



Terrestrial Biomass Resources in Hawaii

Ethanol Workshop
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Biomass as a Feedstock for Ethanol Production

- **Sugars – direct fermentation to EtOH**
- **Starch – hydrolysis to simple sugars followed by fermentation to EtOH**
- **Lignocellulose – hydrolysis to simple sugars followed by fermentation to EtOH OR thermochemical gasification to form gas rich in CO and H₂ that can be synthesized to produce EtOH**

Biomass Resources

- **Agricultural**
 - Crops and Crop Residues
 - Food Processing Residues
 - Animal Manures
- **Municipal/Urban**
 - Biomass Fraction of Municipal Solid Waste
 - Landfill gas
 - Influent at Wastewater Treatment Plants
 - Fat, Oil, & Grease (i.e. used cooking oil, etc.)
- **Forest Industry Residues**
- **Dedicated Energy Crops**

Biomass Resource Classes

- Gross resource – amount estimated to exist
- Technical resource – amount estimated to be technically available for use based on **physical** system constraints

Agricultural – Sugar Cane

	Area Harvested (acre)	Raw Sugar (ton)	Molasses (ton)	Bagasse Fiber (dry ton)	Cane Trash Fiber (dry ton)
Maui	17,500	200,000	80,000	275,000	137,000
Kauai	3,700	61,000	15,000	75,000	37,000
State	21,200	261,000	95,000	350,000	174,000
Resource Type ¹		T	T	T	T
¹ T = technical resource G = gross resource					

Agricultural – continued

	Area Harvested (acre)	Production (ton)	Field Trash (ton)	Processing Waste (dry ton)	Nut Shells (dry ton)
Pineapple Oahu & Maui	19,100	320,000	43,311	15,000	
Mac Nut Hawaii	18,000	31,000			18,600
Resource Type ¹		T	T	T	T
¹ T = technical resource G = gross resource					

Agricultural – Livestock Waste Tons Per Year

	Oahu	Hawaii	Maui	Kauai	State
Gross Resource	20,253	173,764	29,667	16,710	242,470
Technical Resource	10,126	208	271	94	11,738

Source: Based on statistics from Hawaii Dept. of Agriculture

Municipal Solid Waste Disposed (i.e. Entering Landfills or Used in WTE Plant) --Technical Resource--

Island	Oahu	Maui	Hawaii	Kauai
Landfill	Waimanalo Gulch	Central Maui	Pu'uana'hulu	Kekaha
	dry ton/yr	dry ton/yr	dry ton/yr	dry ton/yr
Paper	188,518	34,775	33,158	17,280
Food	27,046	4,211	7,311	3,545
Green Waste	5,6806	7,961	3,393	1,645
Other Organics	2,9292	1,574	10,957	5,313
Treated C&D Lumber	62,242	4,984	4,439	2,152
Clean C&D Lumber	97,057	13,789	12,279	5,954
Total Biomass	460,960	67,295	71,537	35,889

Source: County solid waste management plans, etc.

Forest Resources Based on 15 Yr Harvest Schedule -- Technical

State Timber Area	Harvestable Area (acre)	Annual Sawlog Volume (1000 ft ³)	Total Annual Resource (wet ton)	Total Annual Resource (dry ton)
Waiakea	3,986	823	25,207	12,604
Hamakua	2,837	1,564	35,688	17,844
Total	6,823	2,387	60,895	30,447
<p>Waiakea Annual Total (wet ton) = 10,294 ton Sawmill Residues + 12,119 ton Pulpwood + 2,794 ton Sawdust & Bark</p> <p>Hamakua Annual Total (wet ton) = 19,544 ton Sawmill Residues + 10,839 ton Pulpwood + 5,305 ton Sawdust & Bark</p>				

Source: Jaakko Poyry Consulting Report to Hawaii Forest Industry Groups, 2000

Dedicated Energy Crops

- No dedicated energy crop planting currently in Hawaii
- Several studies conducted for PUC-mandated integrated resource planning by utilities but no implementation to date



Conclusions

- **Technical biomass resources total 1.3 million tons (dry basis) annually in Hawaii, comprising animal manures, agricultural field and processing residues, municipal solid waste, sawmill residues, fat, oil, and grease**
- **Biomass derived materials in municipal solid waste currently landfilled or used in waste to energy conversion plants contribute 50% of the total**
- **Agricultural biomass sources account for 47% of the total**
- **Future work needed to refine these numbers and to estimate resources available if currently idle agricultural lands were put into use to support ethanol production**

Reports

**"Biomass and Bioenergy Resource Assessment,
State of Hawaii"**

<http://www.hawaii.gov/dbedt/ert/biomass-assessment.html>

**"Analysis of Hawaii Biomass Energy Resources for
Distributed Energy Applications"**

<http://www.hawaii.gov/dbedt/ert/biomass-der.html>

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