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Hawaii Clean Energy Initiative – Implications for Kaua'i

Prepared for the 2008 Kaua'i Renewable Energy Forum

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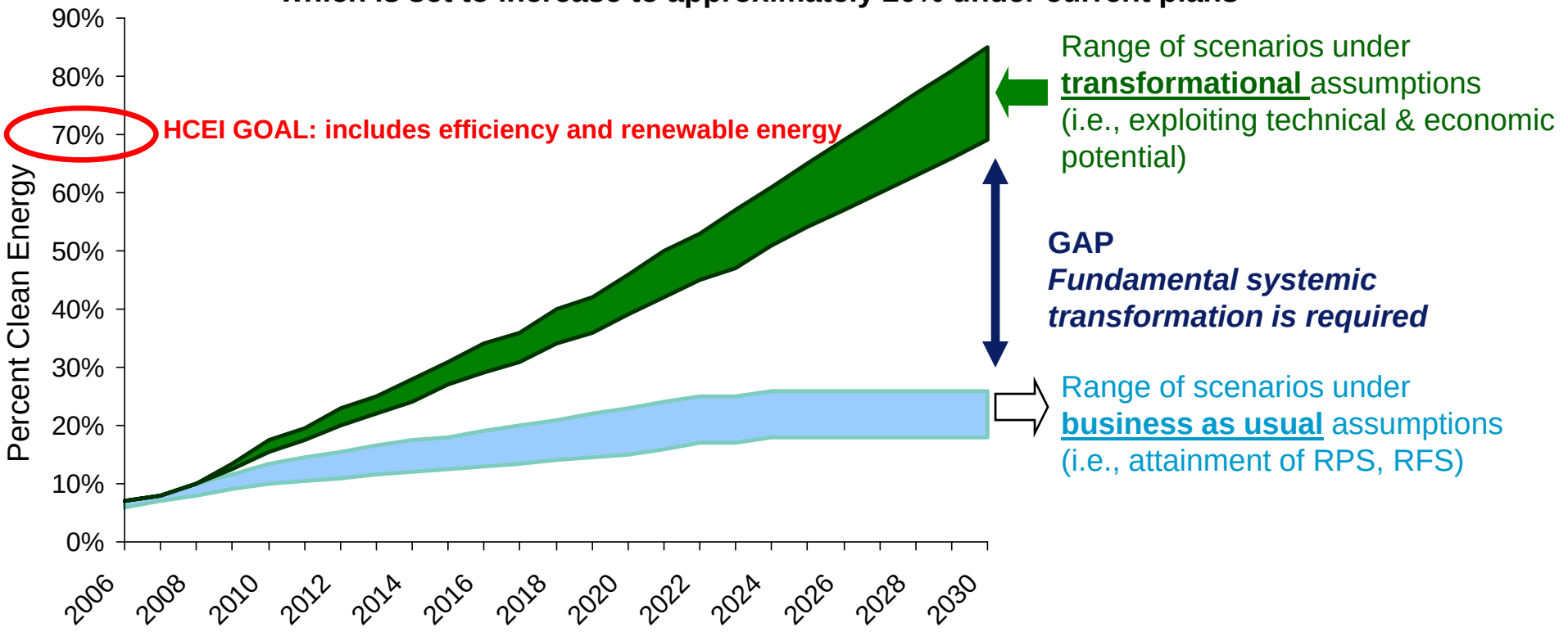
HCEI: Hawaii needs to transition from an economy powered by oil (for 92% of its energy) to one based on clean energy…

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 substantive transformation of regulatory, financial, and institutional systems

As an organic process, HCEI is implemented through the efforts of Working Groups and Partnership Projects

Working Groups

- Working Groups are the means to integrate **DOE's technical and policy expertise** with **Hawaii-based knowledge and project resources**; they will set out the specific goals to be achieved
- Working Groups will be convened around the topics of **Electric Generation, Energy Delivery, Transportation,** and **End Use Efficiency**
- An overarching **Integration** Working Group and the Executive Committee will integrate these efforts
- In addition, a special Policy and Regulatory advisory team is working with the PUC and policymakers to redesign the state's regulatory framework
- These efforts will culminate in recommendations for a new regulatory framework and recommendations for a legislative package for 2009 as a first step

Partnership Projects

- Partnership Projects **test and validate concepts laid out by the working groups**
- Projects combine DOE and Hawaii resources in concrete efforts to increase the use of renewable energy
- Future projects will be identified through solicitations and other means in conjunction with the Working Groups

Clean Energy Transformation Economics / End State Conditions

- Align policy, regulatory, ratepayer/ consumer, investor/shareholder framework and value
- Facilitate and mobilize intelligent investments by capital markets, energy producers and consumers
- Existing and new technology penetration at significant scale
- Accelerate new investment and turnover of outmoded energy assets
- Modernize energy service delivery and improve energy security
- Achieve 70% clean energy

Timeline of the analysis and policy elements of HCEI, which was launched by DOE and the State of Hawaii in January 2008

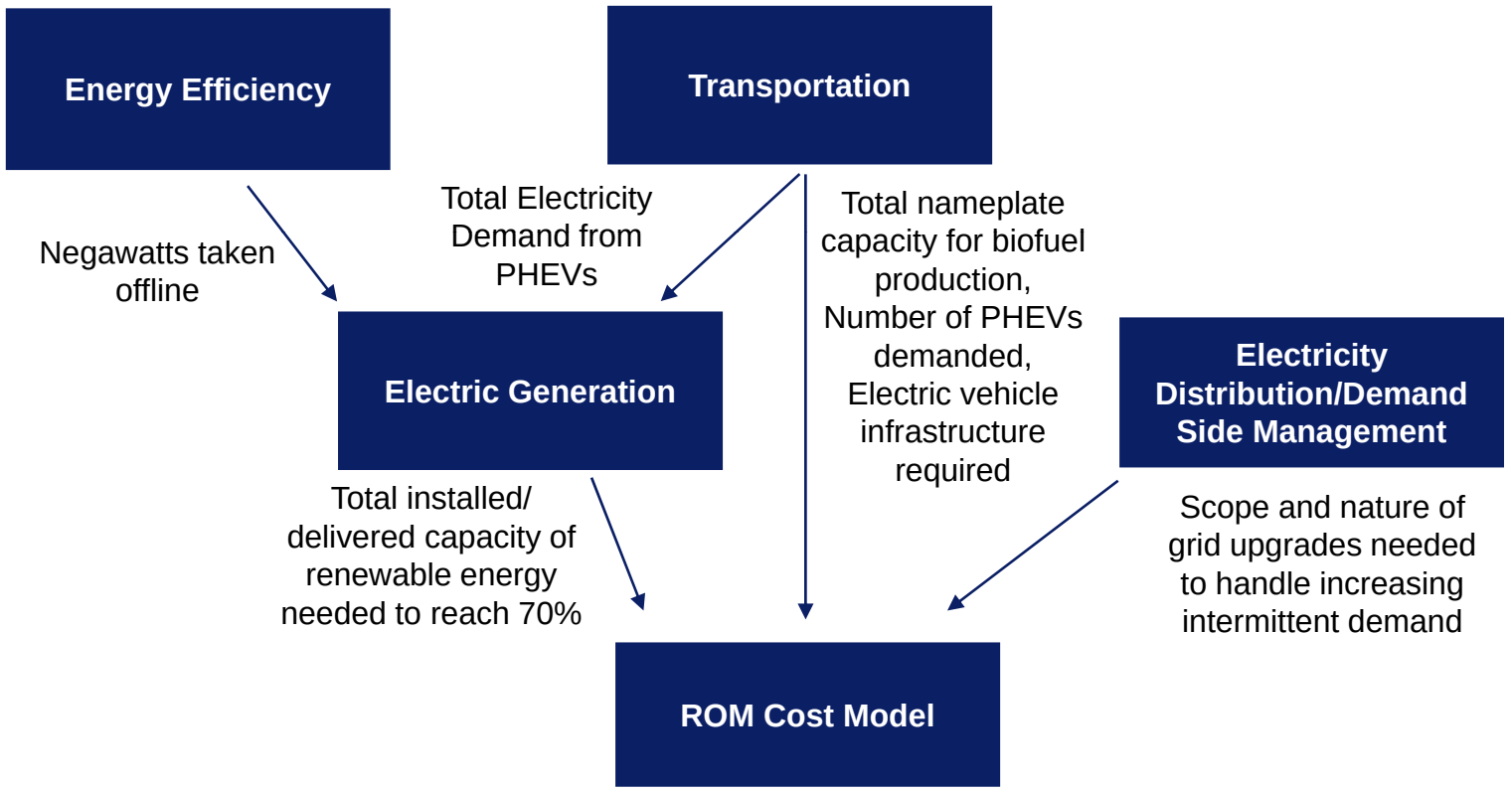
A main HCEI goal is to change the rules through legislation to facilitate the investment in clean energy resources and infrastructure

Four-pronged analysis done to identify the scope and cost of energy investment needed:

- Generation: Renewable energy generation potential across all islands
- Transportation: Future growth of Plug-in Hybrid Electric Vehicles (PHEVs) and local biofuel production across the state
- End Use Efficiency: Implementation of efficiency projects across islands' building stock
- Distribution: Improvements to the grid and business model that allow for successful integration of high levels of clean energy, including Demand Side Management (DSM) practices

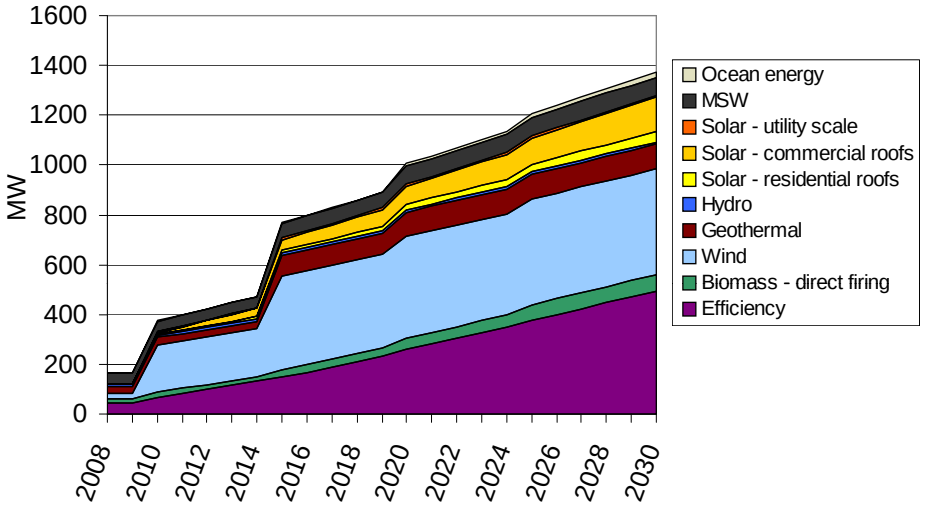
To determine the scope and cost of energy investment for the state, several interactive models are needed

Overall Modeling Needs, State of Hawaii:

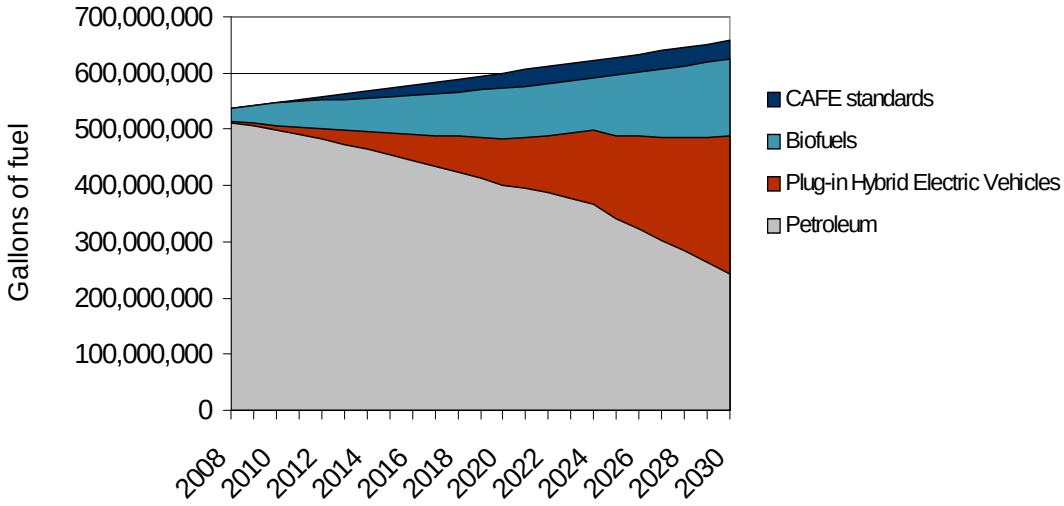


To achieve HCEI goals, significant investments will need to be made to transform the electricity and transportation sectors

State of Hawaii electricity generation
(Delivered capacity)



State of Hawaii Transportation
(chart displays gallons of petroleum fuel avoided by each measure)



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

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

Kaua'i's renewable and clean energy potential is significant

	Source		Oahu	Kauai	Maui	Hawaii	Lanai	Molokai	Total
Biomass	355 Report /1	MW	7	20	8	20	no data	6	
	KIUC Renewable Energy Technology Assessment			20					
	Hawaii Energy Strategy 2000/2	MW	25	25	25	50			
	Value used for BAH model		25	25	25	50	0	0	**125**
Wind	355 Report	MW	At least 50	At least 40	At least 40	At least 10	no data	no data	
	Proposed projects/3	MW			97		400	400	
	Hawaii Energy Strategy 2000	MW	65			85			
	Value used for BAH model		65	40	97	85	400	400	**1087**
Geothermal	355 Report (from GeothermEx 2005)	MW	n/a	n/a	140	750	n/a	n/a	
	Value used for BAH model		0	0	140	750	0	0	**890**
Hydro	355 Report	MW	no data	no data	3	20	20	no data	
	KIUC RETA	MW		21					
	Hawaii Energy Strategy 2000	MW		7					
	Value used for BAH model		0	21	3	20	0	0	**44**
Solar - rooftop	Residential roof analysis /5	MW	416	35	80	94			
	Commercial roof analysis /6	MW	576	48	111	130			
	Value used for BAH model		992	83	191	224	0	0	**1490**
Solar - utility scale	NREL estimate	MW	8	8	8	8			
	355 Report			285					
	Value used for BAH model		8	14	8	8	0	0	**37**
MSW (incl. landfill gas)	Hawaii Energy Strategy 2000	MW		25					
	KIUC RETA / County energy staff	MW	57	8	8	10			
	Existing plant (H-POWER)	MW	46						
	Value used for BAH model		57	8	8	10	0	0	**83**
Ocean energy	Estimates / proposed projects		50		10				
	Value used for BAH model	MW	50		10				**60**
Total	*Value used for BAH model*	**MW**	**1196**	**192**	**481**	**1147**	**400**	**400**	**3816**

1. "Assessment of Dependence of State of Hawaii on Oil" for EPACT Section 355, DOE, 2007.

2. Hawaii Energy Strategy 2000. Prepared by DBEDT

3. Lanai: DBEDT website--Castle and Cooke is investigating a 300 MW wind farm on Lanai; Molokai: Hawaii Star Bulletin, "Wind Power Firm Vows $50M for Molokai Bid."

Maui: DBEDT wesbite: http://hawaii.gov/dbedt/info/energy/renewable/wind

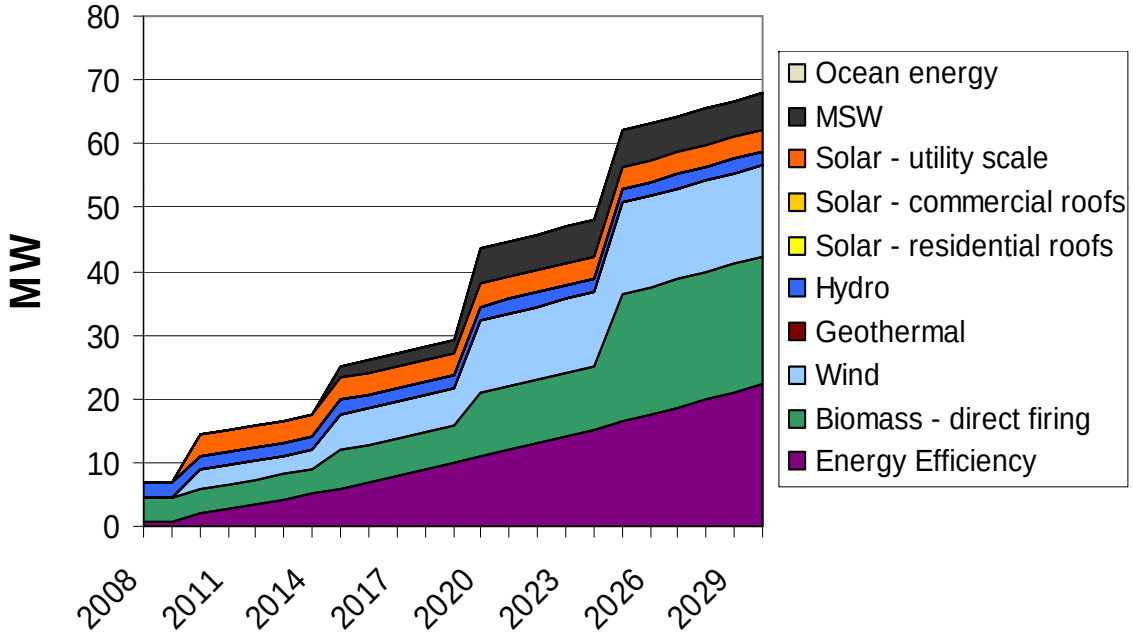
5. NREL estimates 2.5 kW per house, assume that half of Hawaii's 500,036 houses (as of 2006 census) are suitable for PV on the roof

6. In 2003, Hawaii had approx. 173 mil sq feet of commercial buildings, according to HECO (http://hawaii.gov/dbedt/ert/rebuild/minutes/May03Presentations/Benchmarking.pdf), 100 sq ft per kW (which is the figure for the 309 kW, 31,000 sq ft Ford Island array), assume that commercial buildings are proportional to residential buildings on each island to get island by island estimate, then assume that half of Hawaii's commercial buildings are suitable for solar

Note: Proposed projects, existing plants, KIUC RETA, HES 2000, and county energy staff estimates are used if they are greater than those listed in 355 Report

The analysis explored different pathways for reaching HCEI goals, and showed that many resources would need to come online for Kaua'i to reach 70% clean energy

Kauai clean energy deployment in 2030 under one scenario



Notes:

•This chart does not include fossil generation; it shows the clean energy resources that would need to be deployed for Kauai to reach 70% clean energy in 2030.

•The chart shows energy in terms of delivered MW, not installed capacity.

•The model deployed resources based on "economic dispatch," so the least expensive resources were brought on first. This means that while there already is and will be increasing rooftop solar, the yellow wedges do not show up on this particular representation because Kauai can reach 70% clean without deploying PV, which is more expensive than the other available resources.

•The model assumes that efficiency is the least expensive resource, and that efficiency will take care of 30% of the projected load in 2030.

Key conclusions of the analysis

- **Renewable resources**: All types of electricity generating technologies need to be deployed to reach 70% (wind, solar, geothermal, biomass, hydro, etc.)
- **Efficiency**: Aggressive energy efficiency measures are likely to be critical to achieving the 70% clean energy goal to total approximately 30 percent of business as usual demand
- **Cable**: The state cannot reach 70% clean energy for electricity and maintain high levels of clean energy for transportation unless there is a cable to Oahu from the outer islands; the cable explored in this analysis is a shallow cable to Oahu from Lanai and Molokai
- **Electric vehicles**: While the number of electric vehicles on the road in 2030 has only a modest impact on the state's electricity demand, high levels of electric vehicles are needed if the transportation sector is to reach high clean energy goals

HCEI and Kauai's energy plans are unique from a national or global perspective

- HCEI is the most aggressive and sweeping long-term plan to move substantively to a "clean energy" state
  - Incorporates a wide range of renewable, efficiency, and transportation actions
  - Complicated by the nature of the Hawai'i's island-based grids and nature of load shapes—lack of interconnection makes load regulation more important and complicated
  - Also complicated by complexity and scale of the clean energy equation—some large scale additions coupled with many small transactions (e.g., solar PV, many PHEVs, lots of assumed efficiency). Makes the system management equation much more complicated
- Challenge for HCEI is not only to use the right financial incentives, but bring forward advanced energy storage and forecasting technologies to make clean energy at this scale possible

Lessons will flow to and from Hawaii, potentially leading the way to new solutions

- Other states and countries, such as California and Denmark, are struggling with implications of high penetration of renewables (e.g., 20-30%)
  - How to ensure system reliability?
  - Can transition to clean energy be done in such a way to keep short-term rate impacts low without large government subsidies?
  - How to re-define roles of utility as “taker” of renewable energy developer by others in a manner that preserves utility economic stability?
- Others, particularly island nations, are interested in learning how HCEI is handling the challenges and how knowledge gains might be applied elsewhere