PRESENTATION

Hawaii-DOE Clean Energy Initiative

Update to the HEPF

August, 2008

Hawaii presents unique opportunities, both immediate and long-term, for energy sector transformation

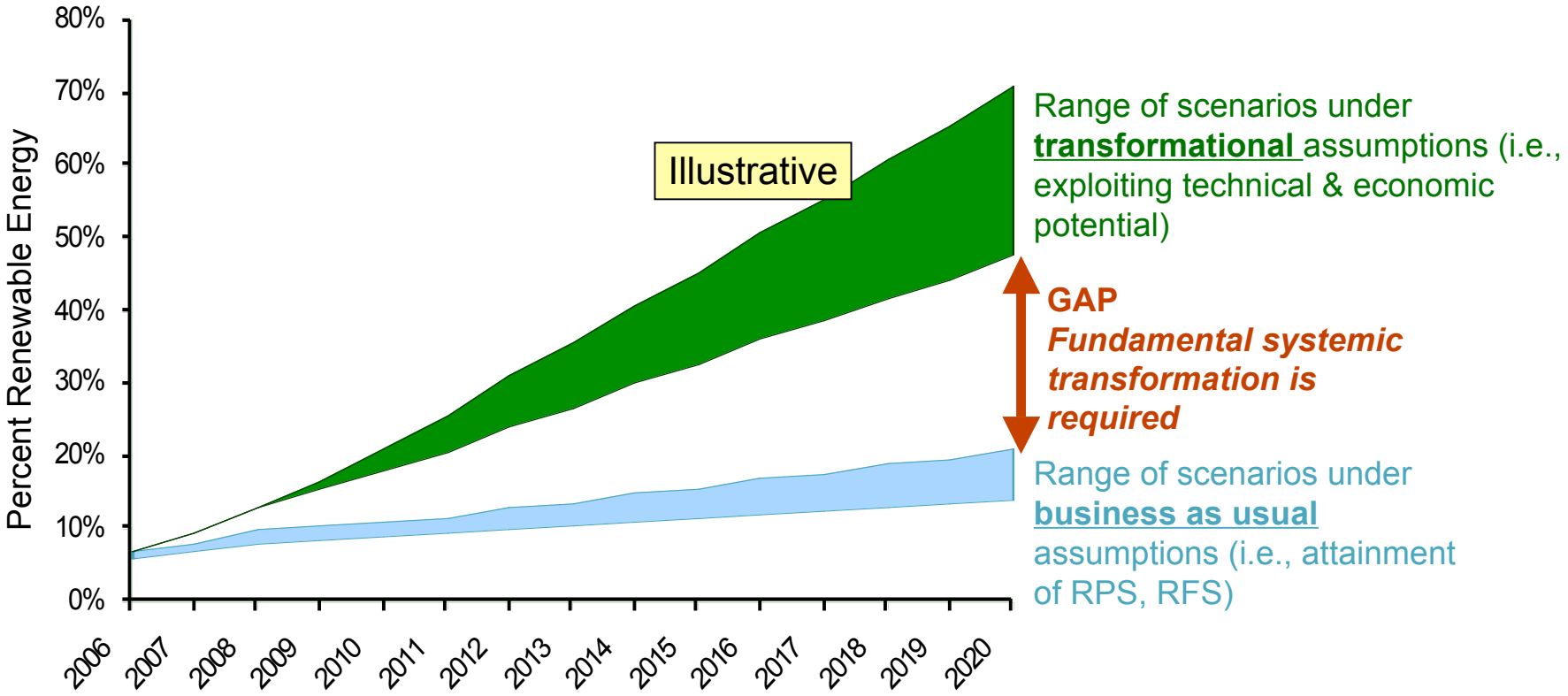
- The state has abundant **local renewable resources**, including sun, wind, geothermal, etc.
- Hawaii pays the **highest electricity costs** in the nation and among the highest transportation fuel costs
- Hawaii has large, relatively **unexploited opportunities for efficiency**
- Oil provides approximately 85% of the state's energy, leaving Hawaii vulnerable to supply disruptions and **energy insecurity**
- Each island is an **isolated micro-grid** providing an opportunity to focus on **integrated systems**

Vision for Hawaii Clean Energy Initiative

To partner with Hawaii and serve as a global model for creating a sustainable, flexible, and economically vibrant path to a carbon-free energy future

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

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



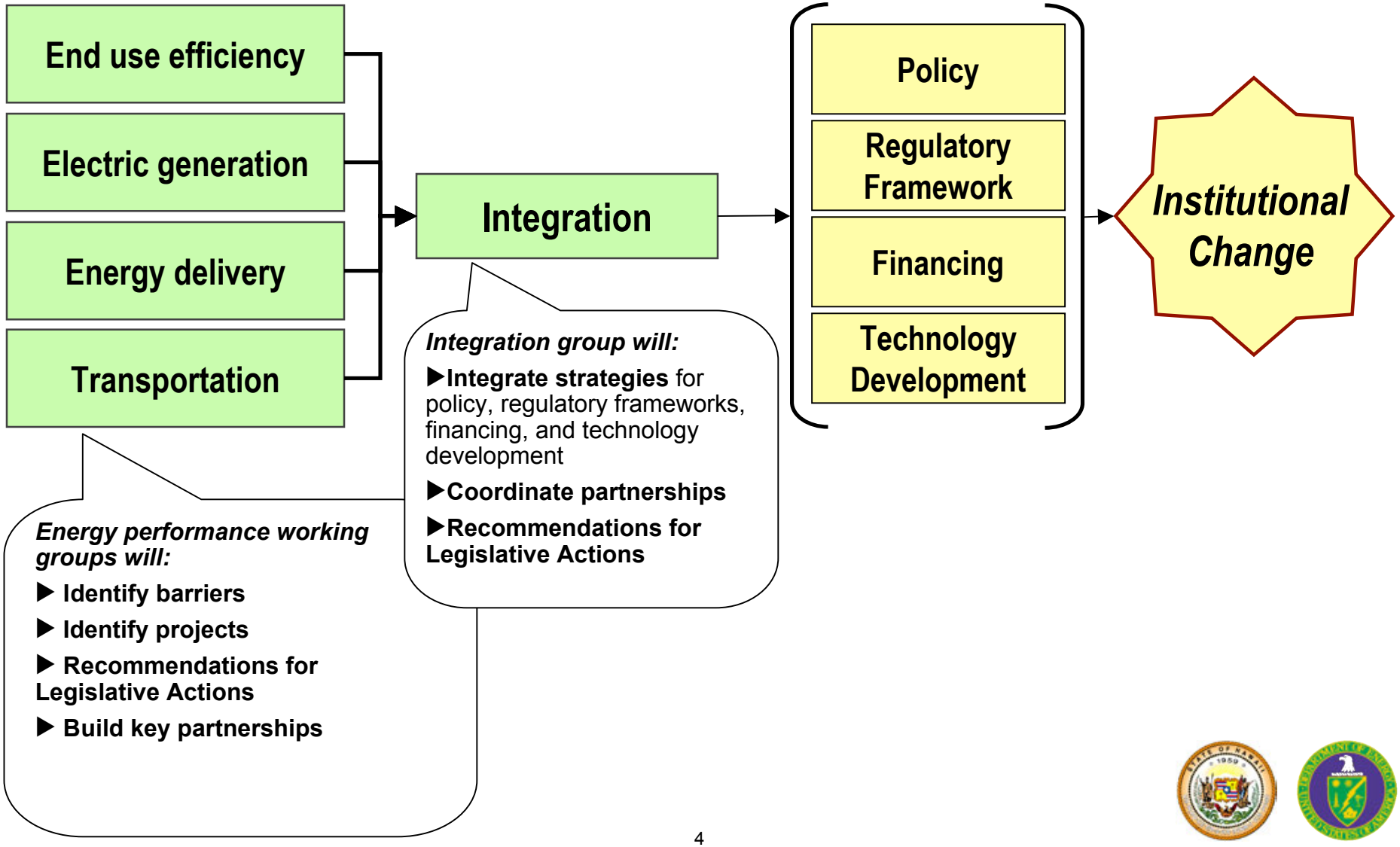
…but doing so will require a substantive transformation of regulatory, financial, and institutional systems

To accelerate this transformative process, Hawaii and U.S. DOE have joined forces to form the Hawaii Clean Energy Initiative

The goals of the initiative are as follows:

- *Achieve a 70% clean energy basis for Hawaii within a generation*
- *Serve as a "open source" learning opportunity:* Make Hawaii a replicable model for achievement of a clean energy-based economy for the world
- *Increase the security of Hawaii*: Diversify Hawaii's energy supply and increase the security of its energy delivery and defense capabilities
- *Create economic opportunity at all levels of society*: Develop and diversify Hawaii's economy through innovative, market-based mechanisms that allow every sector to benefit from the transition to clean energy
- *Foster and demonstrate innovation*: in the technology, financial, organizational and policy models used to achieve a clean energy future
- *Build the workforce of the future:* help Hawaii create educational and employment opportunities necessary to sustain a clean energy economy

The HCEI will outline strategic changes needed in Hawaii's policy, regulatory, financial, & technology structures



Some partners and participants

Public Sector Representatives

- Governor Lingle
- US Congressional Delegation and staff
- Hawaii Legislature and staff
- County Mayors
- Selected County Council members
- Department of Business, Economic Development and Tourism and Hawaii energy leadership
- DOE representatives
- Hawaii DOD Representatives
- USDA Hawaii
- Public Utilities Commission representatives
- Consumer Advocate

Industry, NGO, and Other Representatives

- Hawaiian Electric Industries, HECO, MECO, HELCO
- Kauai Island Utility Cooperative
- Hawaii Energy Policy Forum representatives
- County Economic Development Boards
- Environmental organizations
- Native Hawaiian community
- Kohala Center
- Hawaii Natural Energy Institute representatives
- University and community college representatives
- Private industry, e.g. General Electric, First Wind, Castle and Cooke, Hawaiian Commercial & Sugar, Gay & Robinson, Pacific Biodiesel,etc
- Others

Activities

- MOU signed January 28, 2008
- Working Groups established, third meeting in September
- Studies and Project Starts
- PUC Regulatory Training/Discussions
- Evaluations to Date
  - Scenario Analysis
  - GHG Analysis
  - First cuts at Economics
  - Regulatory Framework

Studies/Evaluations

- Inter-island cable
- Bio-energy Master Plan
- Plug-in Electric Vehicles
- County Interactions

Projects: Building on existing work

- 100% Renewable Lanai
- Forest City Highly Efficient Communities
- Grid Modeling on all islands
- Maui Grid Integration Project
- Support for Bioenergy

Scenarios

- 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 commercially viable technologies; potential game changers like OTEC and algae energy plays are not considered**
- **All scenarios are presented without imported biofuels, all scenarios can hit the goals with imported biofuels**
- Follow-up economic impacts, refinement of Scenario 8 in progress.

The analysis explored eight scenarios to test the effect of energy efficiency levels, PHEV penetration, biofuels, and inter-island cabling

	Transportation: Maximize ethanol production and use all biofuels for transportation; low PHEV penetration	Transportation: Maximize biodiesel production and use biodiesel for electricity needs on Oahu; high PHEV penetration
Moderate Efficiency ("Maximum Achievable Potential" from utility IRPs)	**1** Kauai loaded by economics (limit CSP to 14 MW) Hawaii loaded by economics (limit geo to 60 MW) Maui loaded by economics (limit geo to 42 MW, deploy 3 MW ocean) Oahu resources loaded by economics - no cable Biofuels for transportation (only ethanol) Low PHEV	**3** Kauai loaded by economics (limit CSP to 14 MW) Hawaii loaded by economics (limit geo to 60 MW) Maui loaded by economics (limit geo to 42 MW, deploy 3 MW ocean) Oahu resources loaded by economics - no cable Biofuels fill in Oahu electricity to 70% (only biodiesel) High PHEV
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Note: Grey boxes have an inter-island cable

Summary of results for the eight scenarios

	2030 End-state for Each Scenario (installed capacity)							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Efficiency	220	220	220	220	495	495	495	495
Biomass - direct firing	93	93	120	120	56	56	83	83
Wind	276	1076	276	1076	223	1023	260	1060
Geothermal	102	102	102	102	102	102	102	102
Hydro	36	36	40	40	24	24	24	24
Solar (residential roofs)	182	182	205	205	166	67	179	179
Solar (commercial roofs)	633	633	712	712	578	232	622	622
Solar (utility scale)	29	29	29	29	22	22	29	29
MSW	77	77	79	79	77	77	77	77
Ocean energy	53	53	53	53	53	3	53	53
Dispatchable	271	271	301	301	235	235	261	261
Non-dispatchable	1209	2009	1316	2116	1065	1370	1167	1967
Electricity Sector Clean Energy %	**46%**	**65%**	**46%**	**63%**	**58%**	**70%**	**57%**	**70%**
Oil reduction (million bbls in 2030)	10.0	14.0	11.5	15.5	12.5	15.1	14.0	17.3
CO2 avoided (million tons in 2030)	5.1	7.2	5.9	7.9	6.4	7.7	7.2	8.8
Transportation Sector Clean Energy %	**30%**	**30%**	**57%**	**57%**	**30%**	**30%**	**57%**	**63%**
Oil reduction (million bbls in 2030)	4.7	4.7	9.0	9.0	4.7	4.7	9.0	9.9
CO2 avoided (million tons in 2030)	2.0	2.0	3.8	3.8	2.0	2.0	3.8	4.2

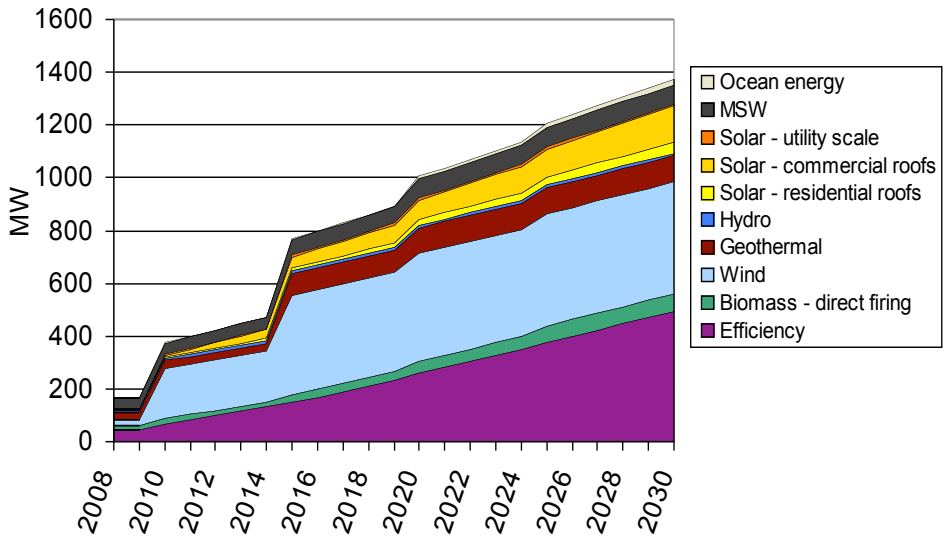
Note: All electricity sector numbers are in total installed capacity needed; transportation sector includes only ground transportation

***Example observation**: While Scenarios 2 and 6 show similar results, they employ different means. Scenario 2 uses less energy efficiency and requires much more solar capacity; also its ratio of non-dispatchable to dispatchable electricity is 7.4, whereas Scenario 6 relies more on energy efficiency (and is likely to cost less) and has a non-dispatchable to dispatchable ratio of 5.8*

Scenario 8 Electricity - High efficiency, high PHEV penetration, and a cable to Oahu from Lanai and Molokai

State of Hawaii electricity generation

(Delivered capacity)



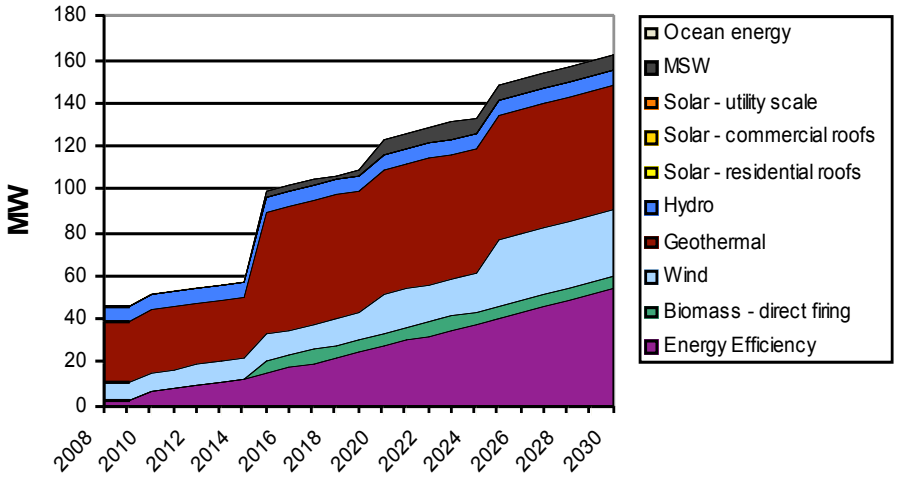
Summary of 2030 Electricity Results	
Clean energy achieved	*70%*
Oil reduction (million bbl/yr)	*17.3*
CO2 avoided (million ton/yr)	*8.8*

- **DESCRIPTION:** Energy efficiency to the level of "HCEI high efficiency," which assumes aggressive gains in net zero energy residential buildings and commercial building efficiency; renewable generation of 70% on all islands except Oahu; Oahu renewable generation to the maximum allowed by resources (46% without imports); cable connecting Oahu to Lanai and Molokai; PHEVs at a high penetration level
  - Oahu requires 7 MGY of biodiesel to reach 70% clean energy for electric generation; the remainder of the biodiesel is used for transportation

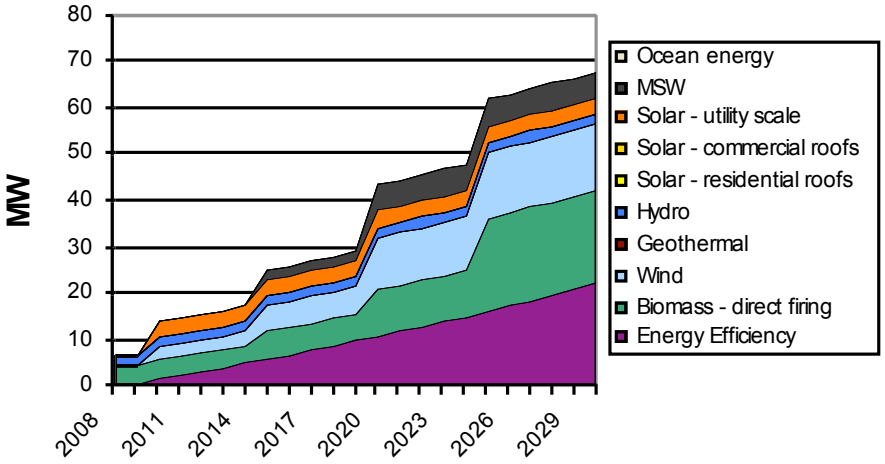
- **RESULTS:**
  - Energy Efficiency: Under HCEI high efficiency assumptions, demand side management measures would decrease statewide electricity demand by 495 MW (30% of 2030 BAU demand)
  - Electric Generation: Under this scenario, electric generation is dominated by wind (424 MW). Note: These figures represent average electricity delivered, i.e., they have been adjusted for capacity factors
  - Transportation: PHEVs increase total electricity demand by 314 MW statewide in 2030

Scenario 8 Electricity - High efficiency, high PHEV penetration, and a cable to Oahu from Lanai and Molokai

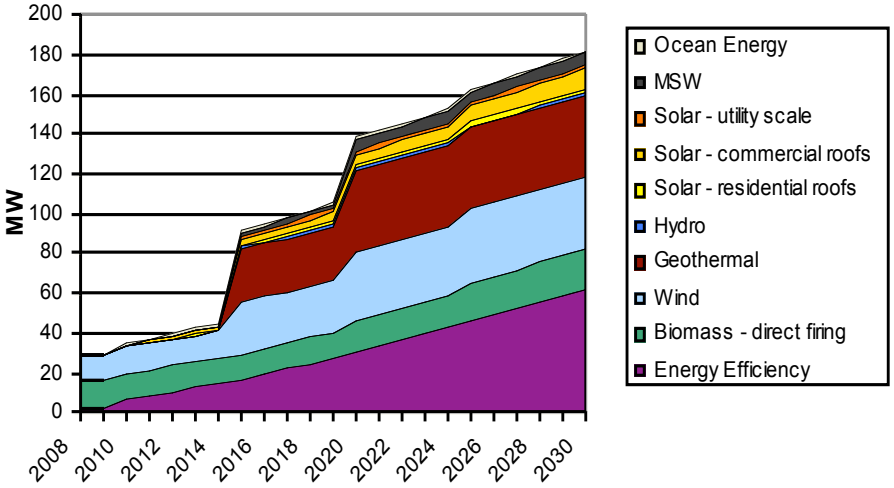
Hawaii



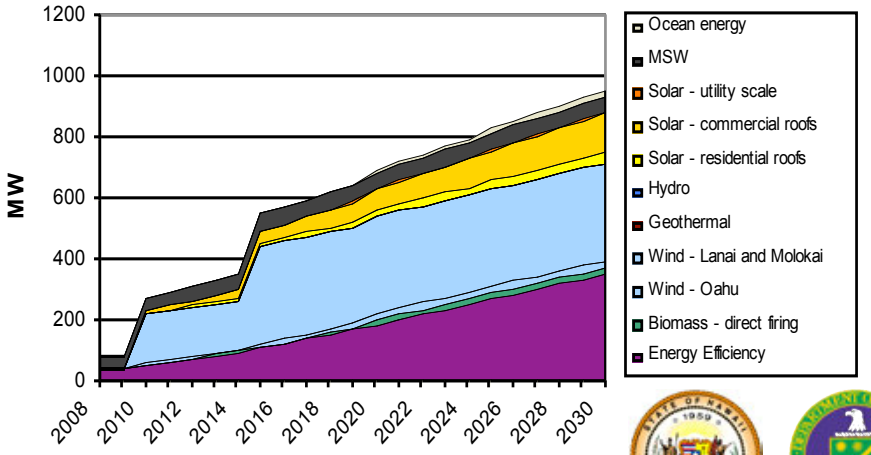
Kauai



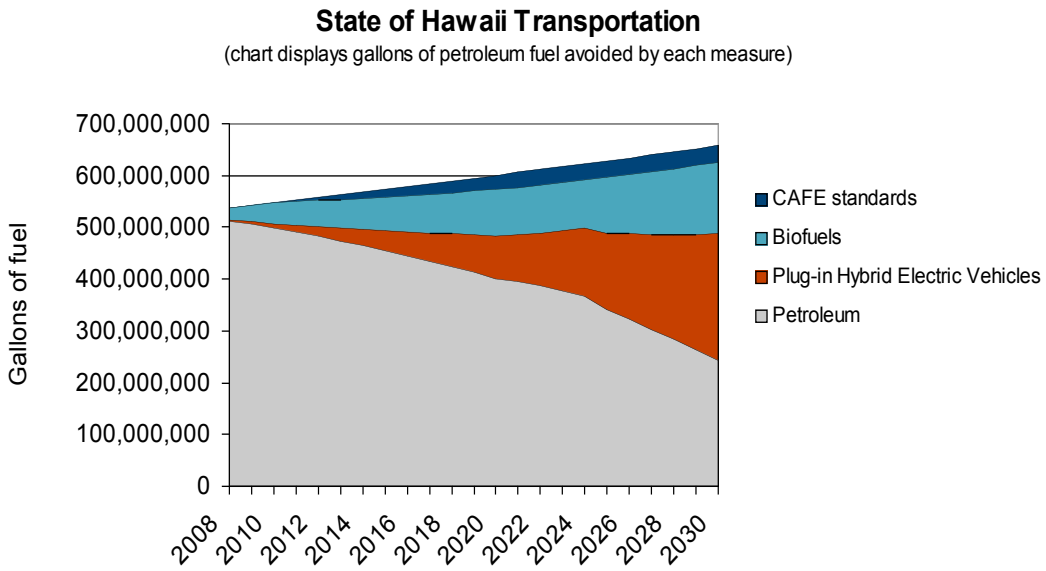
Maui



Oahu



Scenario 8 Transportation - High PHEV penetration, maximize biodiesel production, biodiesel fills electric generation needs to 70%



Summary of 2030 Transportation Results	
Clean energy achieved	*63%*
Oil reduction (million bbl/yr)	*9.9*
CO2 avoided (million ton/yr)	*4.2*

- **DESCRIPTION:** Plug-in hybrid electric vehicles reach a high penetration in 2030 based on a PNNL projection (69% of all vehicles sold in 2030 are PHEVs); land is dedicated to ethanol in sufficient quantity to meet the RFS with locally grown fuels, with the remaining land going to biodiesel production; biodiesel is not needed in Oahu generating units, so all biofuels are used for transportation

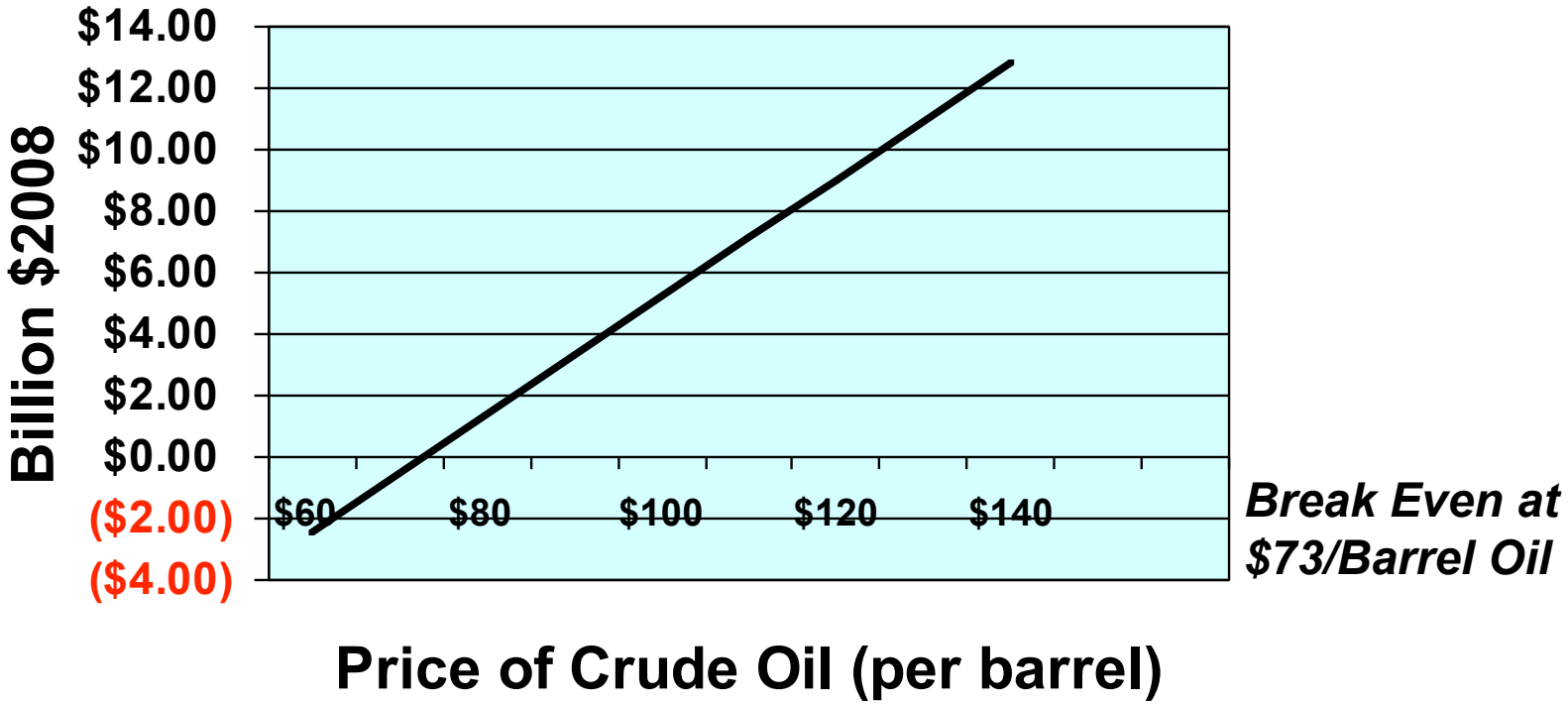
- **RESULTS:**
  - Transportation: Under this scenario, 63% clean energy is achieved primarily through PHEVs
  - Under this scenario, Hawaii would have to import 44 million gallons per year of biofuel (with an energy content equivalent to that of oil) to reach 70% clean energy for transportation in 2030

Scenario 8: Investments and Projected Savings (2008 through 2030)

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

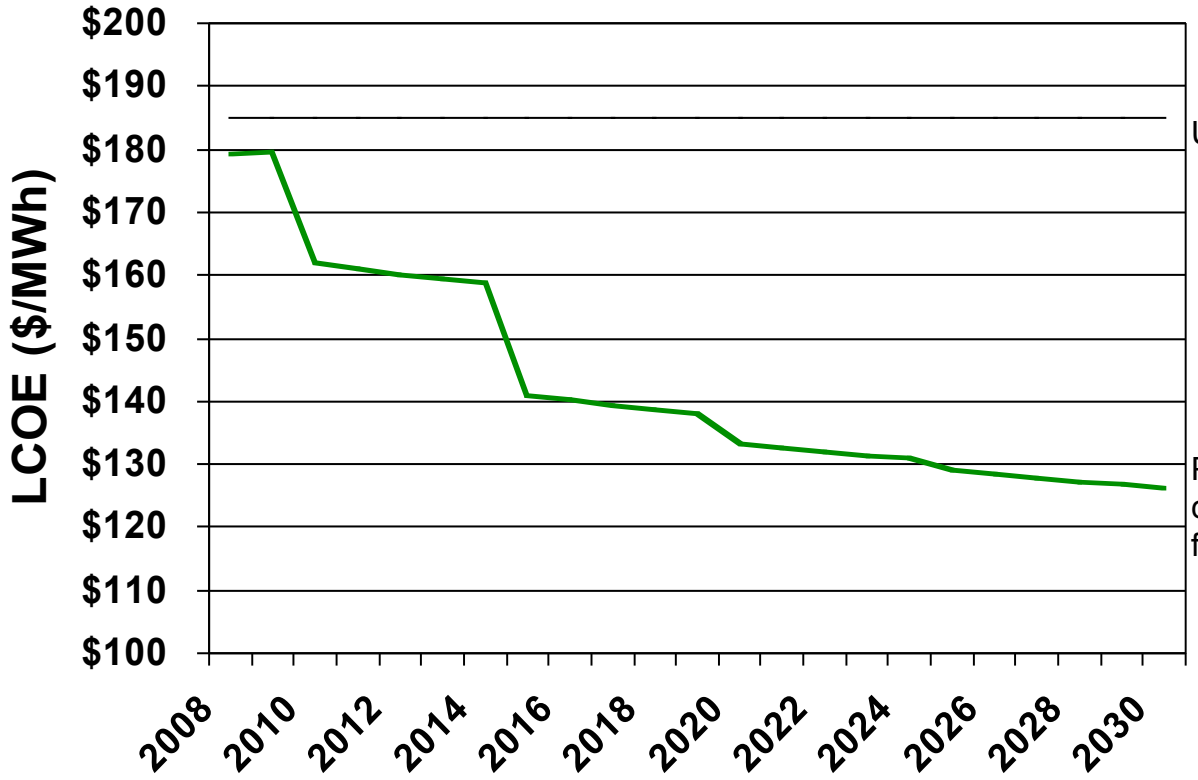
Figures in Billion 2008 dollars (except per barrel cost).
PV figures based on discount rate of 7%

Scenario 8: 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%

Scenario 8: LCOE (Electricity) and Savings Over Time $100/Barrel Oil



Present Value of total savings is $5.9 billion

Figures in 2008 dollars
PV figures based on discount rate of 7%

Regulatory Framework

- De-Coupling
- Renewable Portfolio Standard
- Feed-in Tariffs
- Energy Efficiency, Demand Response, Distributed Generation
- TOU rates, Automatic meters, net metering
- Creating an Energy Scenario Planning process that replaces the current IRP.
- Green energy tariff and/or Renewable Energy Credits
- Revising transmission planning processes to include identification of Renewable Energy Zones with preferred renewable generation development sites, with expedited transmission planning, siting, permitting and interconnection for new renewables.
- Creating a Clean Energy Infrastructure Surcharge

What next?

- Recommendations for an Omnibus Energy Bill
- Specific recommendations for a new regulatory framework
- County interactions through Energy conferences
- Outreach and communications on energy issues
- Bio-energy meetings and master plan
- Completion of studies and analysis over the next year
- Govt FY09 Funding Requirements
- Siting/Permitting Actions

What kind of things I would like from the State in the next 12 months?

- IMPLEMENTATION!!!!!!!
- Sense of urgency

- Big efficiency push
- Initial transportation actions
- Electricity regulatory and statutory actions
  - New regulatory framework
- T and D system improvements started
- More renewable projects in the pipeline
- Reasonable balance between a healthy utility, consumer protection and a working market for energy developers