

Hawaii Clean Energy Initiative

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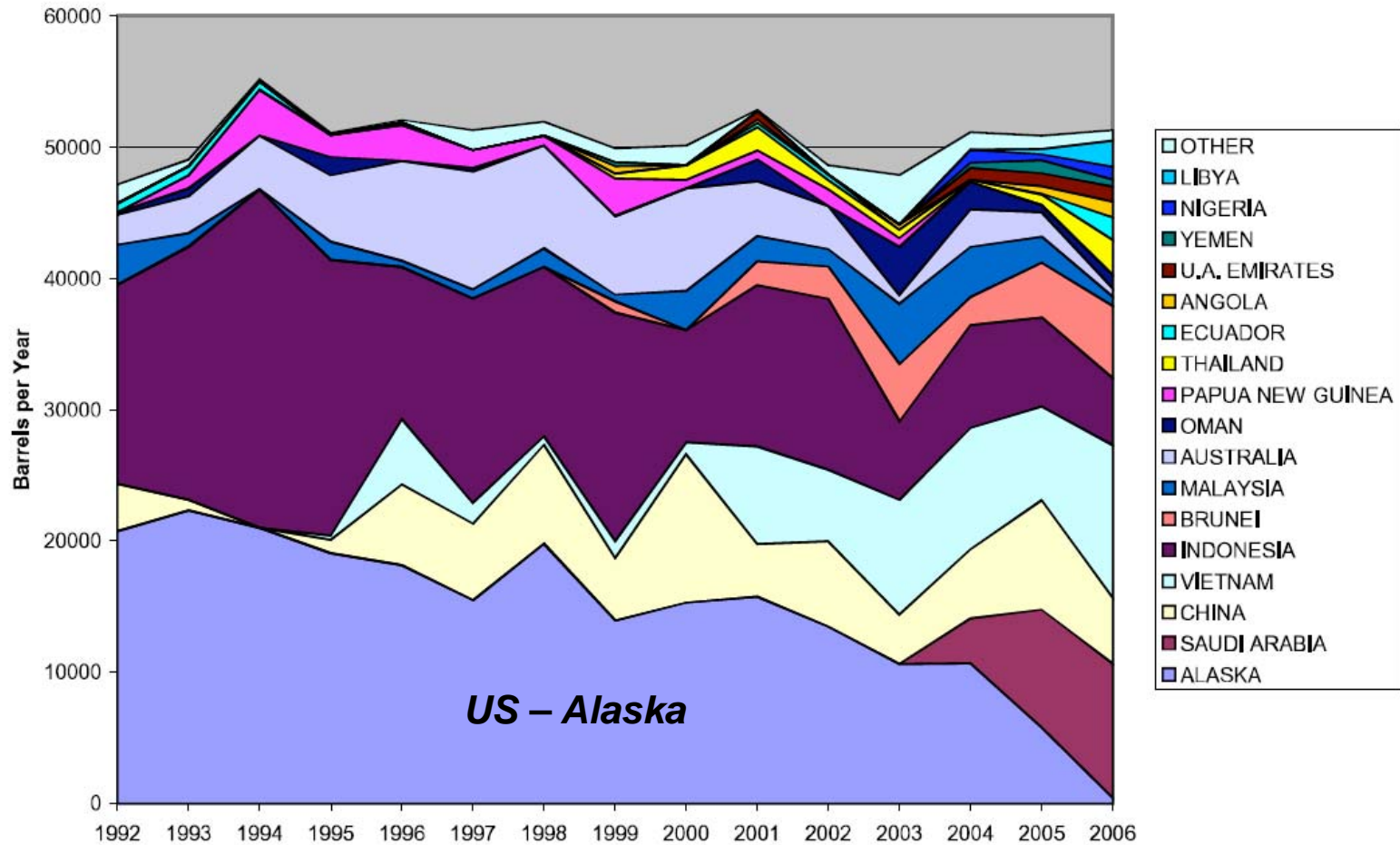


Topics

- ▶ Hawaii's Energy Vulnerability
- ▶ HCEI Goals
- ▶ HCEI Accomplishments
- ▶ Hawaii Critical Issues



Alaska North Slope oil, the basis for the design of our refineries, is no longer available



More than 96% of petroleum in Hawaii now comes from foreign sources



Dependence on foreign oil = dependence on foreign political instabi

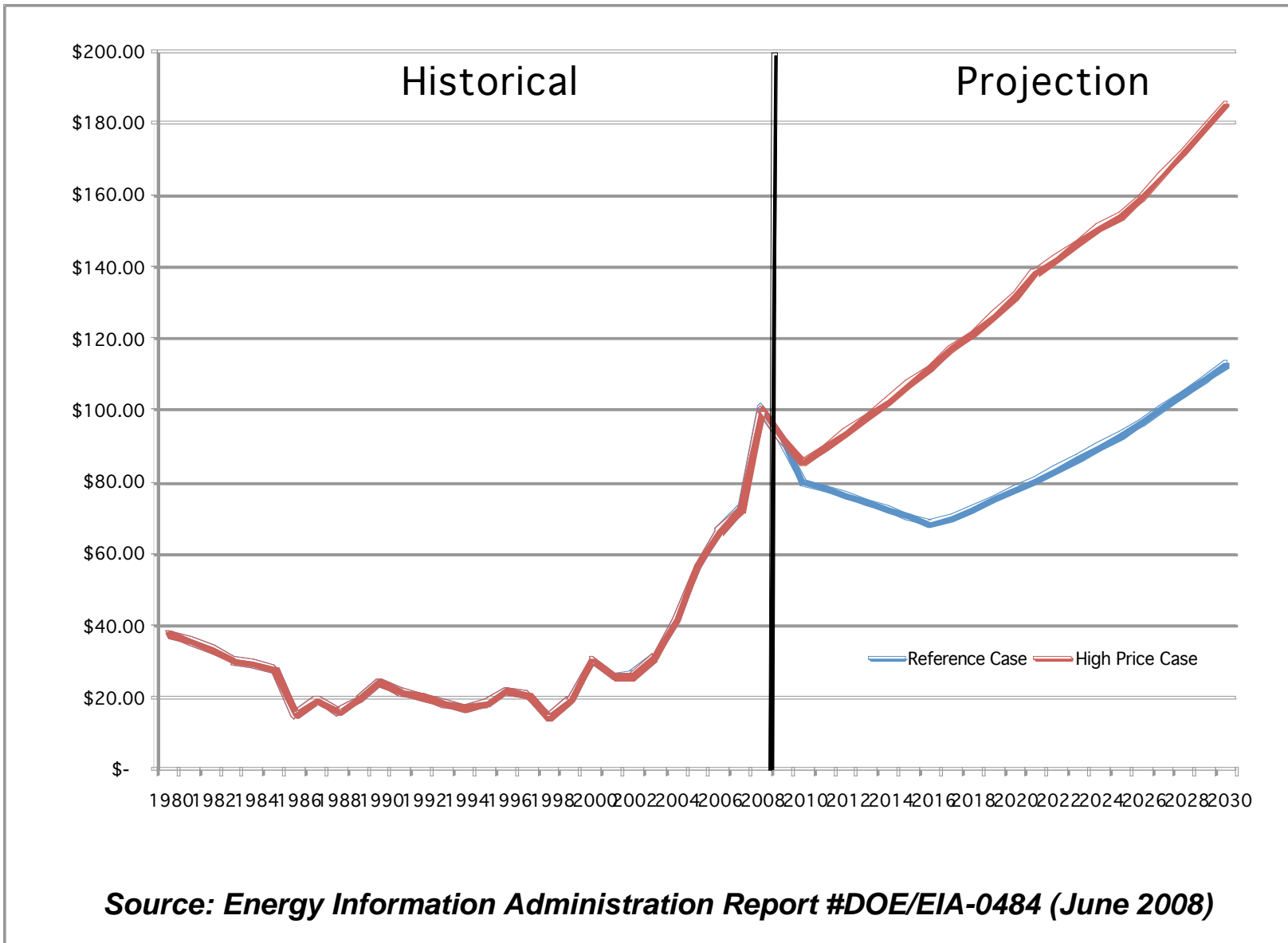
- ▶ October 16, 2007 -- **\$87.61/barrel**
 - “**Weak dollar** and **international tensions** (anxieties over northern Iraq, where there is potential for a Turkish strike on Kurdish separatists)”
 - “**Crude options expire tomorrow** and the market was thought to be heading toward \$90/bbl.”
 - “The market, said OPEC, is ‘**very well supplied.**”

- ▶ January 2, 2008 -- **\$100/barrel**
 - “...a **weakening dollar**, the flow of money into commodities from faltering stocks and bonds, and **Nigerian and Kenyan political unrest**...and oncoming Winter storm, apprehension over tomorrow's DOE report”

- ▶ July 11, 2008 -- **\$147.27/barrel**
 - “...market watchers pointed to concerns in regards to Nigerian production, the ongoing **tensions with Iran** and an **impending strike of Petrobras workers**. In addition, dollar weakness and an early exodus from equities into oil were also considered factors today.”



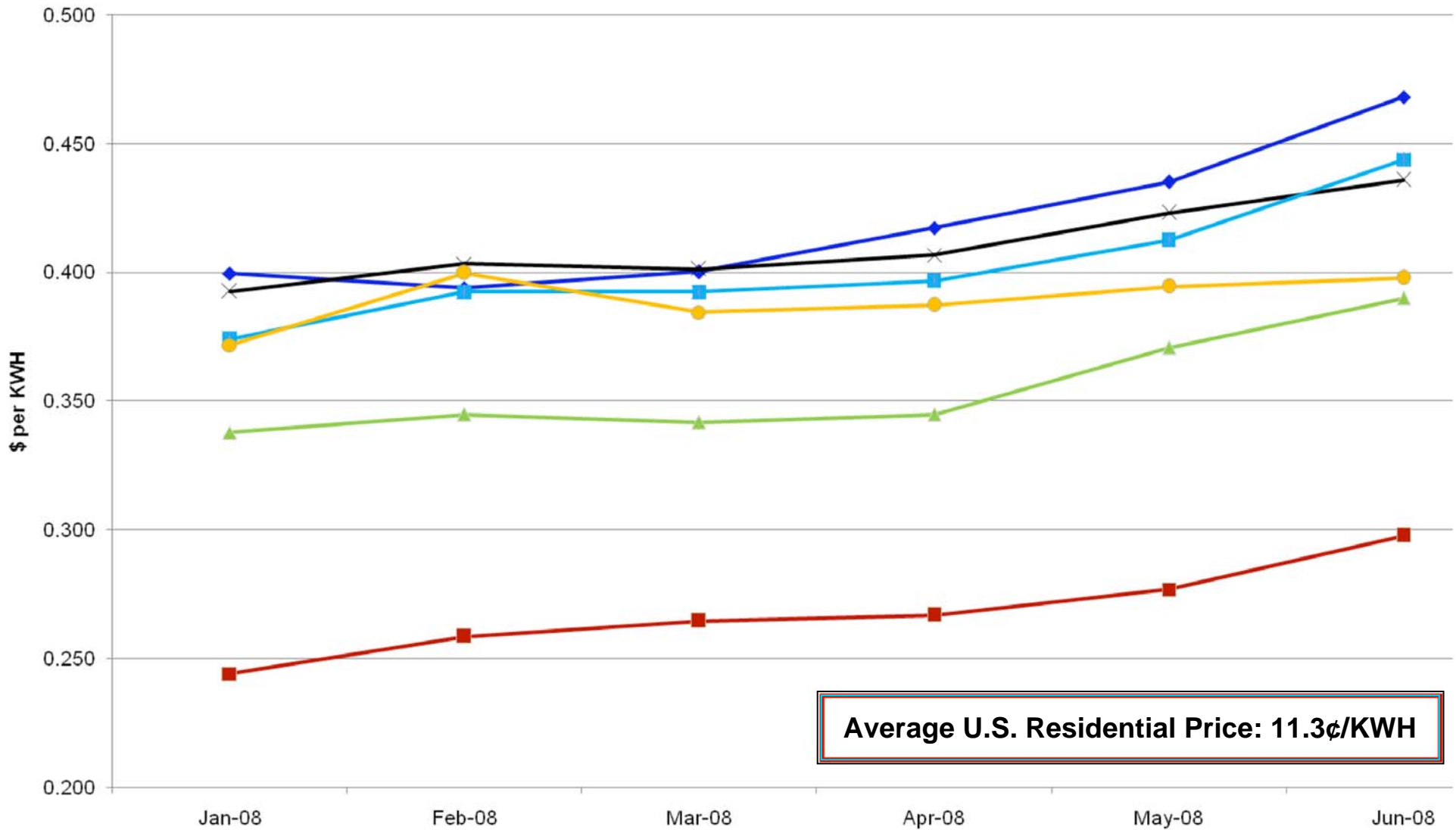
Hawaii's energy system was based on \$20/barrel oil: those days are over



Source: Energy Information Administration Report #DOE/EIA-0484 (June 2008)



Residential price of electricity by island – 1st half '08



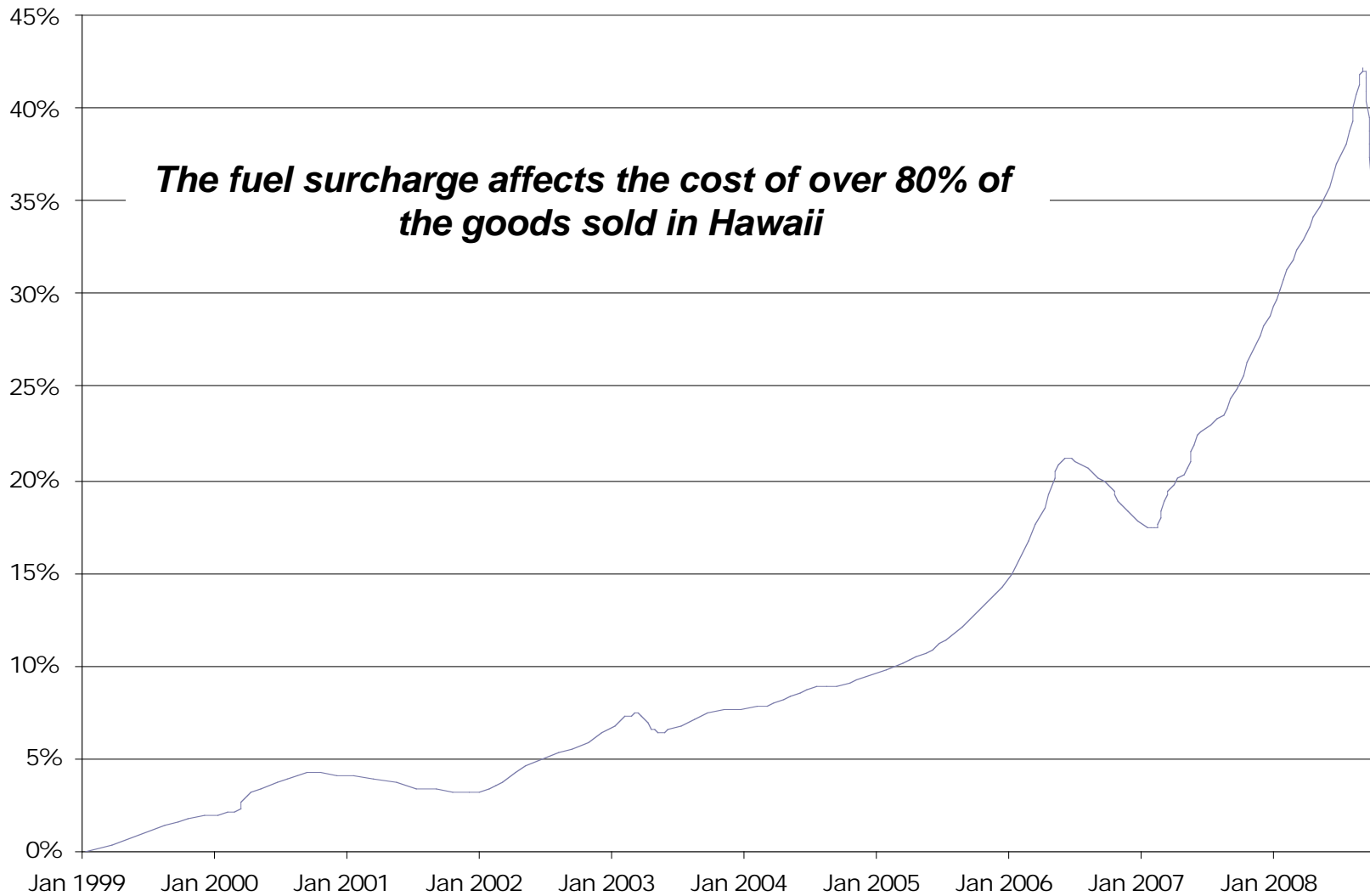
Average U.S. Residential Price: 11.3¢/KWH

◆ Kauai ■ Oahu ▲ Maui × Molokai □ Lanai ● Hawaii

Source: monthly electric utility reports submitted to the Hawaii Public Utilities Commission

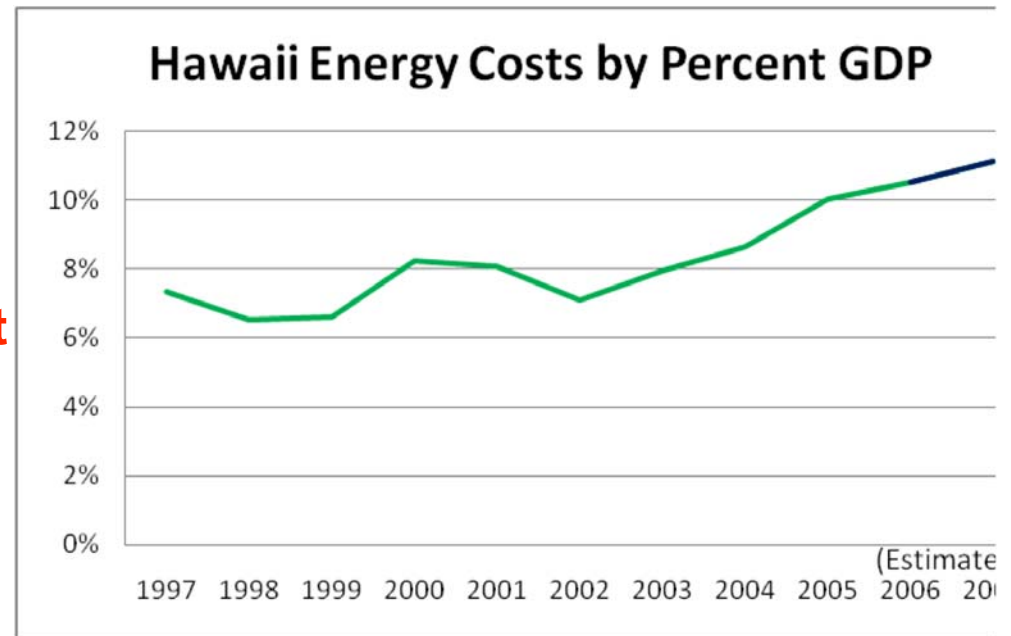


High energy costs multiply throughout the economy



Economic impact of dependence on expensive energy

- ▶ Household fuels and utilities **costs rose 36.4 percent**, year-over-year, in the Honolulu CPI during 2Q'08
- ▶ Mainland energy costs are 4% of a state's Gross Domestic Product; in Hawaii, it approaches 11%, **almost 3 times as much**
- ▶ Between 2007 and 2008, State Government **consumption** of electricity has **decreased 1.17%**, but **expenditures** have **increased 19.55%**



HCEI Target of 70% Clean Energy

- ▶ Move from oil to clean energy basis for energy in Hawaii
- ▶ Include the creation of new business models for a clean energy world
- ▶ Create business environment for success for multiple sectors



Hawaii Clean Energy Initiative

National Partnership to Accelerate System Transformation

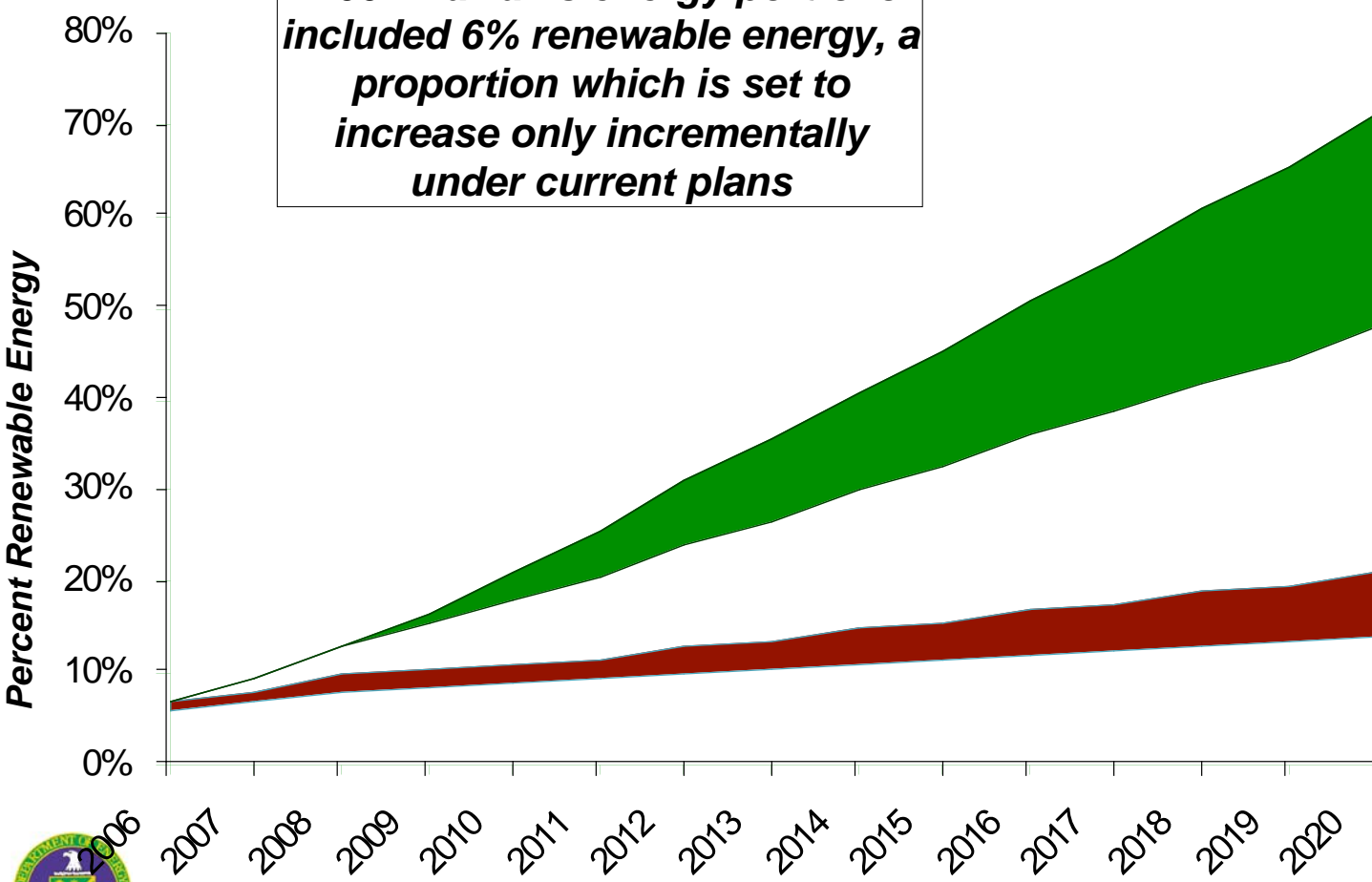
The goals are:

- ▶ Achieve a **70% clean energy economy** for Hawaii within a generation
- ▶ Increase Hawaii's **security**
- ▶ Capture **economic benefits** of clean energy for all levels of society
- ▶ Foster and demonstrate **innovation**
- ▶ Build the **workforce** of the future
- ▶ Serve as a **model** for the US and the world



Transition from imported oil to a clean energy economy requires transformation of regulatory, financial, & institutional systems

2004 Hawaii's energy portfolio included 6% renewable energy, a proportion which is set to increase only incrementally under current plans



Range of scenarios under transformational assumption (i.e., exploiting technical & economic potential)

GAP
Fundamental systemic transformation is required

Range of scenarios under business as usual assumption (i.e., attainment of RPS, F...)



Problem: Four legacy drivers support the status quo and represent barriers to be overcome for electricity

Policy/Regulatory Framework

- Utilities compensated for increased electricity sales; pass-through of fuel price increase is renewable disincentive
- IPPs need transparent “rules of the road,” certainty and predictability
- No clear policy support or incentives for significant new investment and technology upgrades in renewable generation, advanced transmission and distribution
- Need policy on net metering, interconnection, wheeling, and utility protocols for integrating variable generation which will impact transmission and distribution systems

Technology Development & Integration at System Level

- Solutions needed for reliable integration of high levels of variable renewable generation with traditional baseload generation and with existing grid
- Energy storage and “firming” technologies are probably part of the solution, but which technologies will be most effective and how much storage is needed to effectively manage the grid is under development
- Few incentives for advanced metering, dynamic rates, load management, demand response or distributed generation

Financing/Capital

- Need a healthy and financially viable utility to make necessary investments
- Significant new public and private investments required to support the magnitude of system changes needed for a clean energy future: Open up Hawaii’s markets to private capital
- Costs have to be understood and rate structures designed to balance utilities’ financial and consumers’ rate needs

System Planning

- Hawaii’s energy system is built on the assumption of consistent supply of low-cost oil, central power plants, grids that could be continually adjusted to meet load needs; utilities are structured to control transmission and distribution as well as generation



Major Thrusts

- ▶ Efficiency
 - ▶ Electricity Generation
 - ▶ Electricity Transmission and Distribution
 - ▶ Transportation
-
- ▶ Plus the integration of all of these into an interactive energy system



Why Efficiency First

- ▶ Can reduce costs of renewables by 50%
- ▶ Can be 10-20% the costs of renewables
- ▶ Can reduce build-out of the grid
- ▶ Can improve the responsiveness of the grid

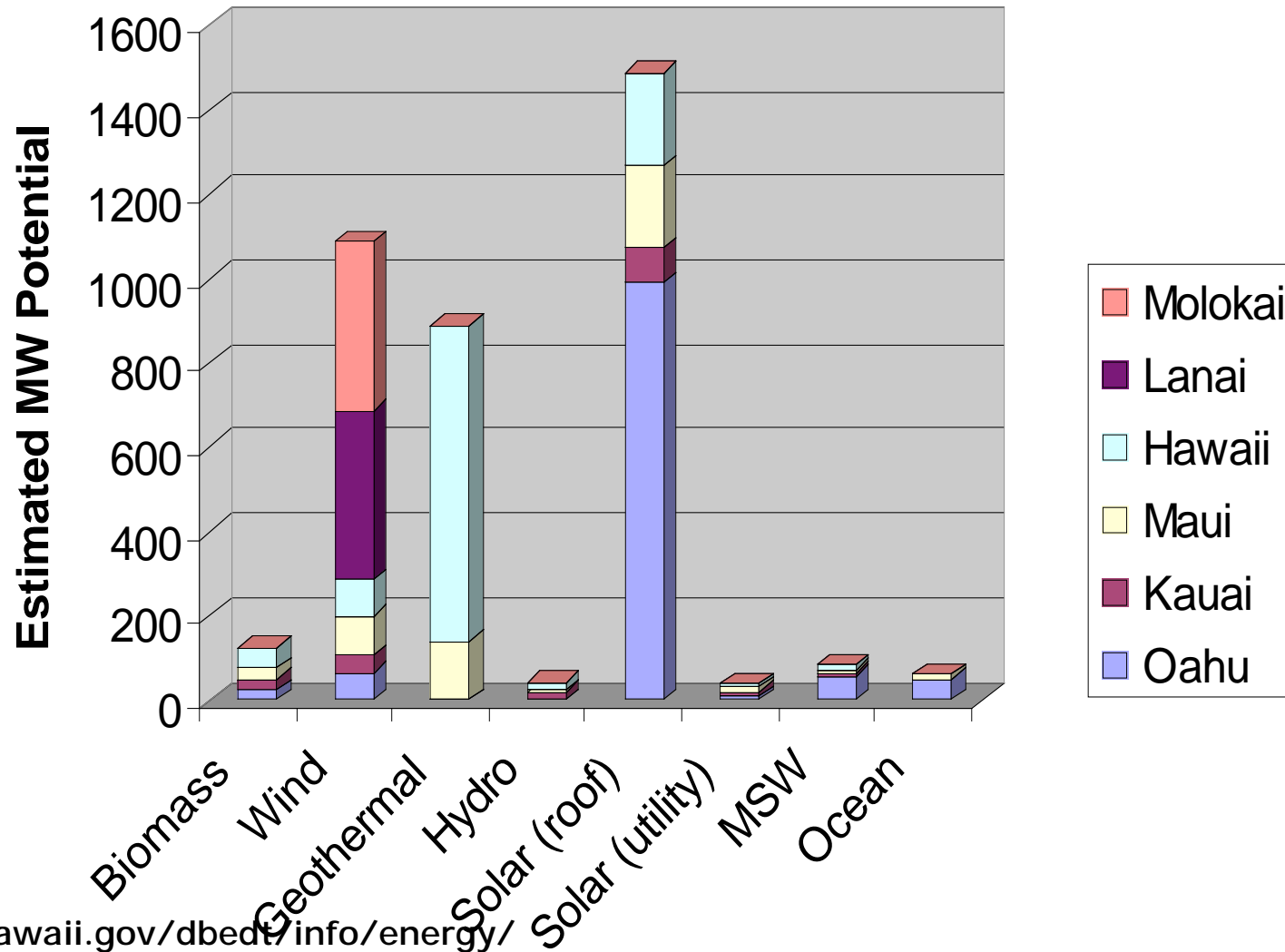


Electricity Generation

- ▶ Technically feasibility for 100% renewable potential across all islands
- ▶ Assumes access to land and resources as well as cultural acceptability
- ▶ Initial capital costs high



Hawaii has a wealth of renewables: estimated @ 150% of current installed capacity



<http://hawaii.gov/dbedt/info/energy/>

Inter-island Cable

- ▶ Load in Oahu
- ▶ Resources in outer islands
- ▶ Basis for electric vehicles
- ▶ Strengthen all interconnected grids



Transmission and Distribution

- ▶ Backbone to create a resilient, reliable grid
- ▶ Grid modeling of all the islands for maximizing reliability and performance
- ▶ Smart grid – a self-aware, responsive, interconnected system
 - Smart meters
 - Time of Use rates
 - Electric Vehicle compatibility



Transportation

▶ Biofuels

- Bioenergy master plan
- Integrated land, water, energy, food, consumer and cultural issues

▶ Electric vehicles

- Create a market friendly to initial fleet penetration
- Create incentives for early adopters



HCEI Accomplishments



Voluntary Agreement: HECO, Consumer Advocate and Governor Lingle

- ▶ Goal: Strike a reasonable balance between a healthy utility, consumer protection and a working market for energy developers
- ▶ Support Regulatory Actions for new utility business model
- ▶ 40% RPS
- ▶ Feed-in Tariffs
- ▶ Plans for over 1000MW of Renewables
- ▶ Plans for energy efficiency, demand response, distributed Generation



PUC Actions since October Agreement

- ▶ Rapid Response, Fast Schedule
 - Feed in Tariff Docket
 - Discussion paper for public
 - Decoupling Docket
 - Wheeling Docket shelved for 12 months
 - IRP process stopped, new process in formulation
 - Schedule Q on hold



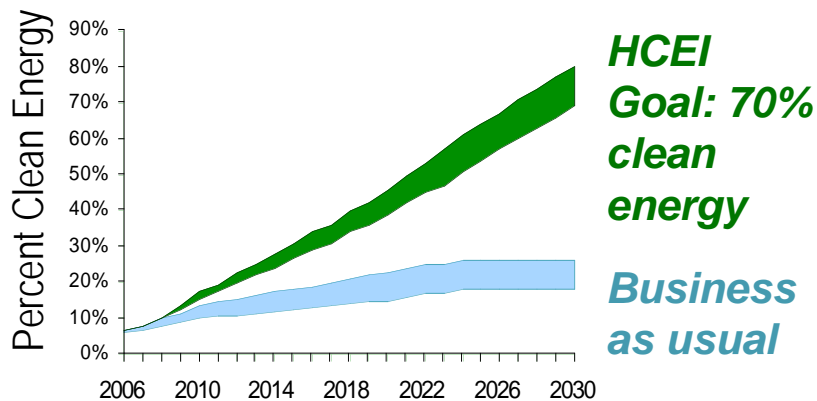
Legislative Action

- ▶ HCEI Energy Package
 - Efficiency
 - Electricity
 - Transportation
 - Incentives and Mandates



The 2009 legislative package is one step toward the 70% clean energy goal, and it sends the message that Hawaii is serious about being a leader

- ▶ **PREMISE:** The primary barriers to reaching 70% clean energy are not technical or financial; they are policy-driven: *change incentives and behavior by changing established framework of rules*



- ▶ This legislative package is one step in the process of changing the rules—to do so it's important to view the package whole, as a comprehensive approach to energy policy, and in the context of other HCEI initiatives

- ▶ *How far does the 2009 legislative package go toward HCEI efficiency, generation and transportation? **Indicatively:***

		HCEI Goal	Expected results 2009 package
Electricity	Efficiency	30%	9%-17%
	Electric Generation	40%	~35%
		70%	
Transportation (ground)		70%	~30%

▶ **Future Steps:**

- **Efficiency:** *In the next years, the State will need to be aggressive on 1) public buildings, 2) a sizable energy efficiency program for commercial buildings, 3) zero net energy build. code by 2015. Promotion and implementation of efficiency programs—e.g., on-bill financing—will be critical to realize*
- **Electric Generation:** *The PUC will be shouldering respons for setting rules for feed-in tariffs, electricity decoupling, etc PUC's timely implementation will be extremely important*
- **Transportation:** *The 2009 package is designed to catalyze market—e.g., create infrastructure for Alternative Fuel Vehicles—so the legislative package starts the process to deliver the transformation needed to hit 70%. In 2010, we v propose policies to ensure adequate supplies of biofuels, c to using AFVs; also we will analyze clean energy options fc aviation/marine transportation*



Electric Vehicles

- ▶ Better Place
- ▶ Phoenix Motorcars
- ▶ Plug-in Electric Hybrid Testing

- ▶ Signal to the world



Hawaii Marine Energy Center

- ▶ One of two National Centers established Fall 2008
- ▶ Concentrate on wave energy and OTEC
- ▶ Awarded to U of Hawaii Team



National Laboratory Actions

- ▶ Strong technical and policy experience
- ▶ Multi-year plan formulated for 2009 and beyond
- ▶ NREL, Sandia, LBNL, Oak Ridge, INEL, PNNL



HCEI analysis & project activities

- ▶ **70% Clean Energy scenario analysis (Booz Allen Hamilton)**
- ▶ **Hawaii greenhouse gas carbon tax/abatement analysis (McKinsey & Company)**
- ▶ **Economic modeling of energy system**
- ▶ **Inter-island cable: feasibility and cost/benefit studies**
- ▶ **Technical and economic assessment of plug-in hybrid and electric vehicles**
- ▶ **100% Renewable Lanai**
- ▶ **Forest City Highly Efficient Communities**
- ▶ **Marine Energy Center**
- ▶ **Modeling electricity grids on all islands**
- ▶ **Maui grid integration**
- ▶ **Bioenergy Master Plan**
- ▶ **Wind resource and storage testing**
- ▶ **Regulatory framework development**

World class studies and expertise leading to projects with a broad base of partners



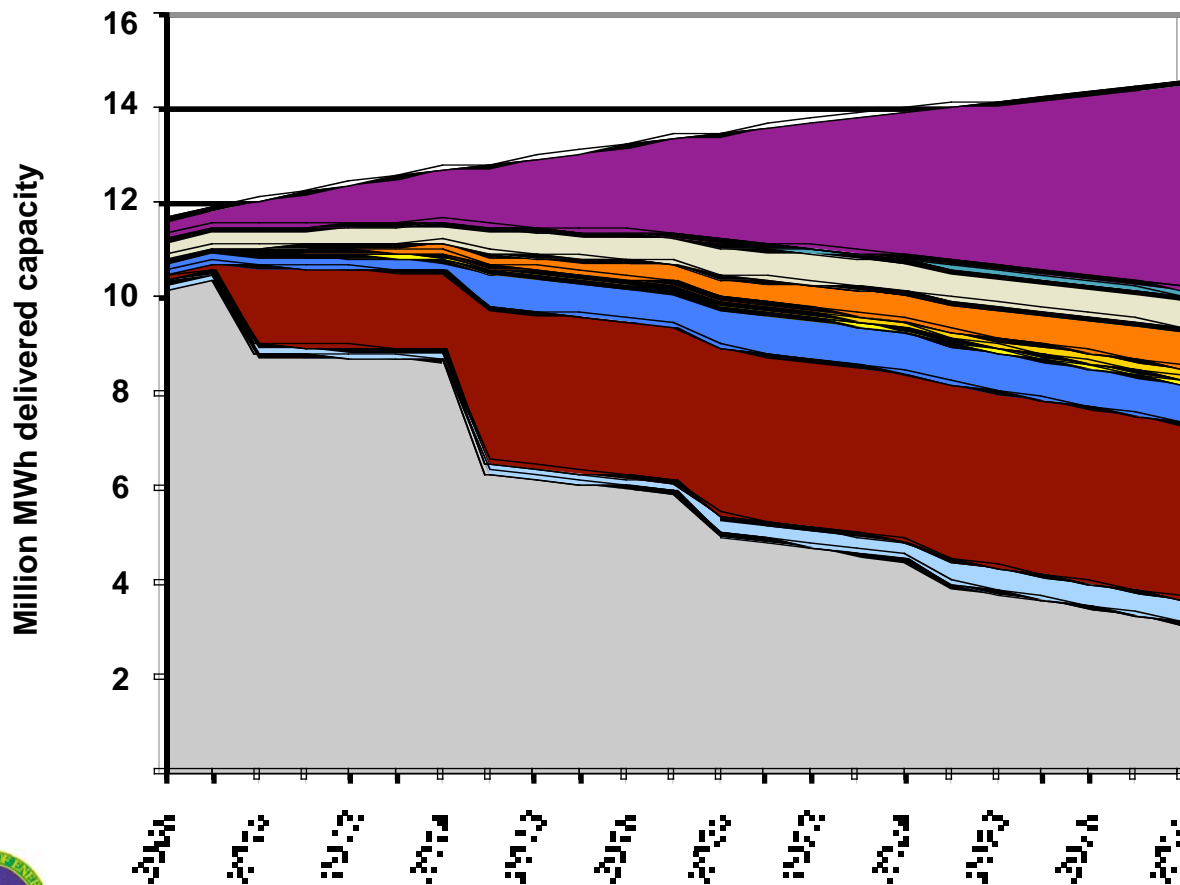
HCEI Scenarios: Can we achieve 70% clean energy? *Really?*

- ▶ First cut at order of magnitude requirements and impacts
- ▶ Evaluated sensitivity to several factors
- ▶ No absolutes defined in this evaluation
- ▶ Most work on electricity, some on transportation, little on jet fuel
- ▶ **Based on current commercially viable technologies; potential game changers like OTEC and algae to energy are not considered**
- ▶ **Scenarios are presented without imported biofuels; all scenarios can hit the goals with imported biofuels**
- ▶ Follow-up economic and cost/benefit impacts, refinements in progress.



Scenario 8 Electricity

Hawaii could reach **70% clean energy** in the electricity sector and reduce oil imports by 20 MM bbl/year by 2030



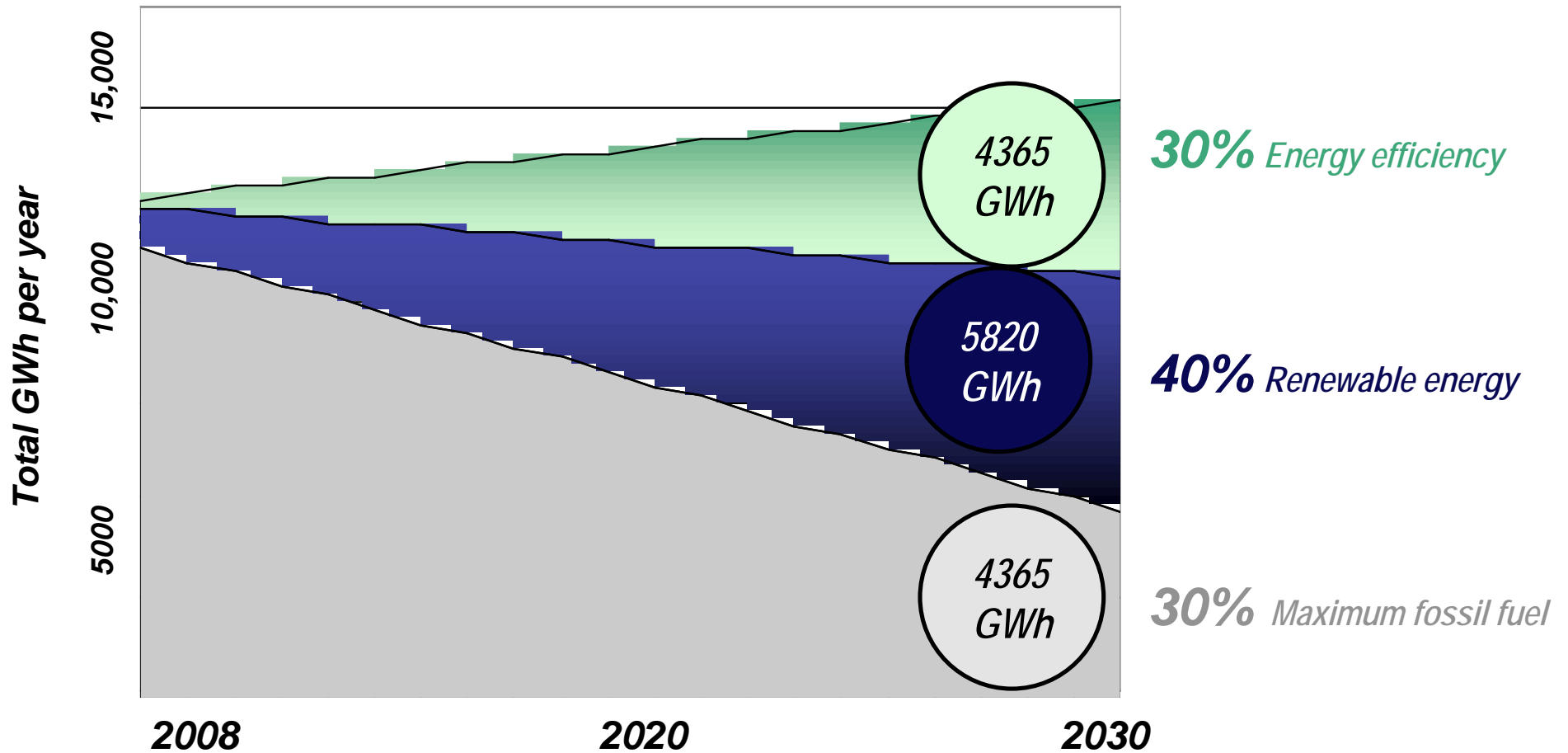
Summary of 2030 Electricity Results	
Clean energy achieved	70%
Oil reduction (million bbl/yr)	17.3
CO2 avoided (million ton/yr)	8.8

- Efficiency
- Ocean energy
- MSW
- Solar - utility scale
- Solar - commercial roofs
- Solar - residential roofs
- Hydro
- Geothermal
- Wind
- Bio mass - direct firing
- Oil



We now know what it will take to reach 70% clean energy in 2030

Hawaii Electricity Portfolio



Note: This just reflects the 2030 targets; still need to determine/set interim targets

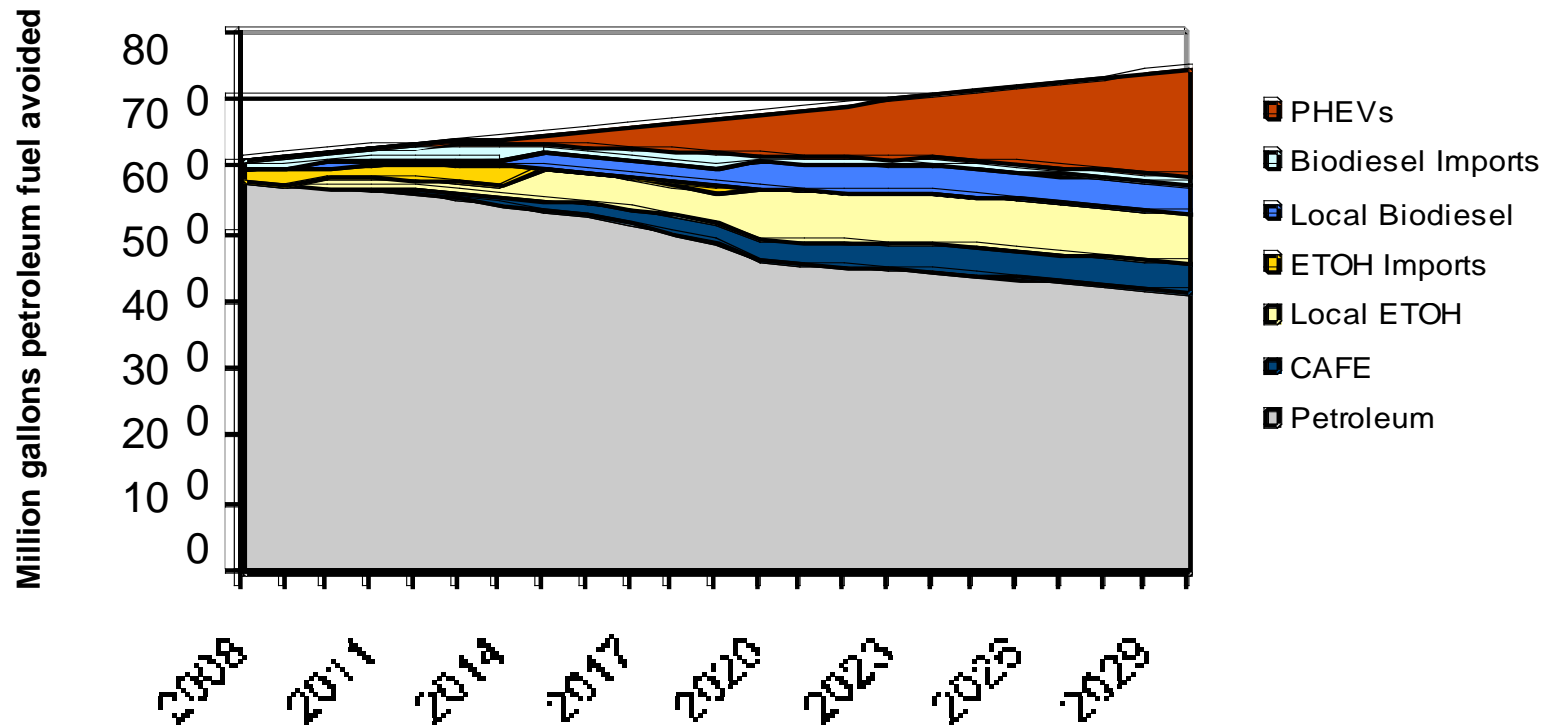


Scenario 8 Transportation

High PHEV penetration, local biodiesel and ethanol production

Summary of 2030 Transportation Results

Clean energy achieved	45%
Oil reduction (million bbl/yr)	9.9
CO2 avoided (million ton/yr)	4.2



Scenario 8

Invest \$16 billion, achieve \$46.1 billion savings @ oil costs \$100/barrel

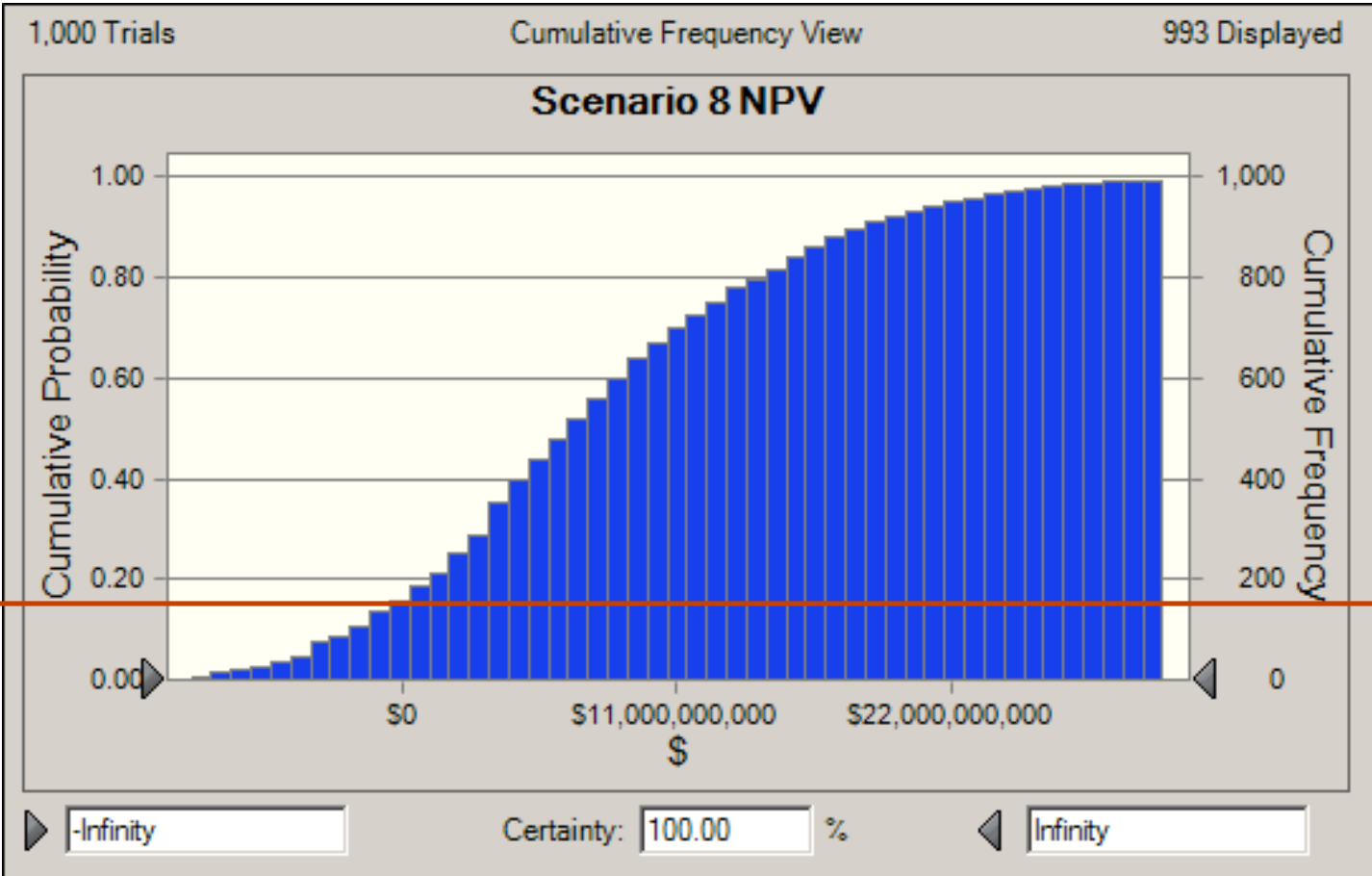
Avg. Crude Oil Price (2008-2030) per Barrel	Investment Cost	PV of Investment Cost	Savings from Oil Displaced	PV of Savings from Oil Displaced
\$40	\$ 16.0	\$ 7.7	\$ 18.5	\$ 7.6
\$50	\$ 16.0	\$ 7.7	\$ 23.1	\$ 9.6
\$60	\$ 16.0	\$ 7.7	\$ 27.7	\$ 11.5
\$70	\$ 16.0	\$ 7.7	\$ 32.3	\$ 13.4
\$80	\$ 16.0	\$ 7.7	\$ 36.9	\$ 15.3
\$90	\$ 16.0	\$ 7.7	\$ 41.5	\$ 17.2
\$100	\$ 16.0	\$ 7.7	\$ 46.1	\$ 19.1
\$110	\$ 16.0	\$ 7.7	\$ 50.1	\$ 21.0
\$120	\$ 16.0	\$ 7.7	\$ 55.4	\$ 23.0
\$130	\$ 16.0	\$ 7.7	\$ 60.0	\$ 24.9
\$140	\$ 16.0	\$ 7.7	\$ 64.6	\$ 26.8

Figures in billion 2008 dollars (except per barrel cost)

PV figures based on discount rate of 7%



Scenario 8: The probability of a negative NPV is less than 20%

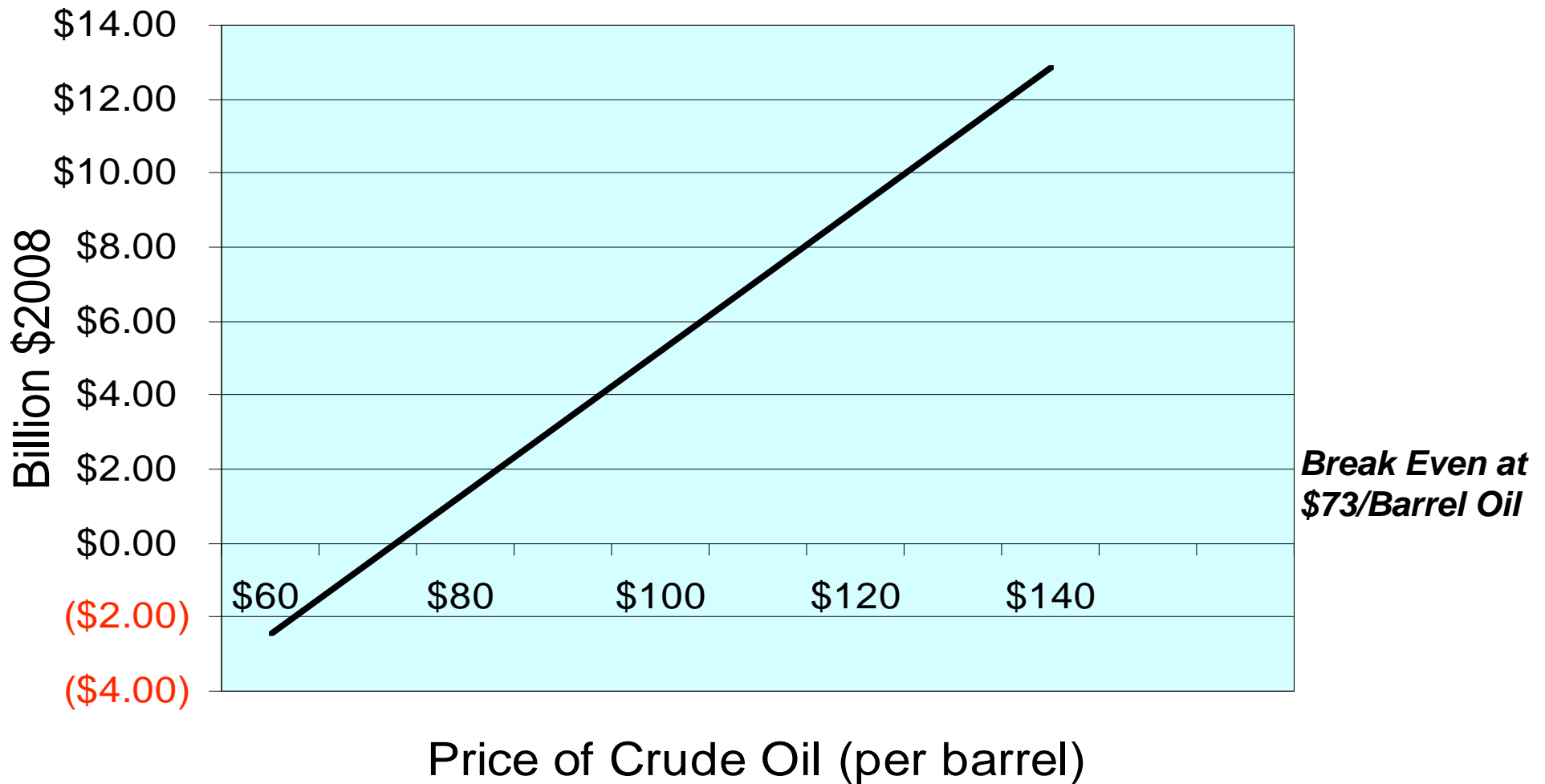


▶ *Approx. 18% probability of a negative NPV result*

Simulation based on 1,000 runs



Net Present Value of Projected Savings Less Total of Levelized Costs for 2008 - 2030



*Figures in Billion 2008 dollars (except per barrel cost).
PV figures based on discount rate of 7%*

What's the price of doing nothing?

- ▶ 3-5 Billion annually, 65-100 Billion by 2030, sent out of Hawaii for oil for electricity and ground transportation
- ▶ Increased vulnerability to disruption, in Hawaii and internationally
- ▶ High energy prices
- ▶ Volatility of prices, uncertainty for businesses on energy costs
- ▶ Dependence on others for solutions, products
- ▶ Leaving problems for the keiki



What's the price of HCEI?

- ▶ Initial estimates, around 16 billion by 2030
- ▶ Change of behavior and personal decision making
- ▶ Disruption of business as usual
- ▶ Initially higher costs for longer term savings



What are the benefits of HCEI?

- ▶ Self-reliance
- ▶ Creation of a healthier business and living environment
- ▶ Reduction of energy price volatility and/or disruption
- ▶ Increased customer choice and conscious decision making in what to pay for energy and those things impacted by energy



Hawaii

Critical Issues for Success

- ▶ Formulate winning policies and regulation
- ▶ Open the market for renewable and efficiency technologies
- ▶ Implement non-partisan clean energy legislation
- ▶ Private leadership
- ▶ Community involvement
- ▶ Partnership approaches



What is needed to be successful?

- ▶ Individual action
- ▶ Legislative action
- ▶ Finding new business models
- ▶ Successful regulatory change
- ▶ Incentives and mandates
- ▶ Leadership at all levels



Coordination/Cost Sharing

- ▶ Congressional Delegation
- ▶ US Department of Energy
- ▶ Other Federal Agencies
- ▶ DBEDT/State
 - Hydrogen Fund
- ▶ Private Sector
- ▶ Hawaii Legislature????



Missing Pieces

- ▶ Feedstock trials
- ▶ New technology performance verification
- ▶ New idea funds/incubators
- ▶ Communication/discussion/consumer awareness



Hawaii

- ▶ A special place
- ▶ Keep it that way for the keiki, for yourselves and for the world-
make conscious decisions on what the future should look like
- ▶ Be a beacon for the world

