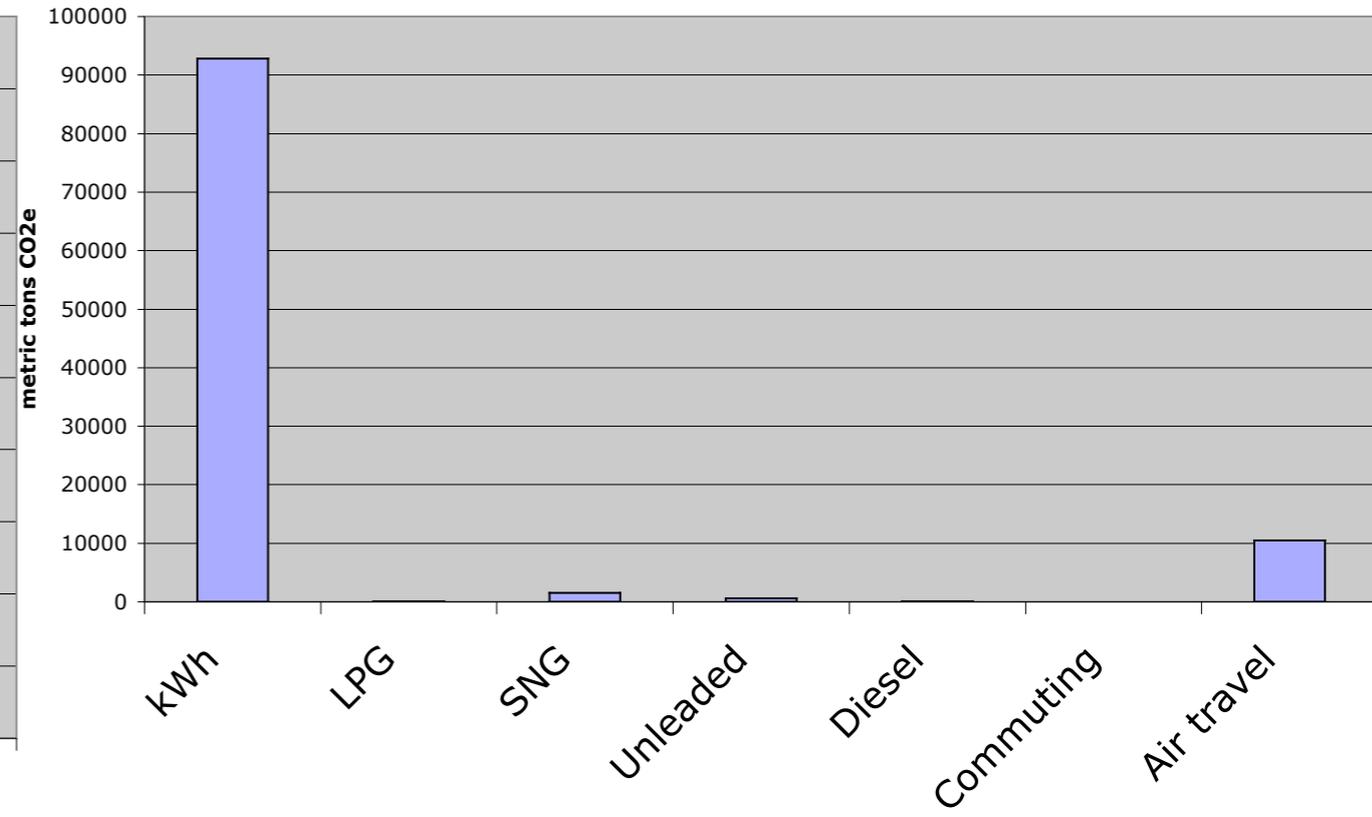
Fuel volumes from UHM Fiscal and Facilities

Calculations made using WRI/WBCSD calculation tools

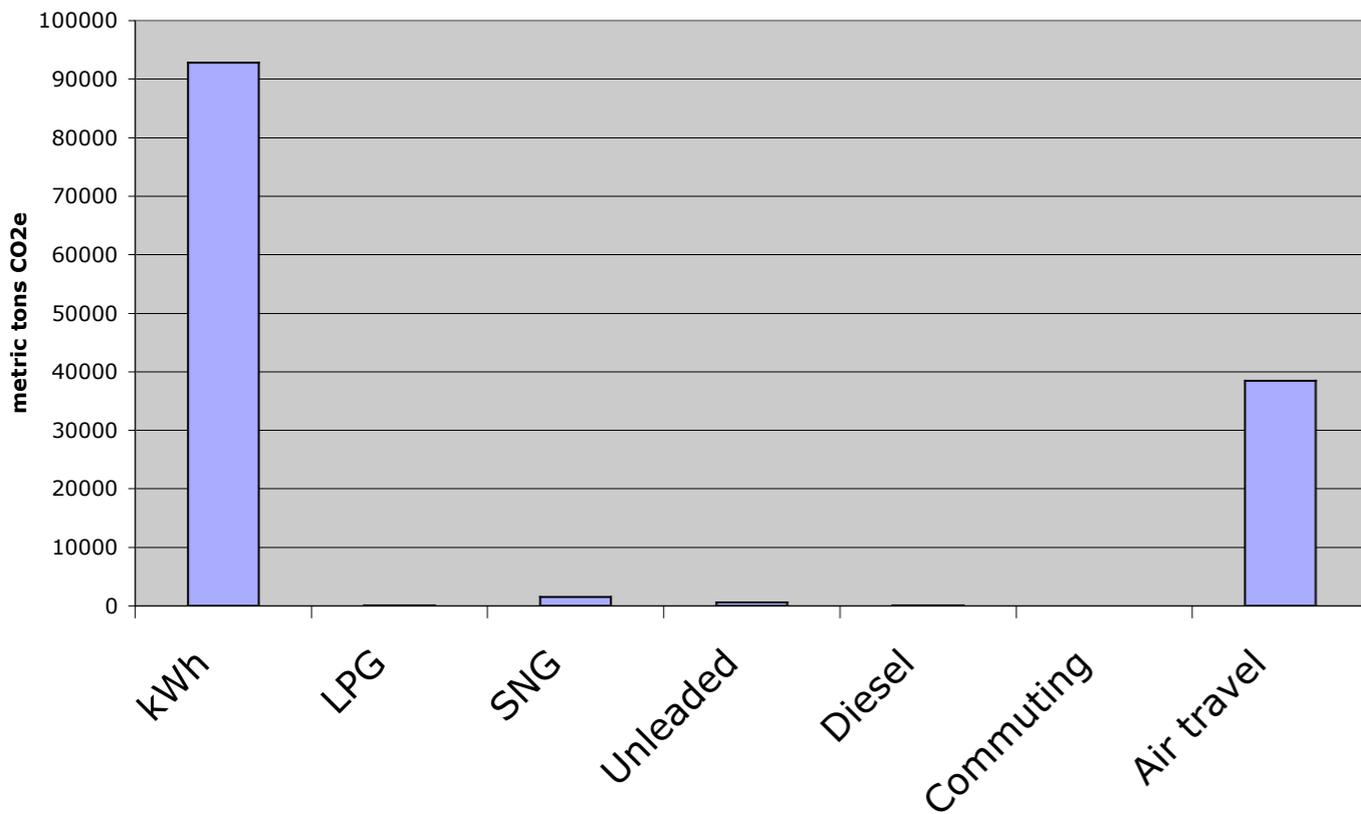
**Without commuting**



**Low Commuting Estimate**



**Medium (?) Commuting Estimate**



**Food for thought:  
An estimate of commuting  
and airline related  
emissions**

# Commuting/Airline Assumptions

		Count	Commuting %	Roundtrip miles	% days in year	GHG Emissions
Faculty (teaching)		1,272	0.7	10	0.69	6115
Graduate Students		6000	0.5	10	0.62	18544
Undergraduate Students		14000	0.5	10	0.55	38462
Adminstration and Staff		1000	0.7	10	0.69	4808
Research		1000	0.7	10	0.69	4808
					Total Miles	72736
					Total Emissions	33.69
		Count	Interisland	passengers/section	Longrange flights	passengers/section
Faculty (teaching)		1,272	2	2544	2	2544
Graduate Students		6000	1	6000	1	6000
Undergraduate Students		14000	0	0	0	0
Adminstration and Staff		1000	2	2000	2	2000
Research		1000	2	2000	2	2000
		Total Passengers		12544		12544
		Interisland total emissions		615		
				Long-haul total emissions		9871
				<b>Total Airline travel emissions</b>		<b>10487</b>
		Count	Interisland	passengers/section	Longrange flights	passengers/section
Faculty (teaching)		1,272	3	3816	4	5088
Graduate Students		6000	2	12000	3	18000
Undergraduate Students		14000	1	14000	1	14000
Adminstration and Staff		1000	10	10000	5	5000
Research		1000	4	4000	4	4000
		Total Passengers		43816		46088
		Interisland total emissions		2150		
				Long-haul total emissions		36268
				<b>Total Airline travel emissions</b>		<b>38418</b>

# Progress made.

WRI/WBCSD Scope 1 and 2 of UHM inventory near completion

- Resolve appropriate emission factors (EIA, HECO, The Gas Company, DBEDT)

WRI/WBCSD Scope 3 items of UHM inventory strategy clear

- Use surveys to estimate past year(s) commuter and airline travel emissions

UHM systems being designed to update at regular frequencies to measure progress

- Fiscal
- Facilities

# UHM Inventory Methods Compatible To The Climate Registry (TCR)

Question:

How does The Climate Registry develop its protocols?

Answer:

**The Climate Registry's protocols are founded on the WRI/WBCSD Greenhouse Gas Protocol Corporate Accounting and Reporting Standard** are the result of a public process involving all participating member states, provinces, and tribes as well as input from stakeholders and the public.

- Instructions focus on WRI/WBCSD Scope 1 and 2 components in order to limit double-counting

General Reporting Protocol For the Voluntary Reporting Program -  
Draft for Public Comment - October 29, 2007:

<http://www.theclimateregistry.org/crdocuments.html>

# Vision clear.

- The University of Hawai'i at Manoa can be the first submitter to The Climate Registry
- UHM can streamline process to guide and facilitate other Hawai'i organizations executing their inventories

# The Manoa Ahupua'a Education Network

## Emerging Community-Based Concept for a Sustainable Hawai'i



- Unique educational network opportunity right in our neighbourhood
- Approximately 40,000 students are educated in this Ahupua'a daily
- The area includes almost 50 significant educational institutions, including the University of Hawaii at Manoa

# The Manoa Ahupua'a Education Network

## Emerging Community-Based Concept for a Sustainable Hawai'i



- The Manoa Ahupua'a is a significant epicenter in a larger island-wide educational network
- We hold an unique opportunity to have a far-reaching impact on Hawaii and the rest of the country
- The introduction of more sustainable and environmentally focused programs will stimulate effective community-based change in our islands

# Sponsors

- University of Hawai'i at Manoa Chancellor's Office
  - Interim Chancellor Denise Eby Konan
- Hawaiian Electric Company
- UH Sea Grant Program Development Grant
- 2 Anonymous Donors