Hawaii's Energy; Biofuels Assessment Project; and Bioenergy Master Plan

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Energy Challenges in Hawaii

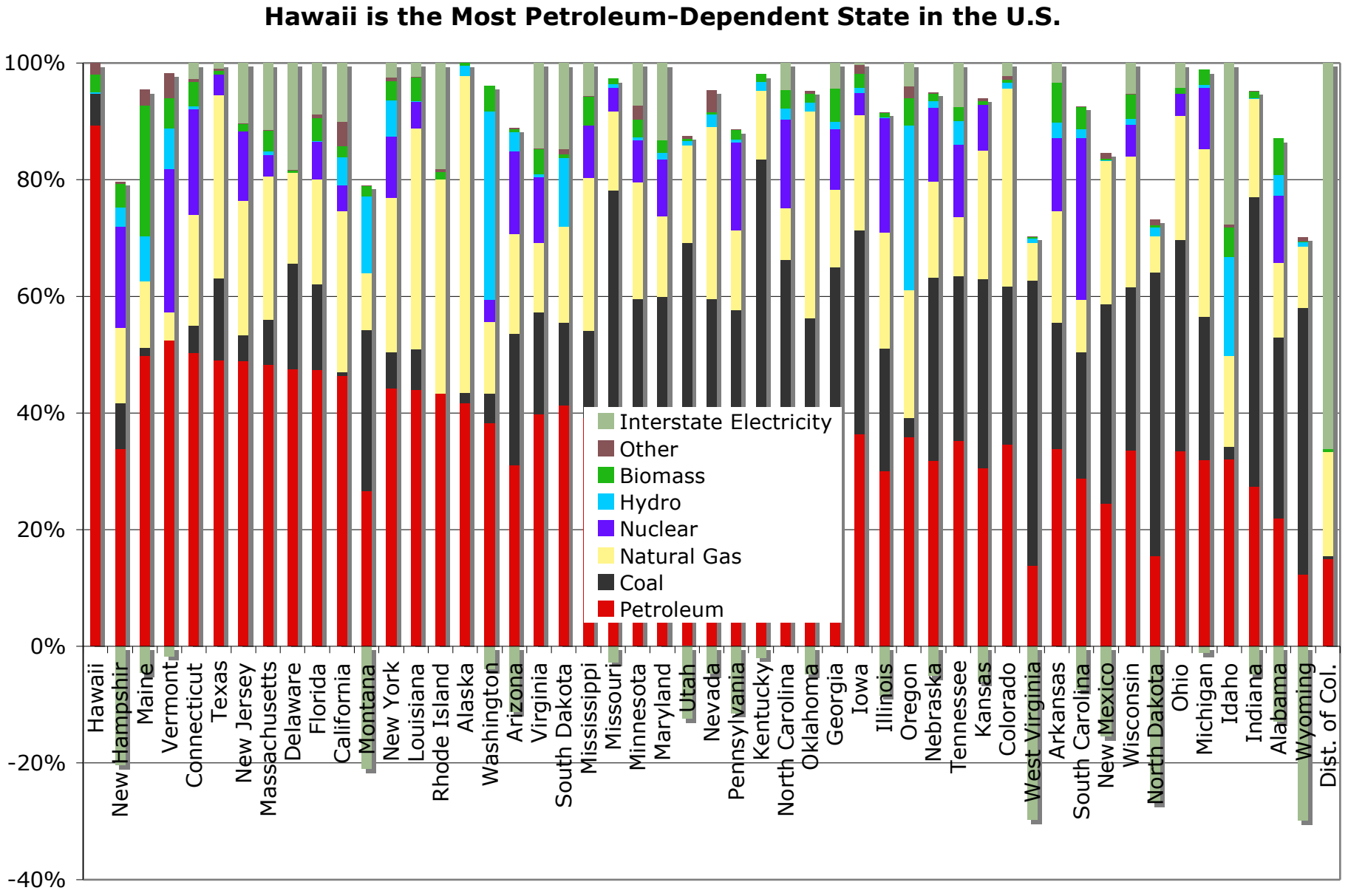
- Small state, small market
- No fossil fuel resources
- Barriers to entry
- High energy costs
- External forces are significant
  - Technology
  - Global supply/demand
  - Geopolitical events

Opportunities/Assets in Hawaii

- Abundant renewable resources
- High energy costs in all sectors make integrated energy projects* viable
- Federal and State support for renewable energy
- Local knowledge & ability

* Transportation fuels AND electricity

United States Energy Sources

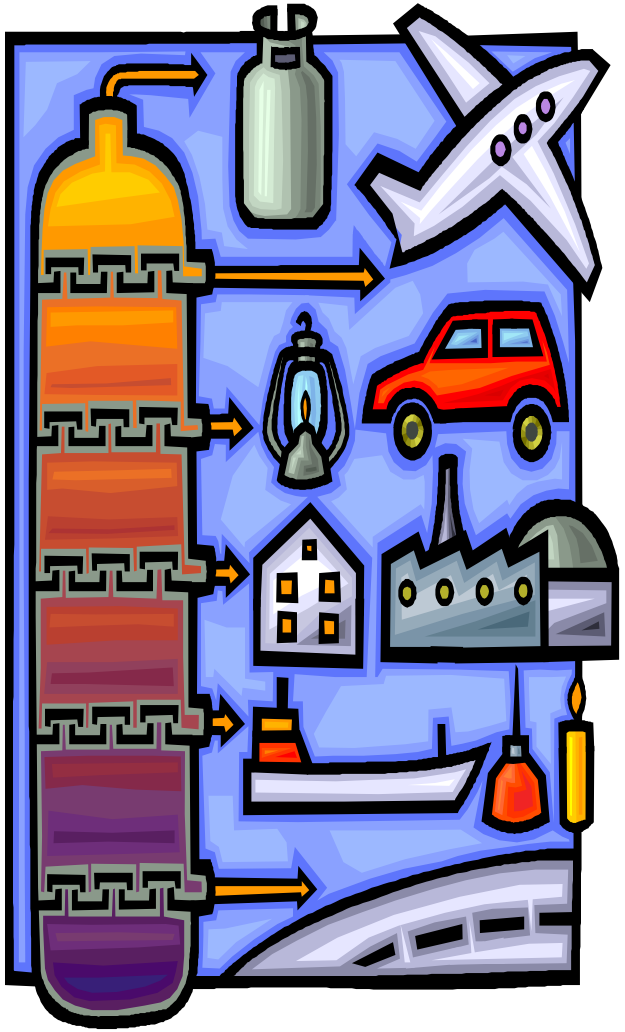


What Is Petroleum Used For?

- Fuels - gasoline, diesel, jet fuels, heating oils, propane …
- Plastics - used in cars, houses, toys, computers, clothing …
- Textiles - polyester, nylon, acrylic, rayon …
- Asphalt - used in road paving, roofing, waterproofing …
- Synthetic rubber - used to make tires, toys, rubber bands …
- Candles, floor polish, car wax, coatings …
- Adhesives
- Cosmetics
- Inks
- Paints
- Chemicals - in fertilizers, pesticides, herbicides, detergents, furniture, packaging materials, surfboards …

Source: Illinois Petroleum Resources Board, http://iprb.org/petroleum_products_in_our_daily.htm

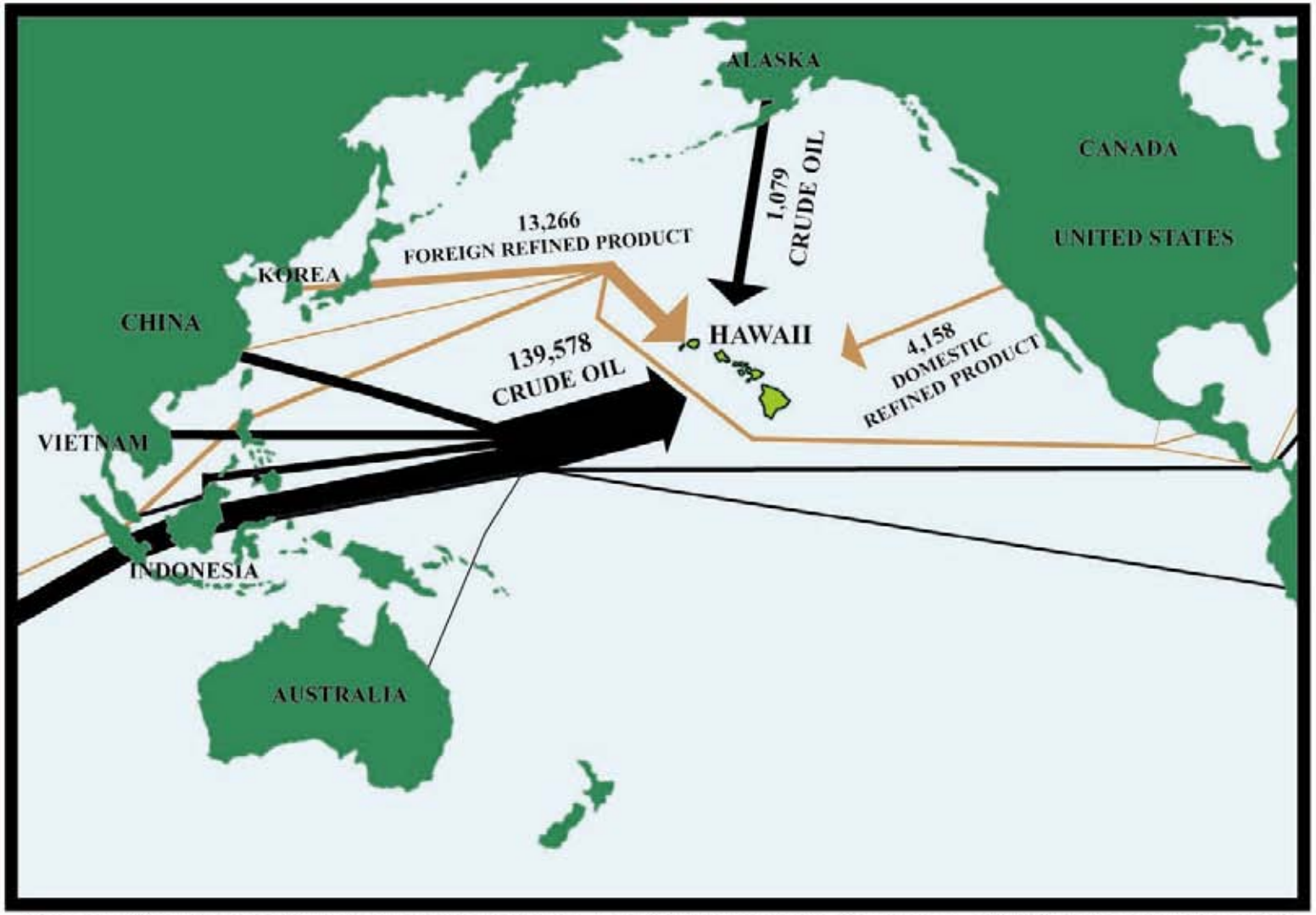
Gasoline, Diesel, Low Sulfur Fuel Oil, Naphtha, Jet Fuel, etc. are Refined from Petroleum (Crude Oil)



Tesoro refinery
95,000 Barrels per day

Chevron Refinery
60,000 Barrels per day

Movement of Petroleum to Hawaii - 2006



CRUDE OIL

Vietnam	22.9%
Saudi Arabia	19.9%
Brunei	10.7%
Indonesia	10.0%
China	9.8%
Thailand	5.2%
Libya	3.9%
Equador	3.4%
Angola	2.3%
U.A.E	2.2%
Oman	2.0%
Other Foreign	7.4%
USA-Alaska	0.8%

REFINED PRODUCT

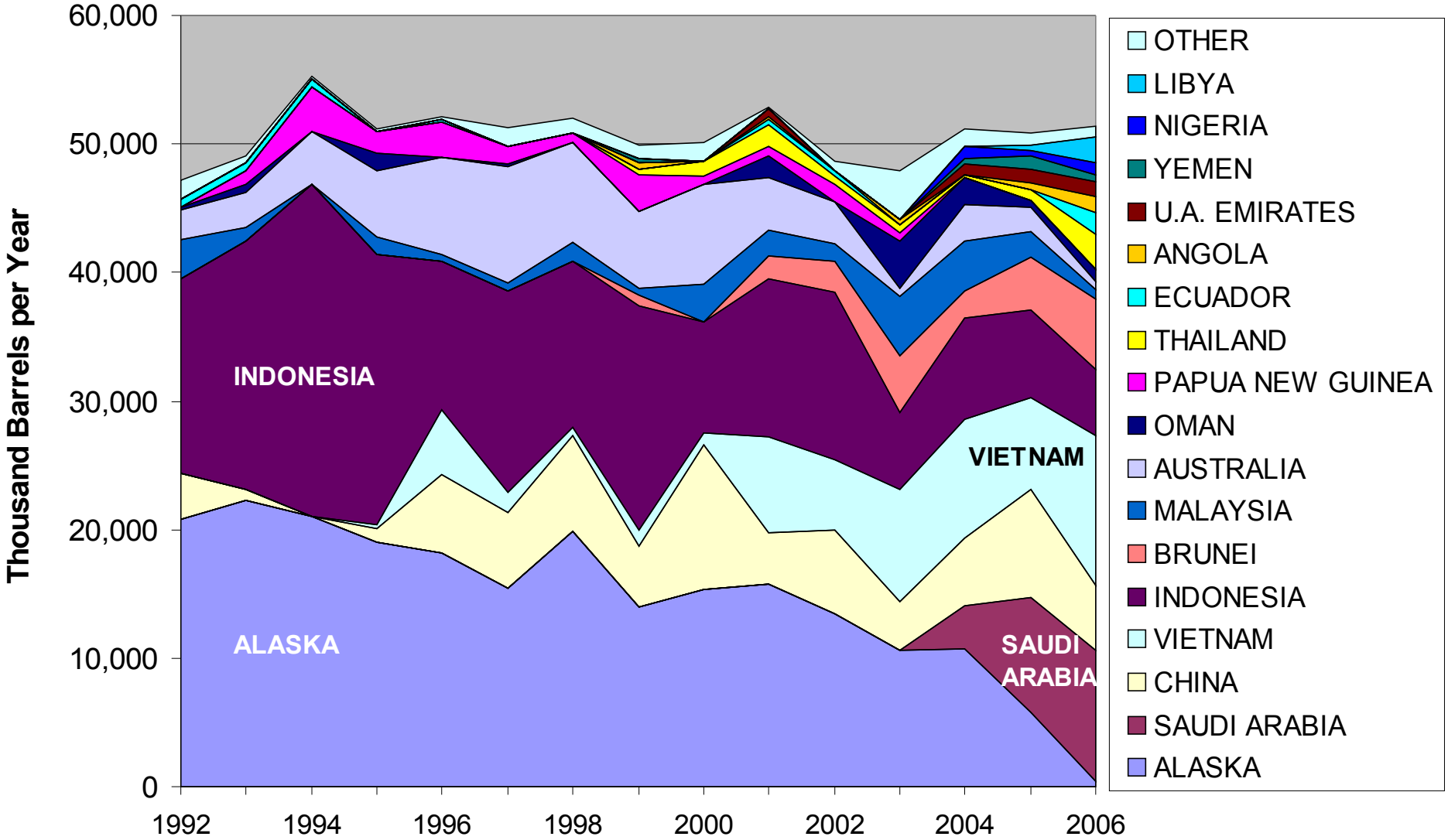
S. Korea	26.8%
USA	23.9%
India	14.3%
El Salvador	11.1%
Singapore	7.8%
Mexico	3.8%
Indonesia	3.4%
Jamaica	3.3%
Trinidad	2.9%
Other Foreign	2.8%

Sources: State of Hawaii Strategic Industries Division; and U.S. Energy Information Agency - 2007 (P): Preliminary-May 2007

NOTE: Arrows' width are roughly proportionate to percentages of oil imports from sources.

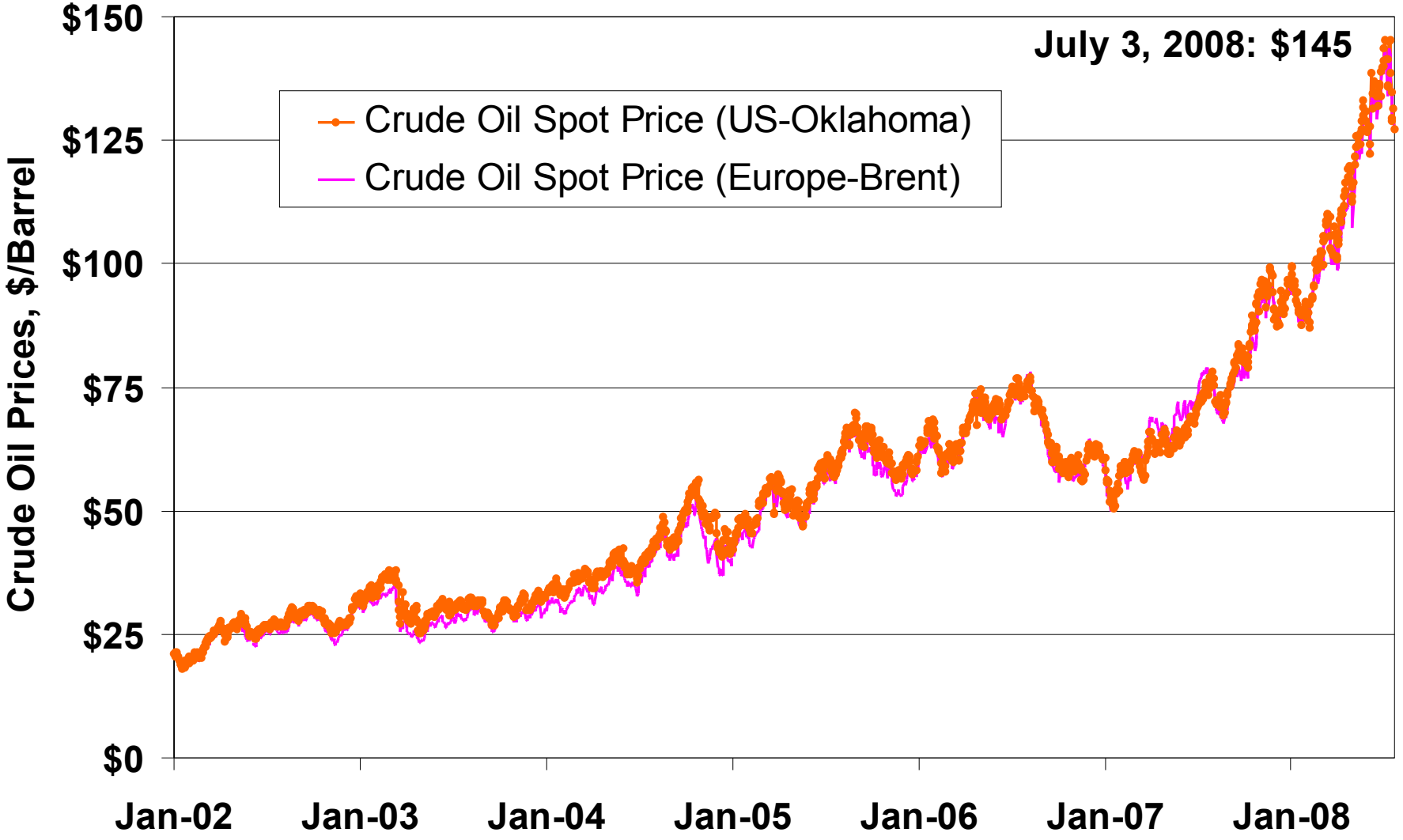
Numbers near arrows are barrels per day.

Hawaii's Crude Oil Sources, 1992-2006



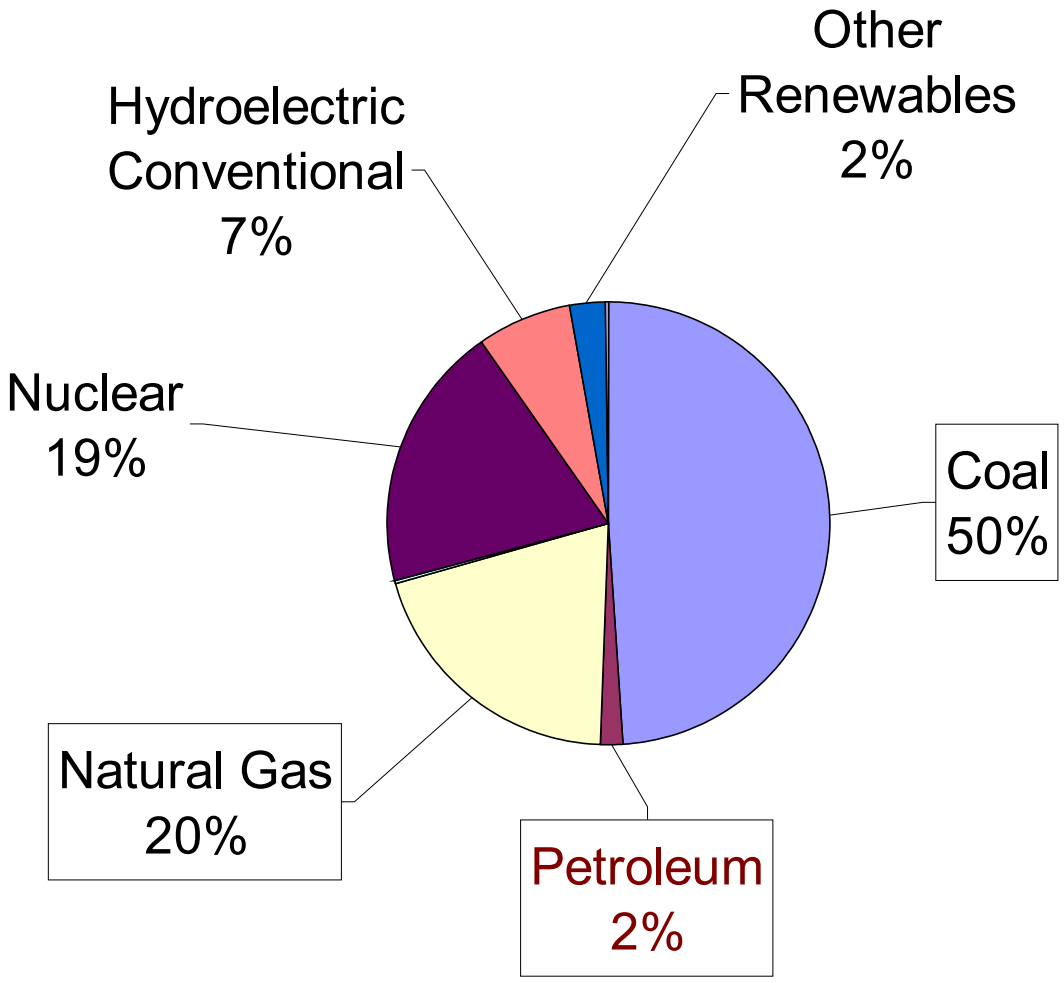
Sources: State of Hawaii Strategic Industries Division and U.S. Energy Information Agency, 2007

Petroleum Prices up 500% since 2002



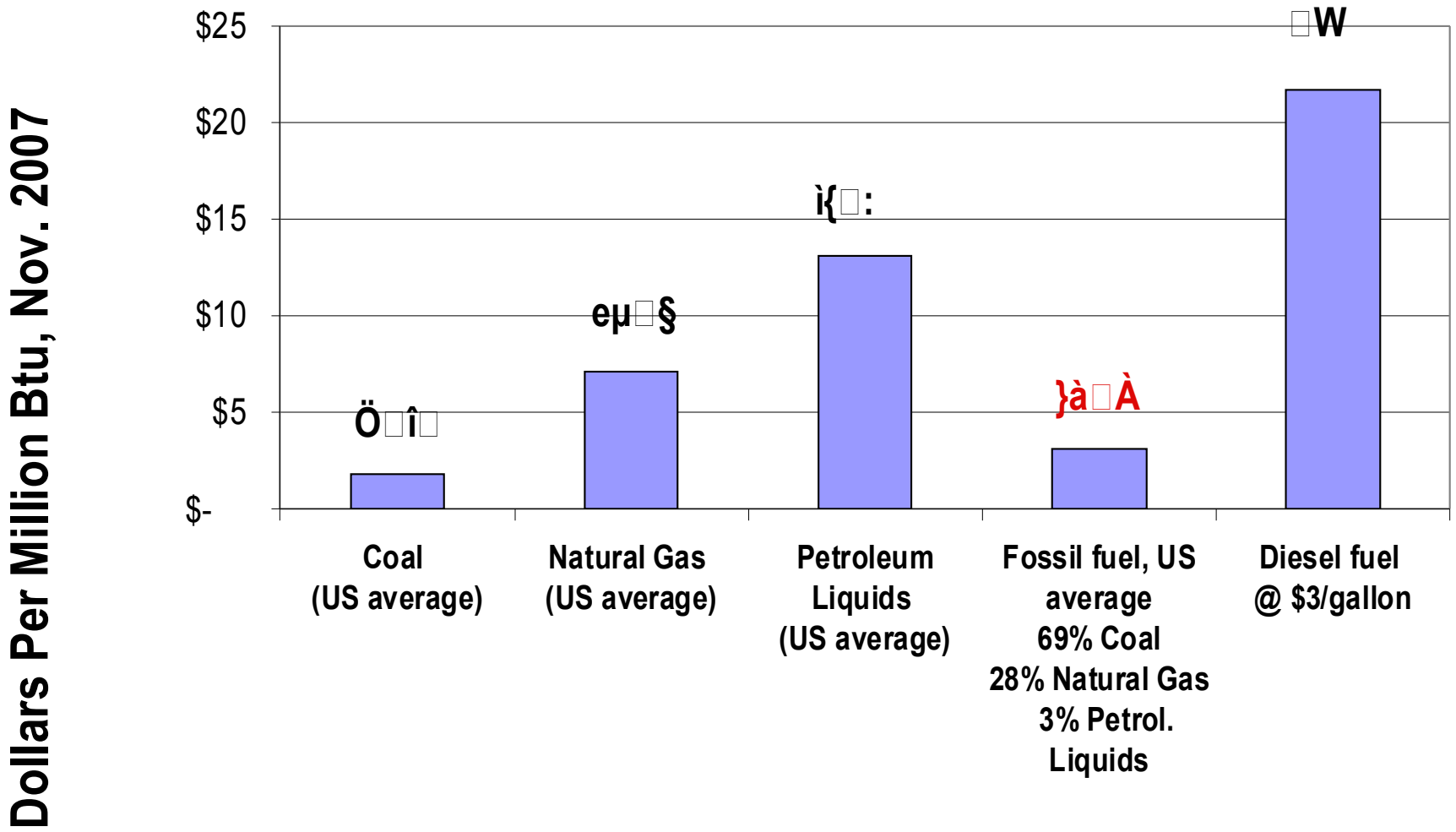
http://tonto.eia.doe.gov/dnav/pet/xls/pet_pri_spt_s1_d.xls

U.S. Electricity Generation by Source, 2006

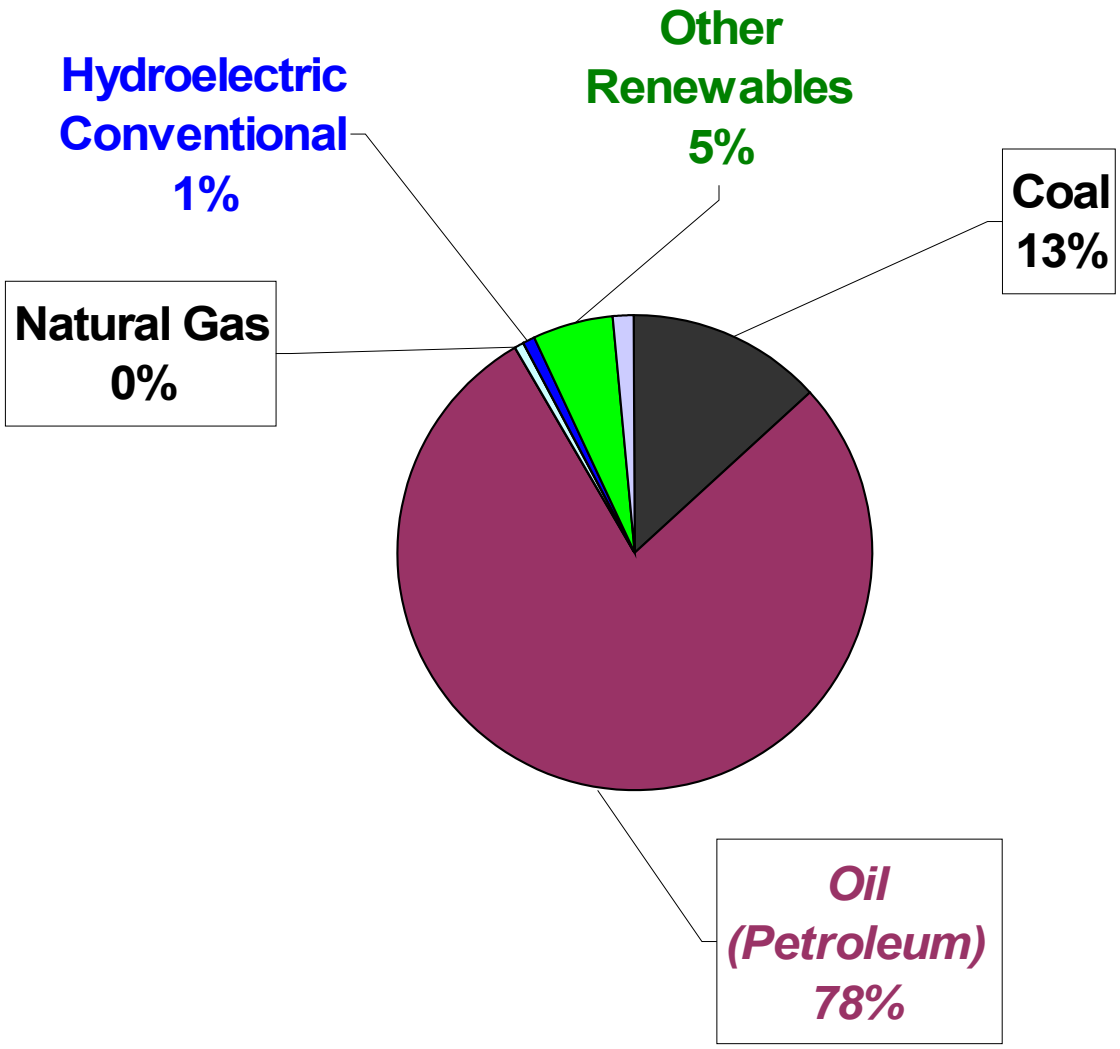


http://www.eia.doe.gov/cneaf/electricity/epa/generation_state.xls

Fossil Fuel Costs per Million Btu



Hawaii Electricity Generation by Source, 2006



http://www.eia.doe.gov/cneaf/electricity/epa/generation_state.xls

State Energy Policy

§226-18, Hawaii Revised Statutes

Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:

1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;
2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;
3) Greater energy security in the face of threats to Hawaii's energy supplies and systems; and
4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.

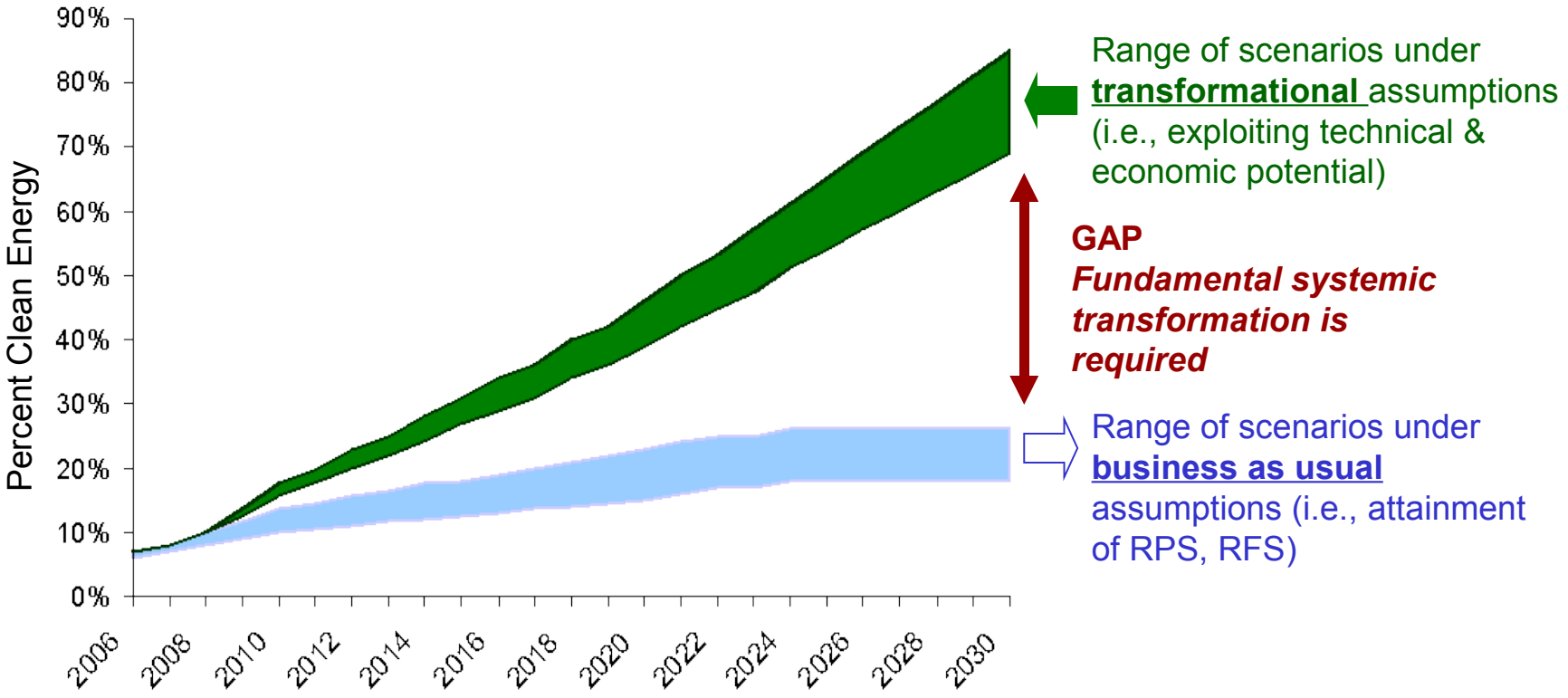
Hawaii's Renewable Energy Objectives*

- **Renewable Portfolio Standard** for Electricity Production
  - 10% by December 31, 2010
  - 15% by December 31, 2015
  - 20% by December 31, 2020
- **Revise Energy Cost Adjustment Clause**
- **Alternative Fuel Standard** for vehicle fuels
  - 10% by December 31, 2010
  - 15% by December 31, 2015
  - 20% by December 31, 2020
- **Ethanol Content Requirement**
  - Most gasoline in Hawaii contains 10% ethanol

* In statute. The Hawaii Clean Energy Initiative will be discussed next.

Hawaii needs to transition to an economy powered by clean energy, instead of imported oil…

In 2007 Hawaii's energy portfolio included 8% renewable energy, a proportion which is set to increase to approximately 20% under current plans



…but doing so will require a transformation of regulatory, financial, and institutional systems

What is the First Step?

Step 1:

Reduce energy waste

Efficiency
is the lowest cost energy resource.

Solar

Wind

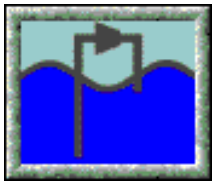
Step 2:

Hydropower

Renewables

Biomass

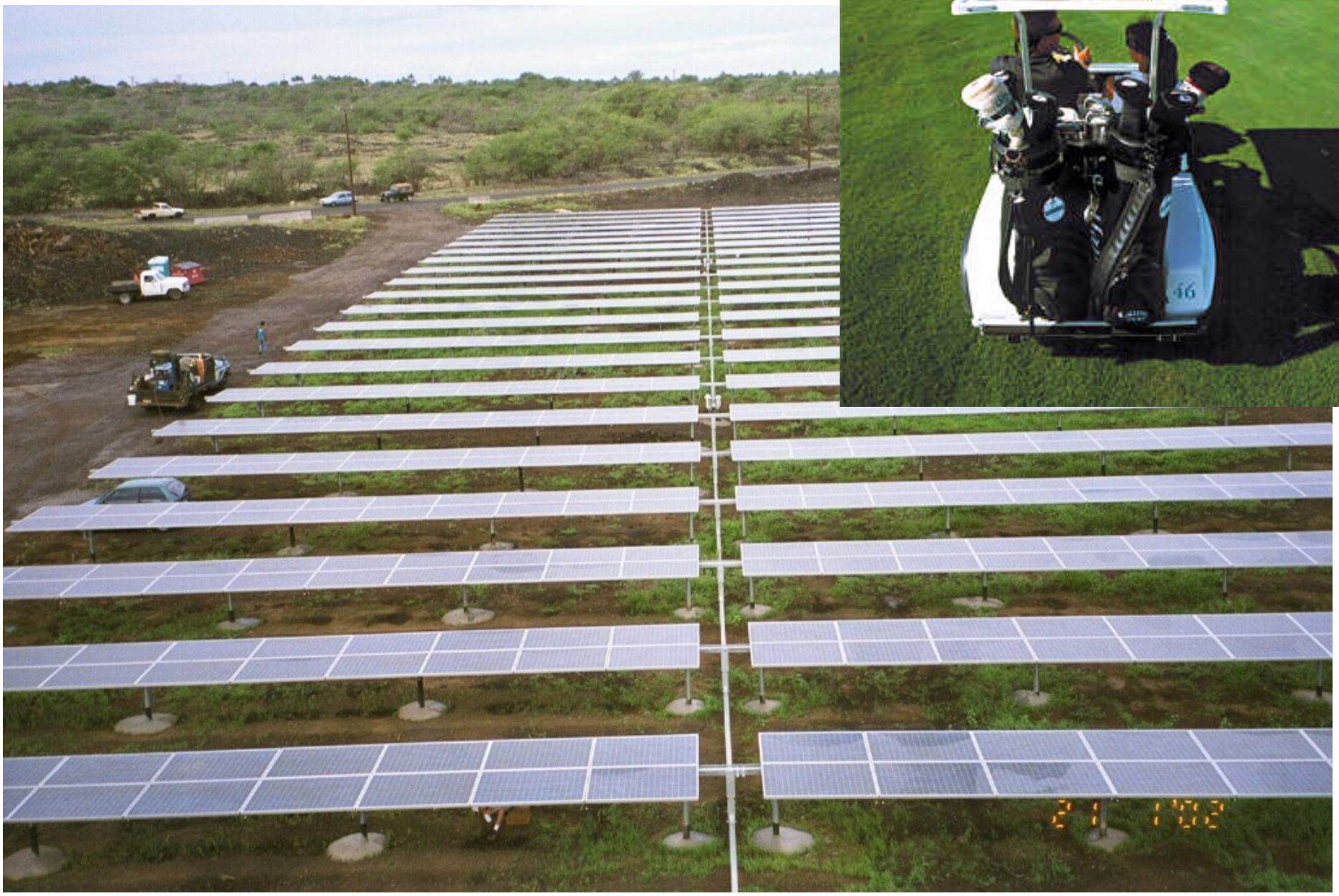
Geothermal



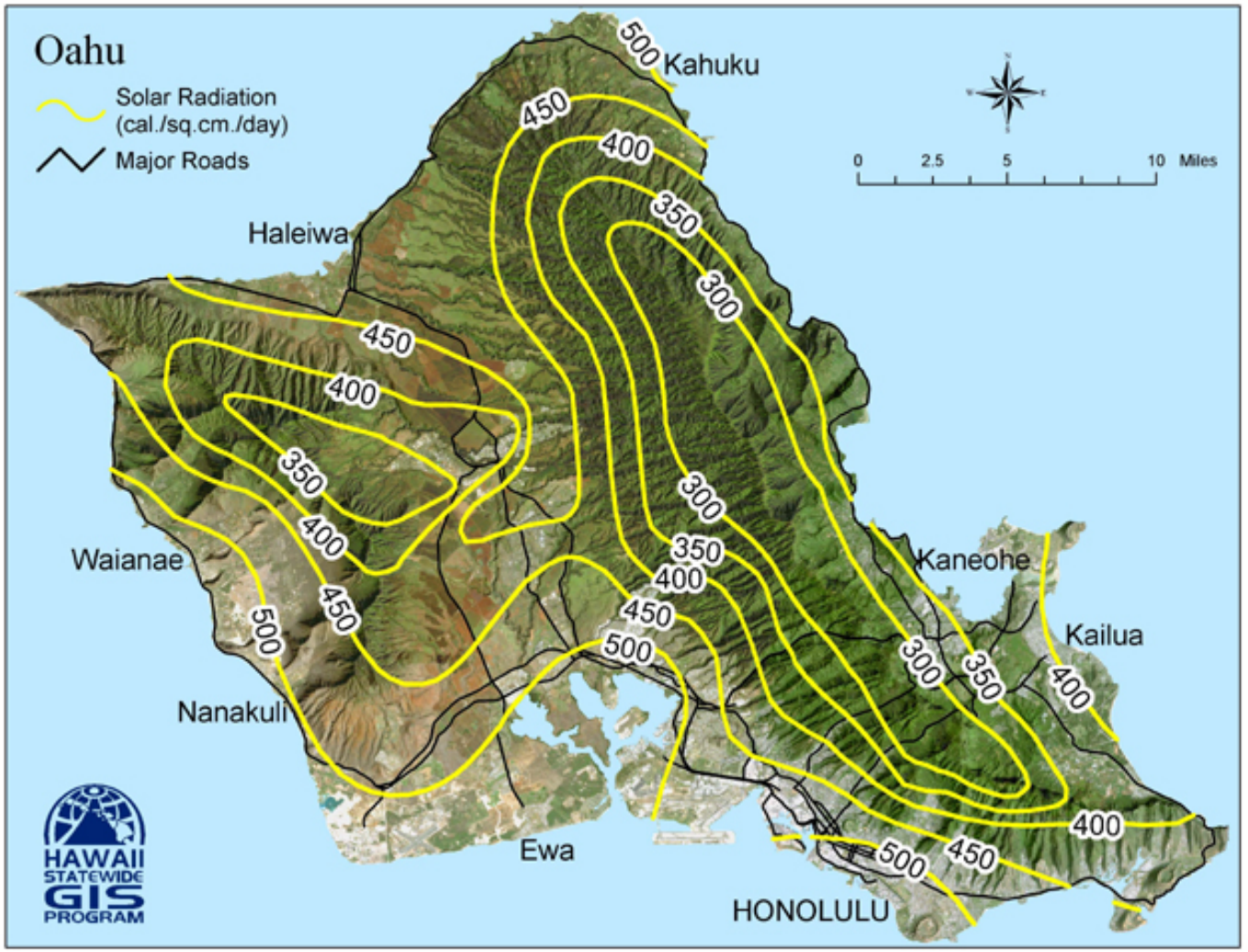
Ocean Energy

Hawaii has abundant renewable energy resources.

Solar Energy



Solar Energy



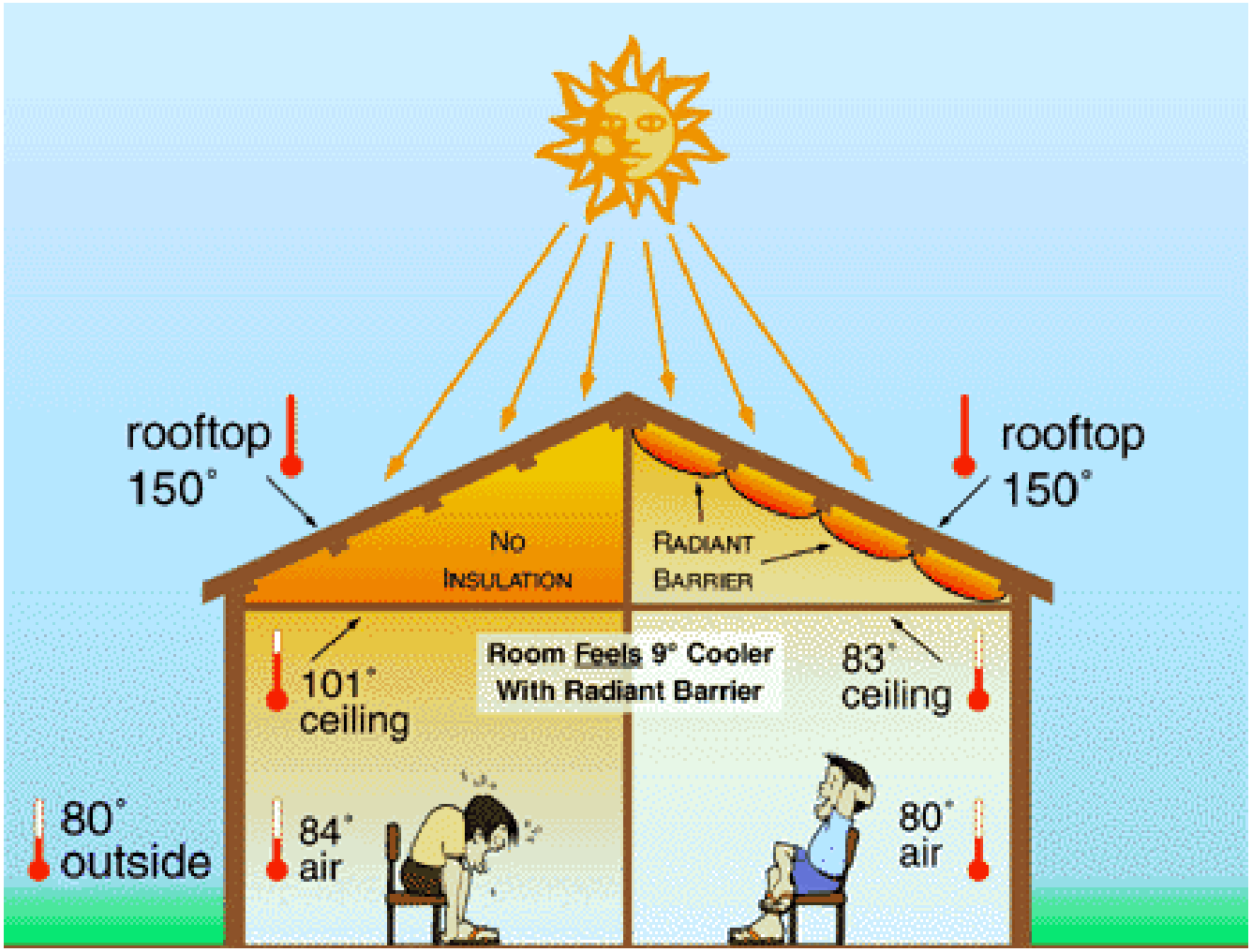
Energy Unit Conversion

600	calories per square centimeter	=	2200	Btu per square foot	=	7	peak sun hours
500	calories per square centimeter	=	1800	Btu per square foot	=	5.8	peak sun hours
400	calories per square centimeter	=	1500	Btu per square foot	=	4.6	peak sun hours
300	calories per square centimeter	=	1100	Btu per square foot	=	3.5	peak sun hours

Cal/cm^2 times 3.688 gives Btu/ft^2 . Cal/cm^2 times 0.0116 gives peak sun hours.

http://hawaii.gov/dbedt/info/energy/publications/solardata/

Energy is Everywhere



You can work against it…

…try to avoid it…

…or work with it.

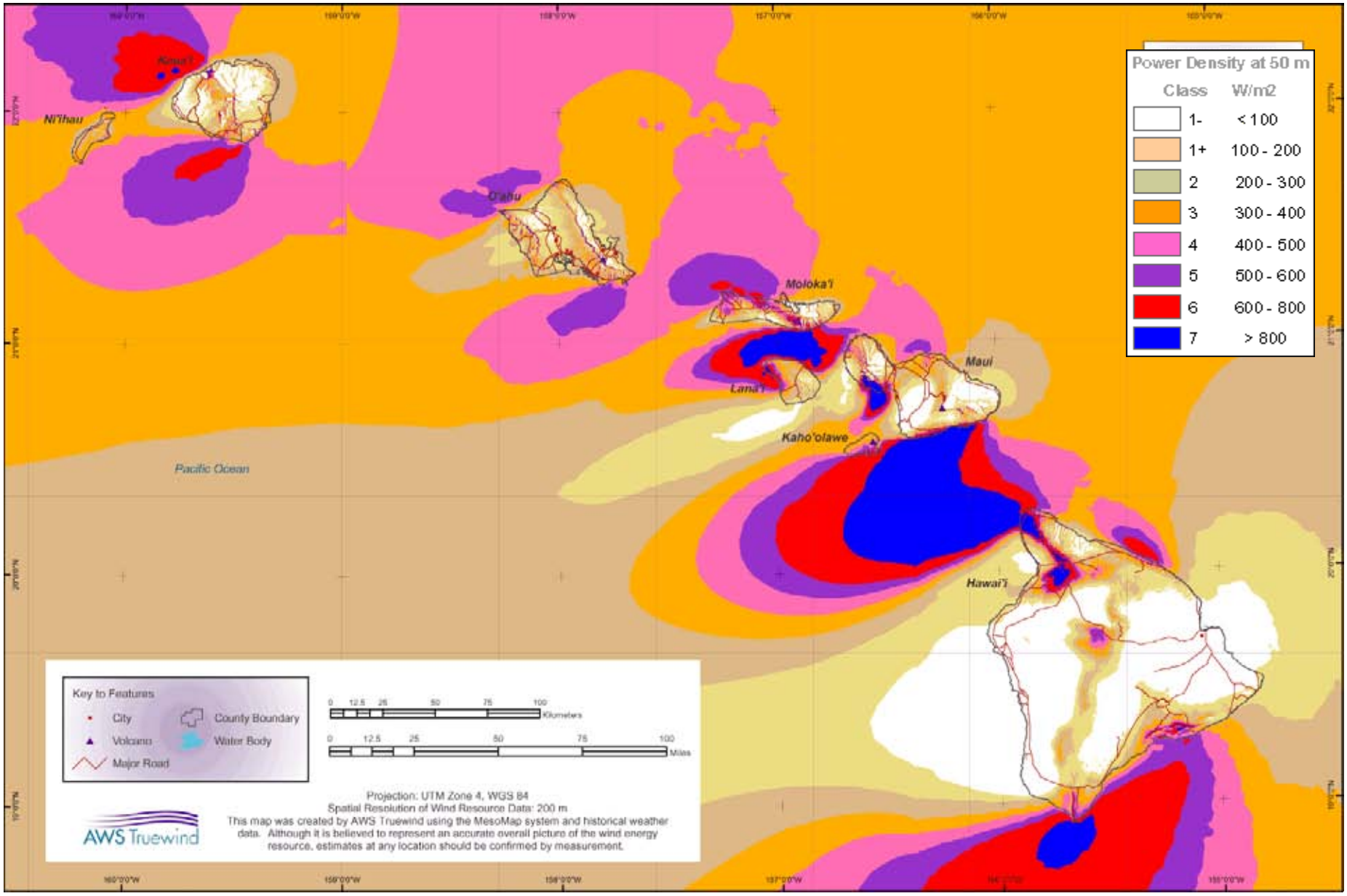
Example: Working With the Sun

The sun's energy goes into the water → -- not into the house

Solar panels shade the roof (and produce electricity)

← Skylight provides high-quality light

Wind Energy



http://hawaii.gov/dbedt/info/energy/renewable/wind

Hydropower

http://www.heco.com

Ocean Thermal Energy Conversion – OTEC

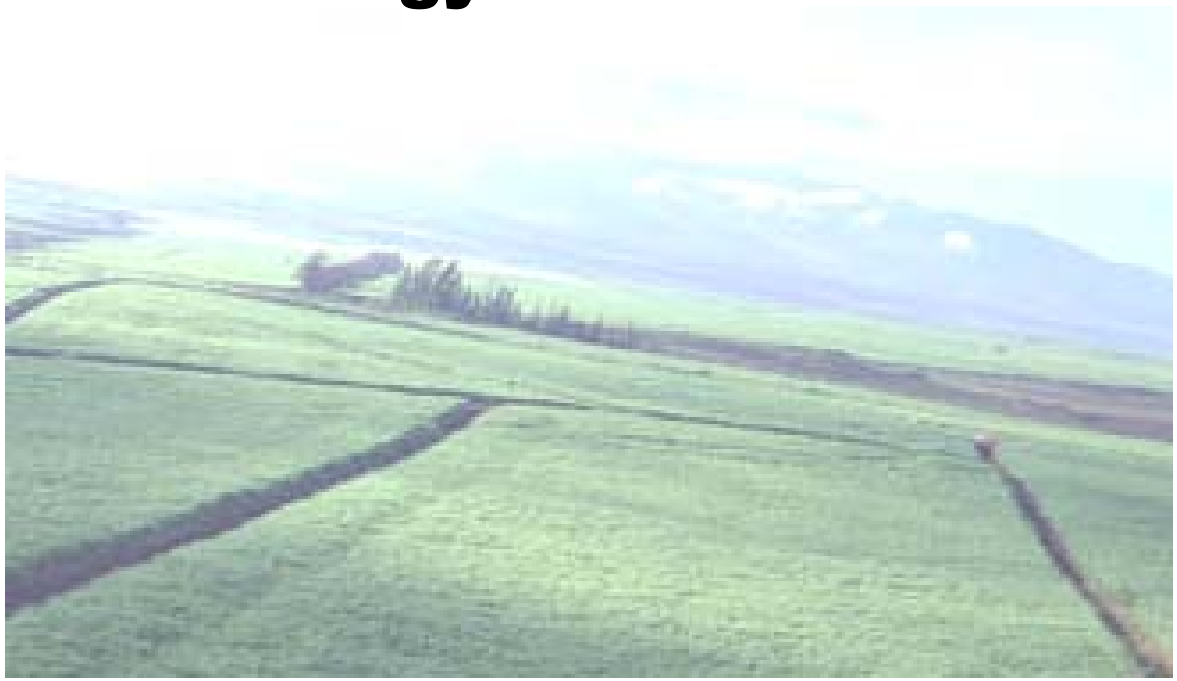
http://www.nelha.org/

Ocean Energy – Waves

Geothermal

http://www.punageothermalventure.com/

Bioenergy



SUGAR CANE / GRASSES

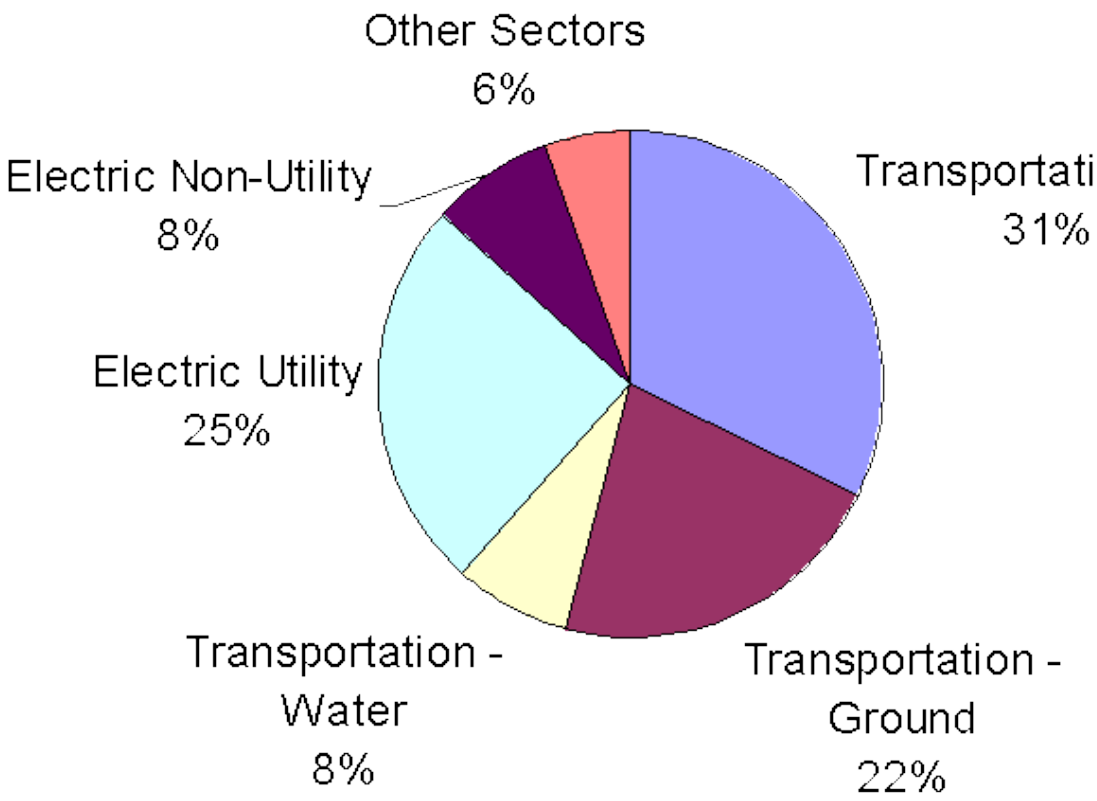
WOOD

SOLID WASTE

OIL SEEDS

ALGAE

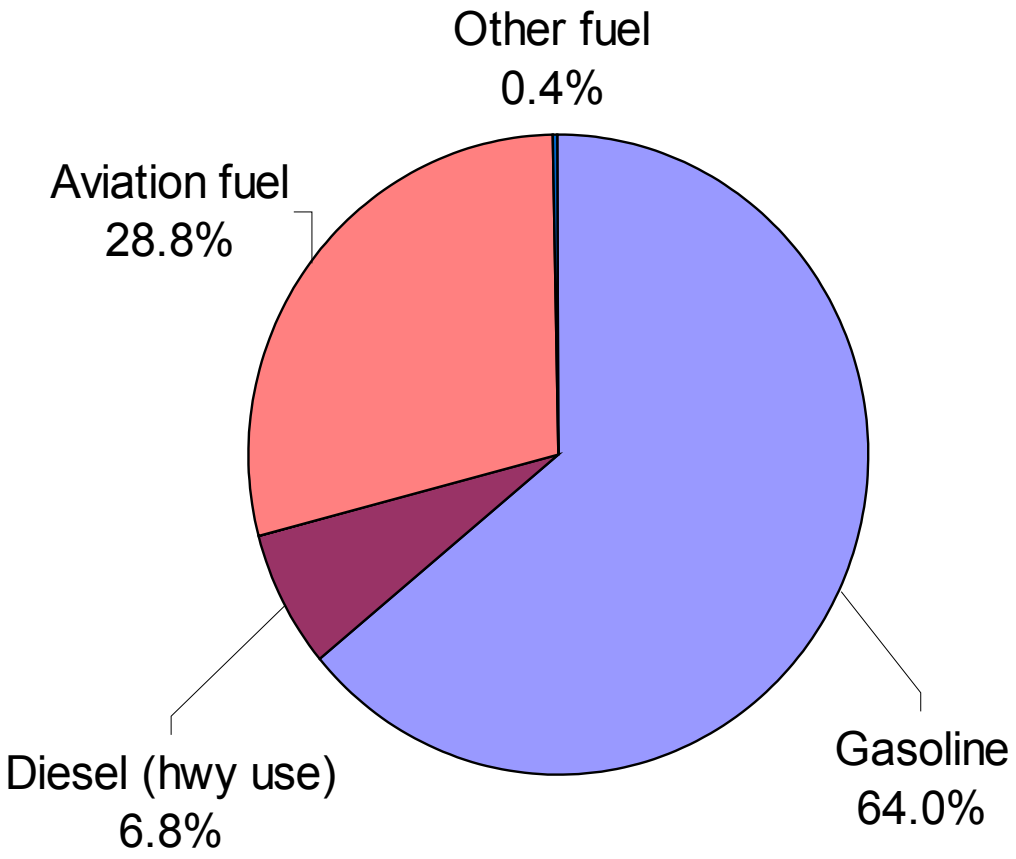
Hawaii Petroleum Consumption by Sector, 2005



Transportation: 61.7%
Electricity: 32.7%
Other: 5.6%

Source: State of Hawaii, Department of Business, Economic Development, and Tourism

In-State Use of Transportation Fuels*



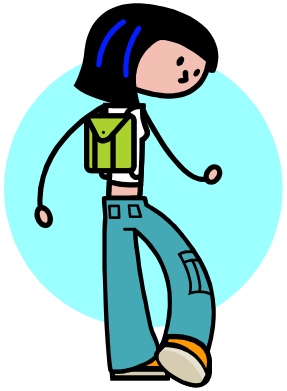
- Does not include off-highway use of fuel, such as for marine transportation, or fuels not subject to in-state tax, such as jet fuel for international travel. Source: Department of Taxation, Fiscal Year 2007: http://www.hawaii.gov/tax/a5_3txcolrpt.htm

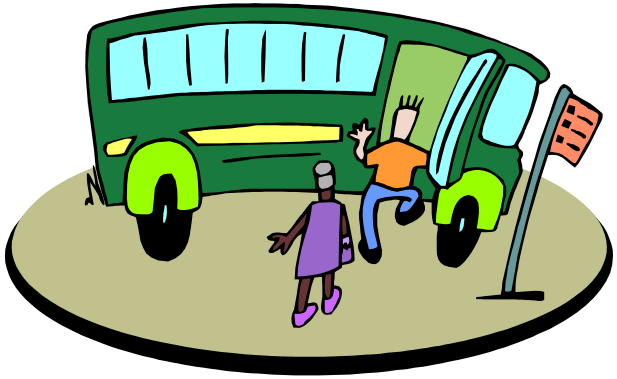
Transportation Fuels

No Single Solution

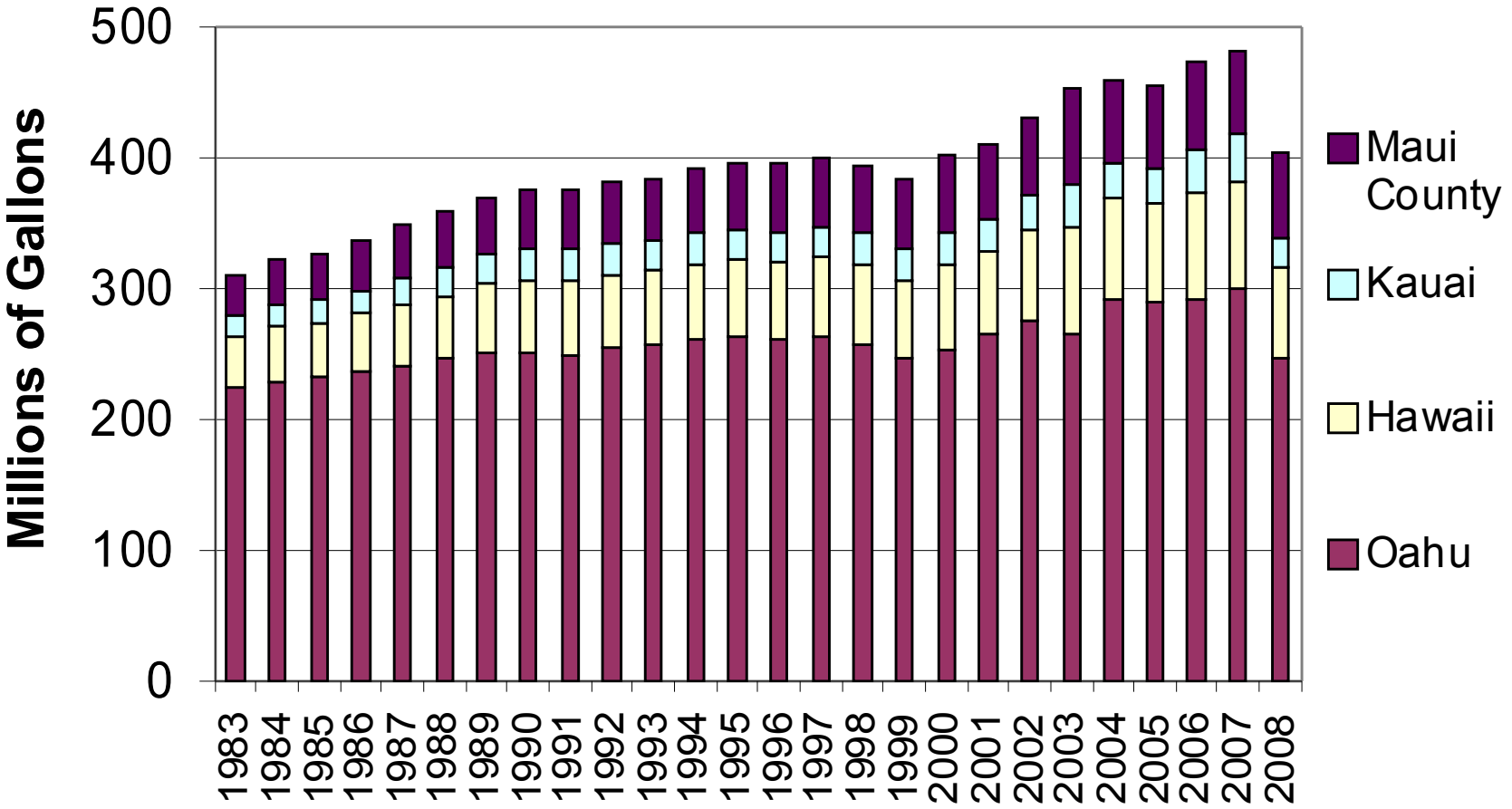
- Land Use Planning / Urban Design
- Transportation System Improvements
- Vehicle Fuel Efficiency
- Diversification of Energy Sources

Alternatives

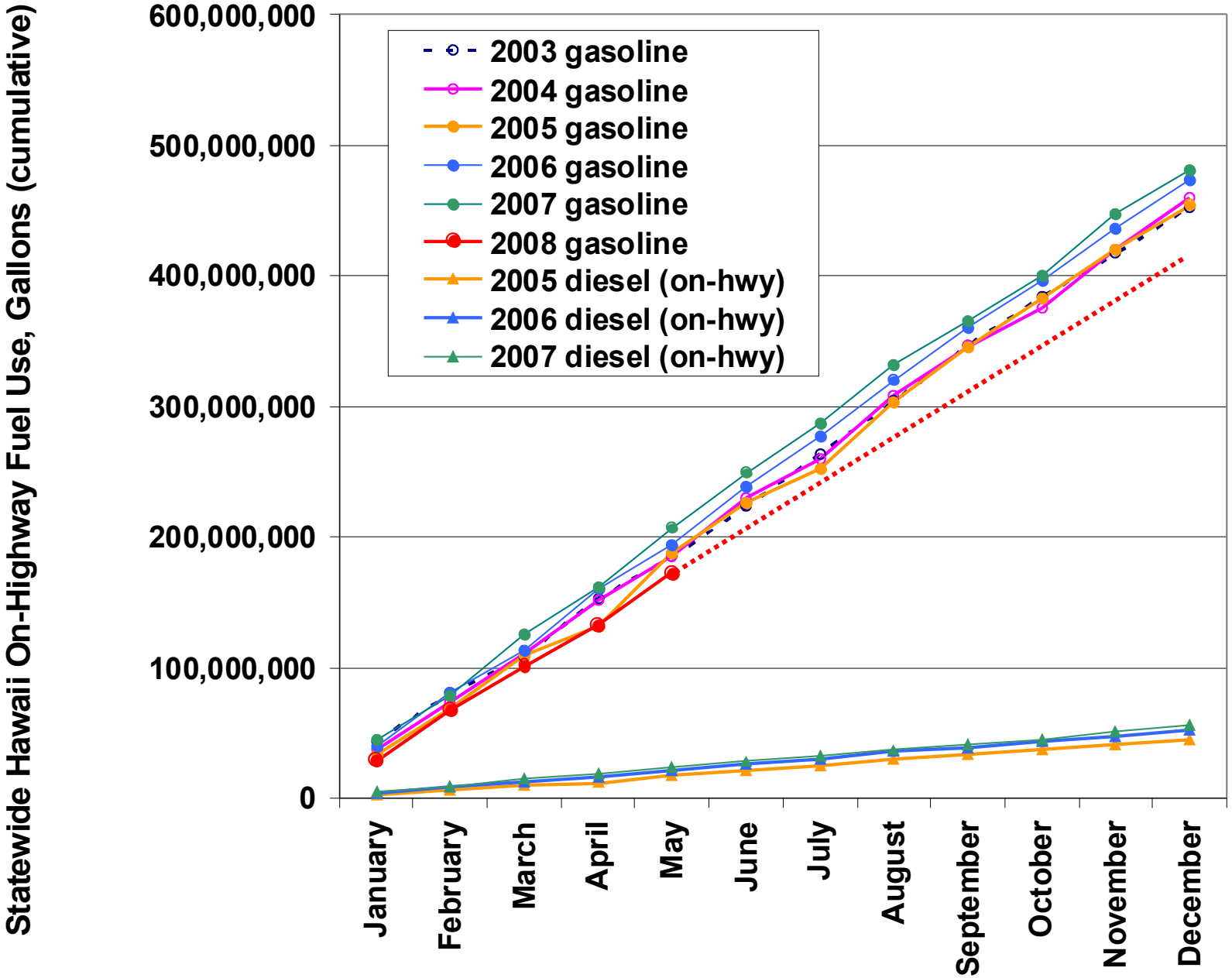




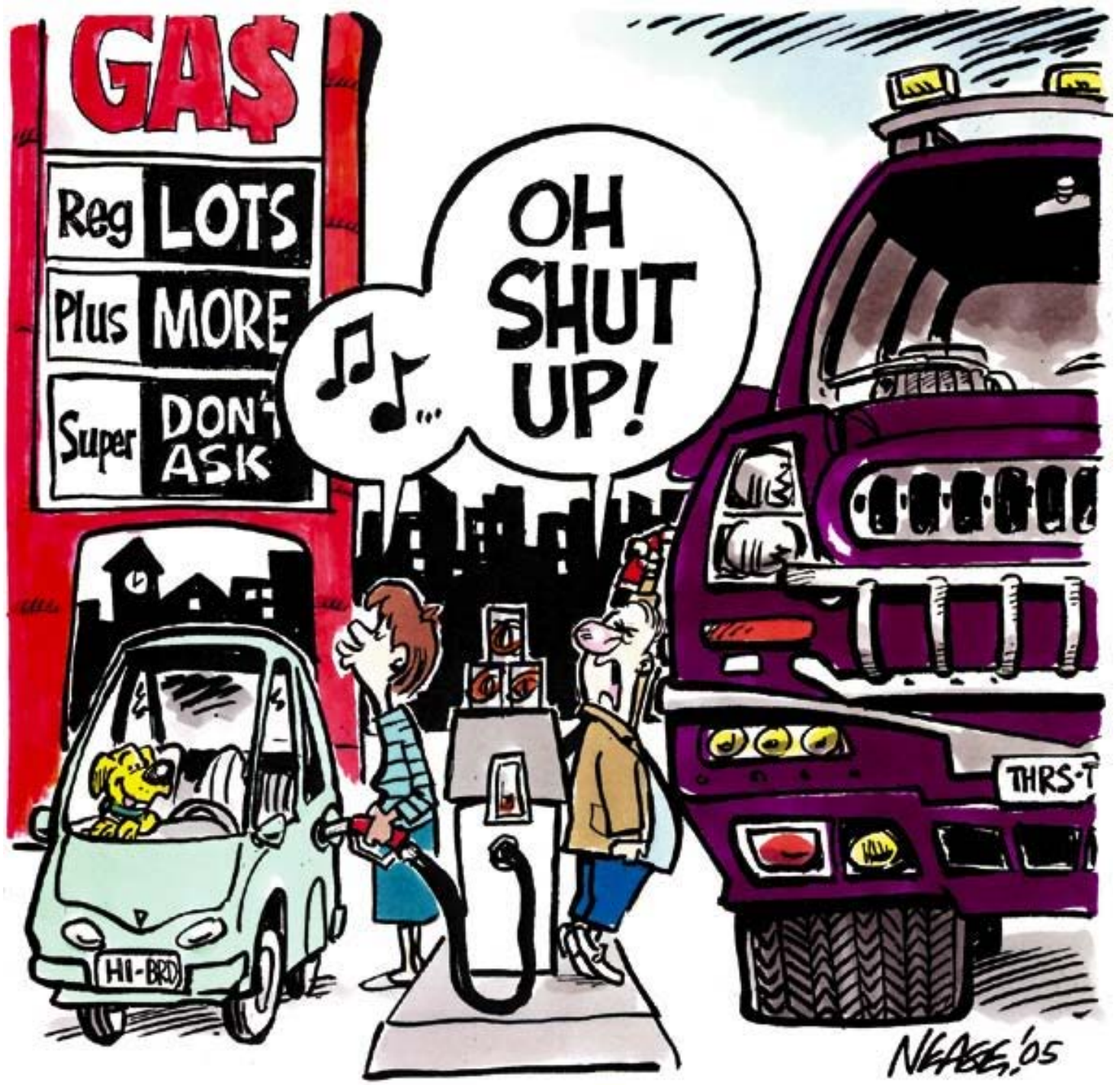
Hawaii's Actual and Projected* Ground Transportation Fuel Demand, 1983-2008



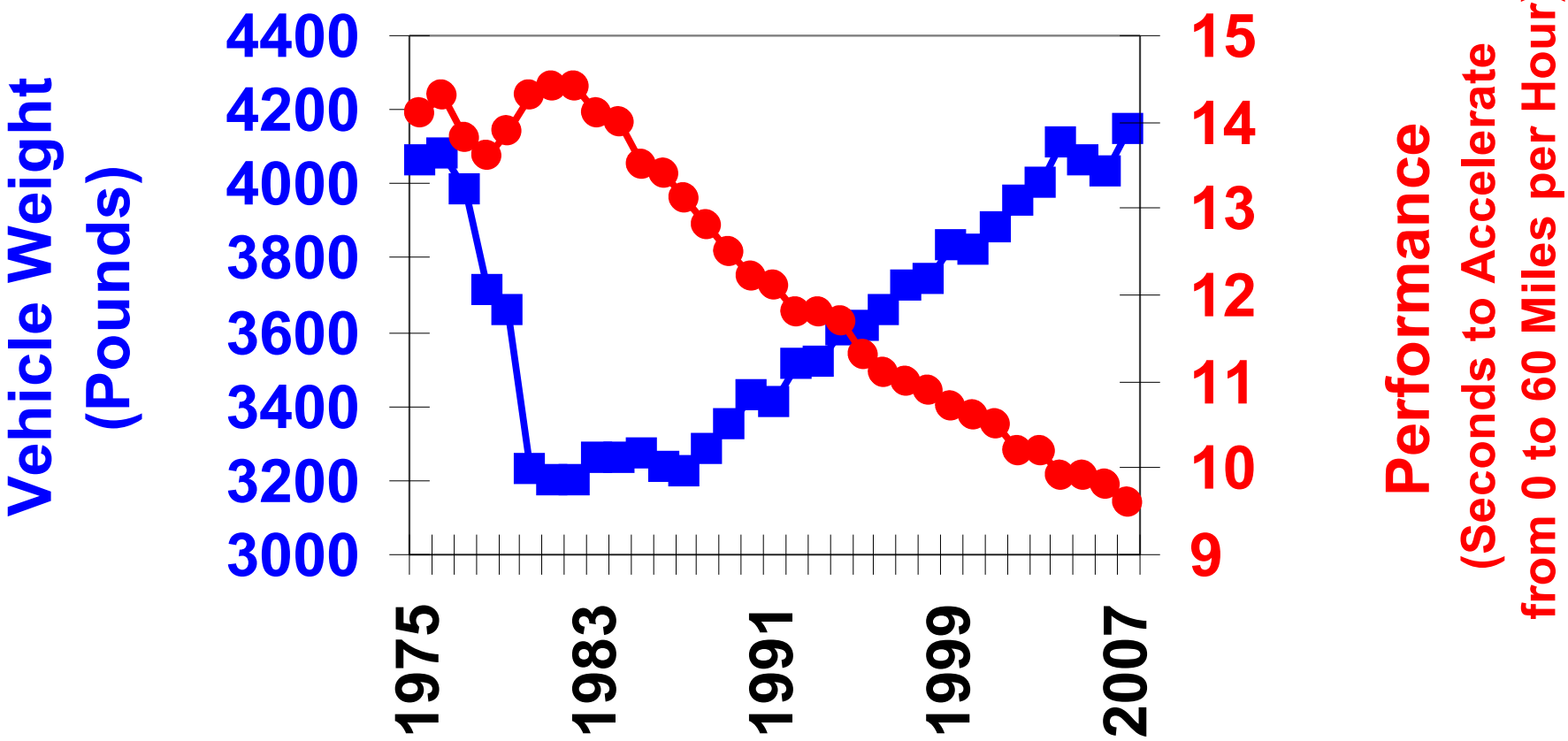
* 1983-2007: actual, based on Hawaii State Fuel Tax receipts;
2008: projected, if Jan-May trends continue



http://www.hawaii.gov/tax/a5_3txcolrpt.htm

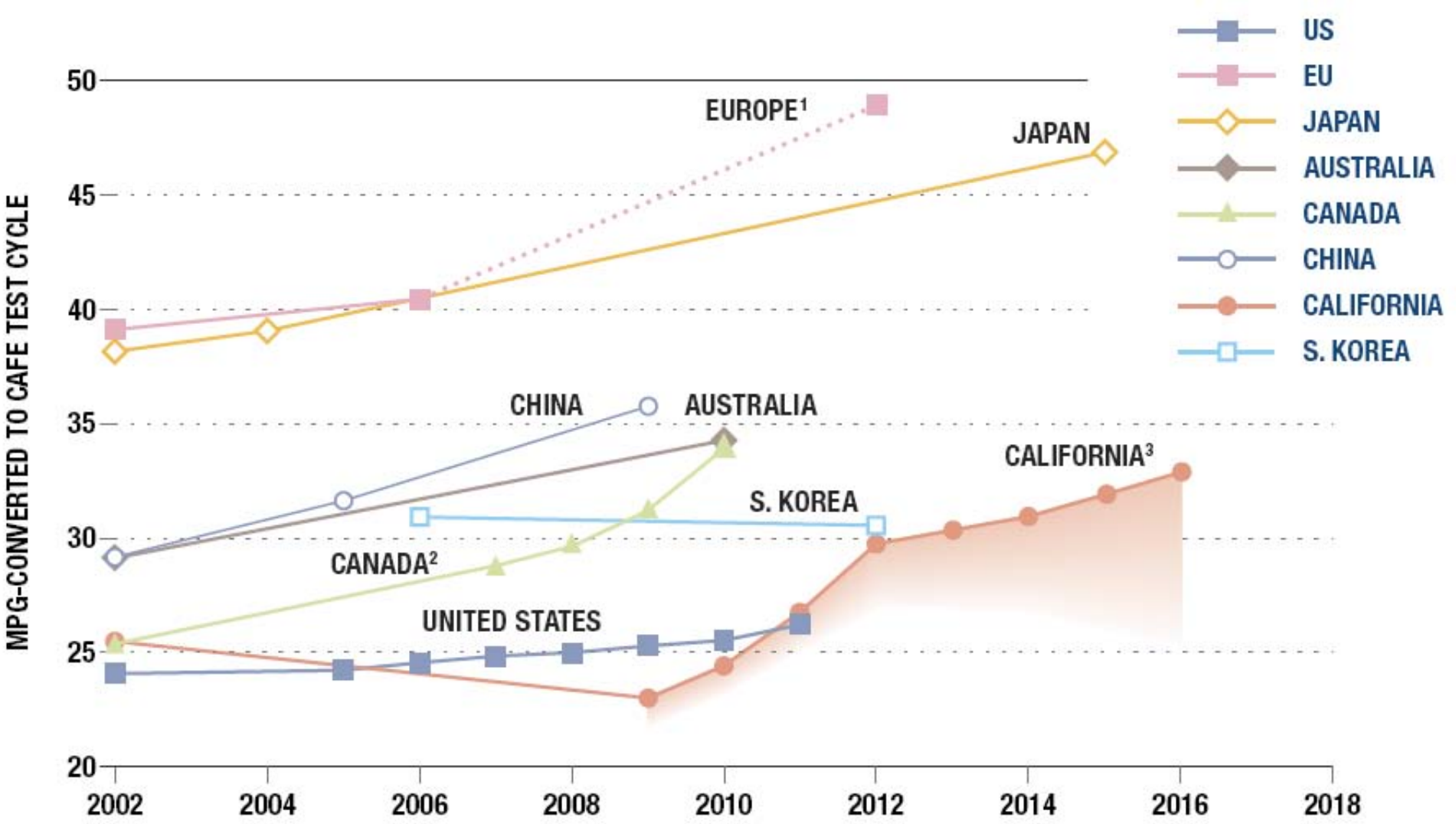

GA$
Reg LOTS
Plus MORE
Super DON'T ASK
OH SHUT UP!
HI-BRD
THRS-T
NEASE '05

Vehicle Weight and Performance



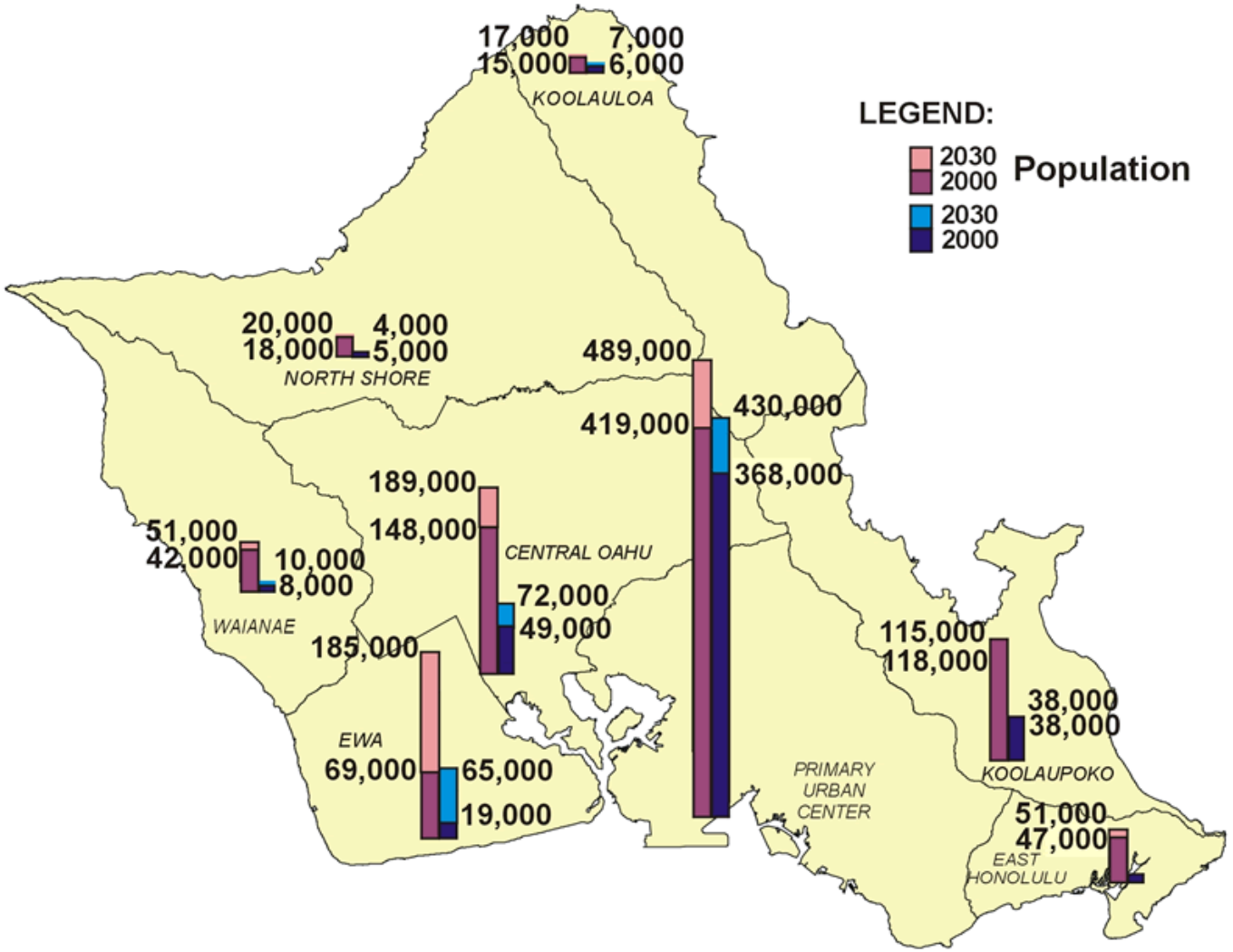
http://www.epa.gov/otaq/cert/mpg/fetrends

New Passenger Vehicle Fuel Economy



http://www.theicct.org/documents/ICCT_GlobalStandards_2007.pdf

Transportation Demand



http://www.oahumpo.or

/ortp/media/1-1_lg.gif

Population and Employment Growth by Development Plan Area

Most Significant, Near-term

Alternative Fuels for Hawaii

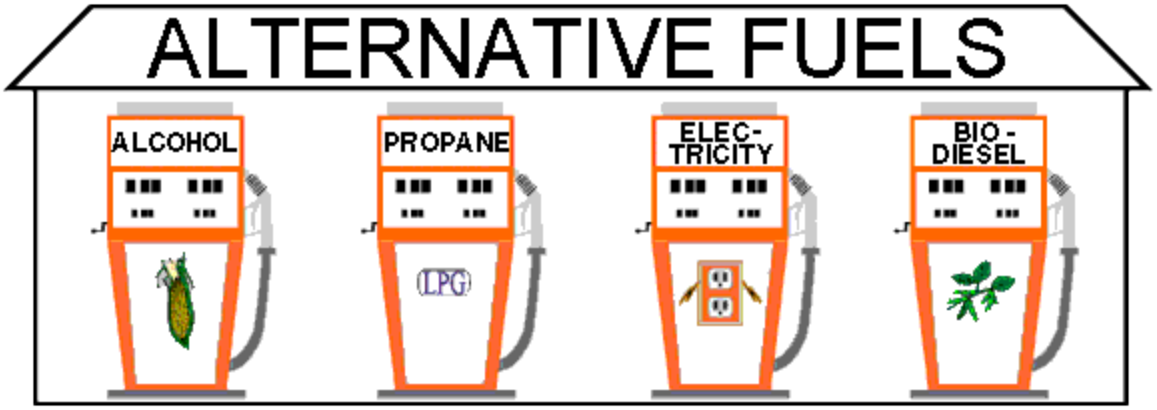
✓ **Ethanol**

- E-10: Additive (10% ethanol + 90% gasoline)
- E-85: Alternative fuel for E85 vehicles

✓ **Biodiesel**

Additive OR replacement for diesel

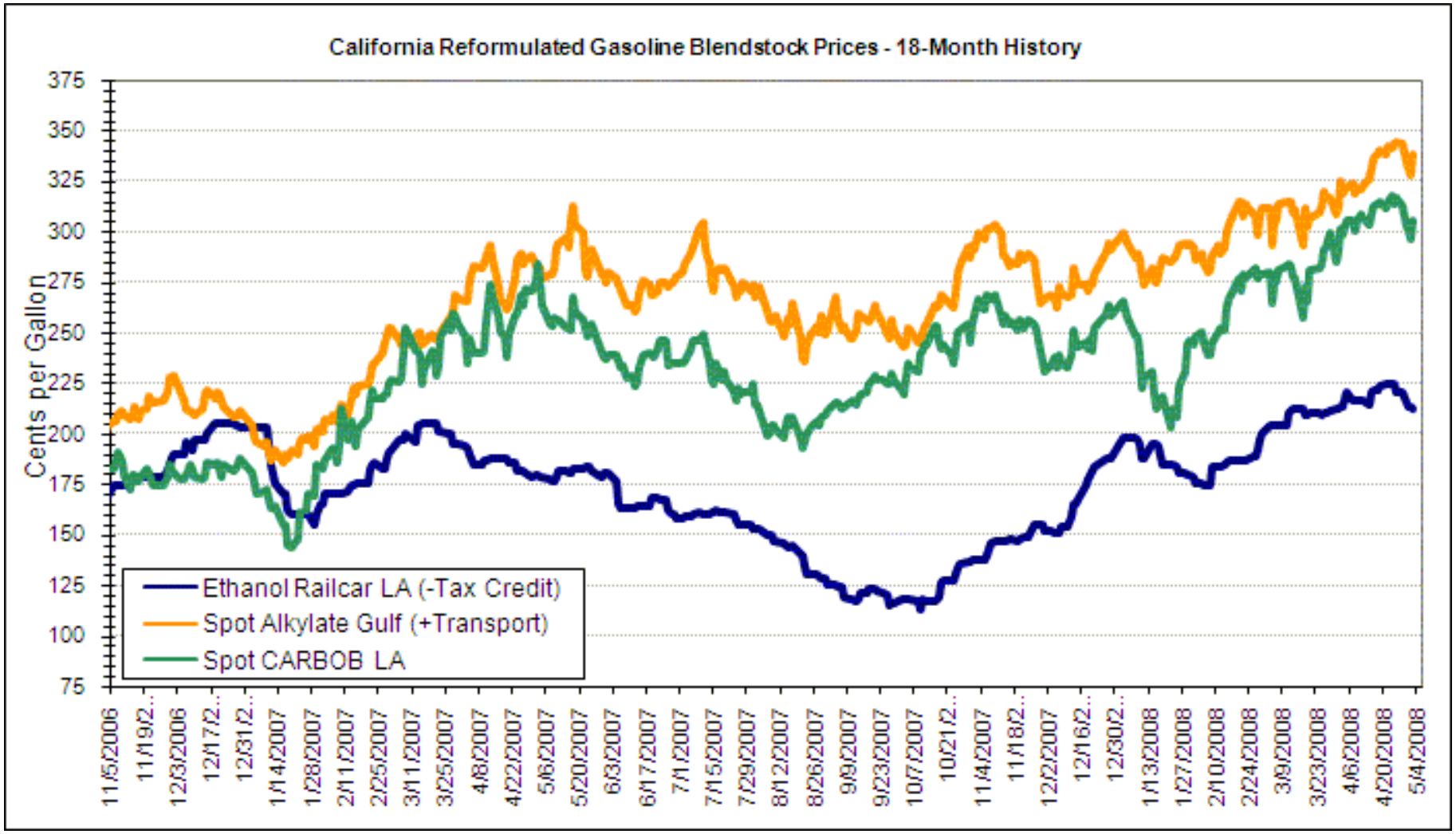
✓ **Hydrogen / Fuel Cell / Electricity**



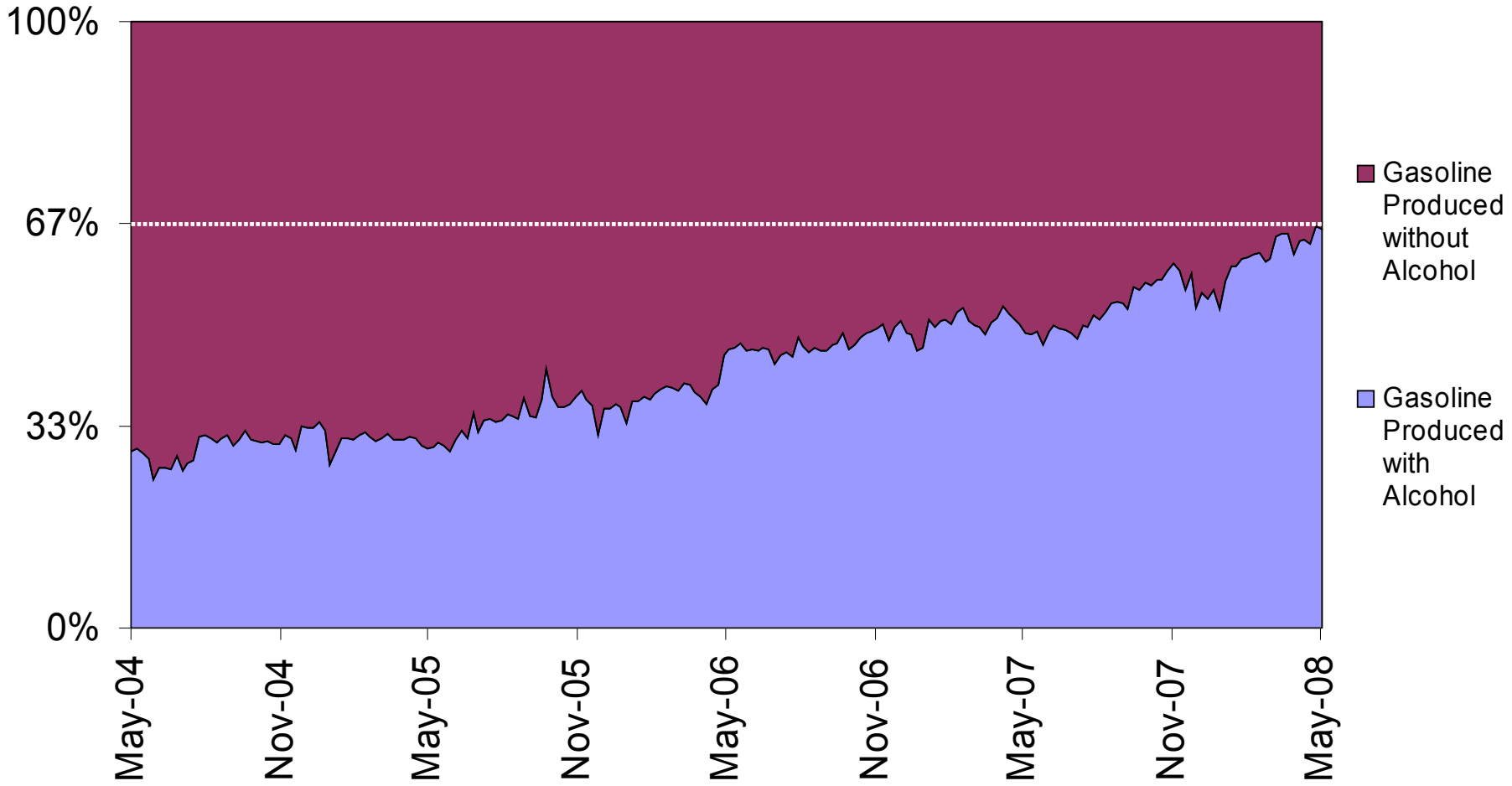
Hawaii's Gasoline Now Contains 10% Ethanol

10% ethanol • 90% gasoline

Blending economics: ethanol is cheaper than gasoline



About two-thirds of U.S. Gasoline Now Contains Ethanol



Source: U.S. Department of Energy, Energy Information Administration, psw11.xls

Biodiesel

- Produced locally (Maui & Oahu) from used cooking oil
- Can also be produced from oilseed crops
- For use in diesel engines
- Available at retail stations on Oahu and Maui

Retail Biodiesel Fueling locations

Oahu:

B99: 76 station on Nimitz, by Carls Junior

B20: 76 station at Niu Valley 7-11

B20: 76 station on King Street near Piikoi

Maui:

B99: Pacific Biodiesel pump in Kahului, Hobron Lane

B20: Paia Chevron

Electric, Hybrid, and Fuel Cell Vehicles

Neighborhood Electric Vehicles

Fuel Cell Car

Plug-in Hybrid

Hybrid electric-fuel cell bus for Hickam Air Force Base

Energy for Tomorrow

Electricity

- Energy Efficiency First
- Customer-Sited Generation
- Combined Heat and Power
- Development of Renewable Energy Resources
  - Solar
  - Wind
  - Biomass
  - Geothermal
  - Hydropower
  - Ocean (OTEC/Wave)
- Energy Storage
- Smart Grids
- Changes in Electricity Regulation

Transportation Fuels

- Land Use
- Transportation System Design
- More Efficient Vehicles
- Vehicles Capable of Using Non-petroleum Energy Sources
- Local Production of Alternative Fuels
  - Biofuels
    - Ethanol
    - Biodiesel
    - Biojet
  - Electricity from renewable sources, off-peak
  - Hydrogen

Biofuels Assessment

A 2-year project to conduct a statewide multi-fuel biofuels production assessment of:

- potential feedstocks and technologies;
- the economics of the various renewable fuels pathways; and
- the potential for ethanol, biodiesel, and renewable hydrogen production to contribute to Hawaii's near-, mid-, and long-term energy needs

Scheduled for completion in July, 2009

Bioenergy Master Plan

DBEDT shall…

… develop and prepare a bioenergy master plan in consultation with representatives of the relevant stakeholders. The primary objective of the bioenergy master plan shall develop a Hawaii renewable biofuels program to manage the State's transition to energy self-sufficiency based in part on biofuels for power generation and transportation.

The bioenergy master plan shall address the following outcomes:

(1) Strategic partnerships for the research, development, testing, and deployment of renewable biofuels technologies and production of biomass crops;

(2) Evaluation of Hawaii's potential to rely on biofuels as a significant renewable energy resource;

(3) Biofuels demonstration projects, including infrastructure for production, storage, and transportation of biofuels;

(4) Promotion of Hawaii's renewable biofuels resources to potential partners and investors for development in Hawaii as well as for export purposes; and

(5) A plan or roadmap to implement commercially viable biofuels development.

The bioenergy master plan shall address the following issues:

(1) Specific objectives and timelines;

(2) Water resources;

(3) Land resources;

(4) Distribution infrastructure for both marine and land;

(5) Labor resources and issues;

(6) Technology to develop bioenergy feedstock and biofuels;

(7) Permitting;

(8) Financial incentives and barriers and other funding;

(9) Business partnering;

(10) Policy requirements necessary for implementation of the master plan; and

(11) Identification and analysis of the impacts of transitioning to a bioenergy economy while considering applicable environmental concerns.

Your help is needed.

Survey:

- hawaii.gov/dbedt/info/energy/renewable/bioenergy/
- In which areas do **you** have expertise?
  Please select up to 3 topics.
- What **specific** information / resource would be helpful?
- Please provide details: name, phone number, email; document link; actual document(s)
- hawaii.gov/dbedt/info/energy/renewable/bioenergy/

Input:

- Send via email: bioenergy@dbedt.hawaii.gov
- Or mail to: PO Box 2359, Honolulu, HI 96804

Additional information

50,000,000	barrels per year
1,300,000	resident population
38.46	barrels per resident per year
42	gallons per barrel
1615	gallons per resident per year
365	days per year
4.4	gallons per resident per day