

Potential for Ethanol Production in Hawaii

Scott Turn

Associate Researcher

Hawaii Natural Energy Institute

University of Hawaii

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Major Goals of Hawaii Energy Strategy 2007

- **Reduce Hawaii's dependence on oil**
- **Protect the environment**
- **Reduce the negative impacts related to using imported fuels**
- **Enhance renewable energy use and energy efficiency**
- **Improve the security and reliability of Hawaii's energy system**

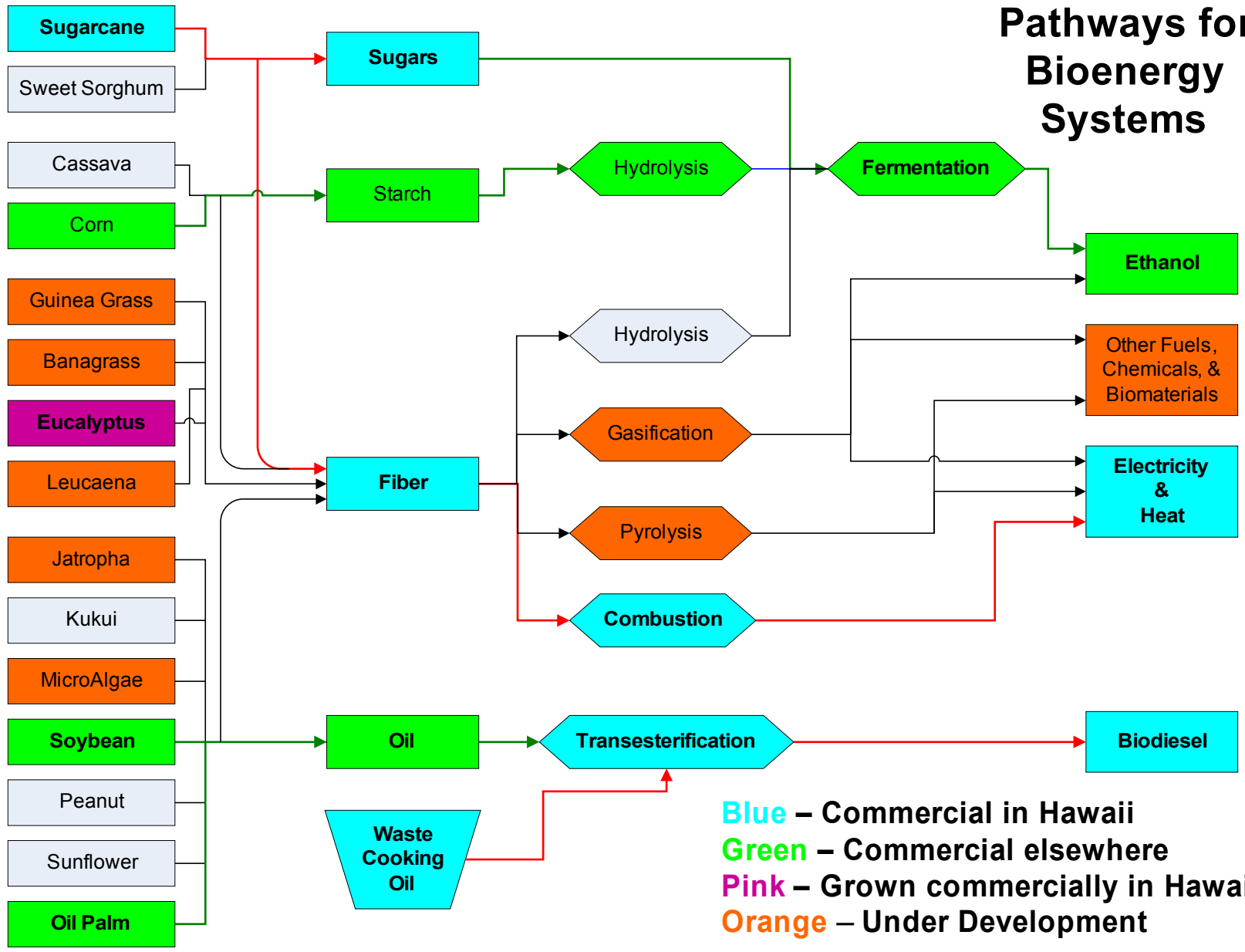


Selected Legislation Recently Enacted in Support of Hawaii Energy Strategy

- **Act 95 (2004):** Requires 20% of Hawaii's electricity to be generated from renewable resources by 2020
- **Act 199 (1994):** Requires that 85% of gasoline for use in motor vehicles contain 10% EtOH by volume
- **Act 240 (2006):** Mandates statewide alternative motor fuels standard to reach 20% by 2020



Pathways for Bioenergy Systems



Crops

Intermediate Products

Conversion Technologies

Bioenergy Products

Objectives of Current Study

- **Inventory agricultural lands and determine suitability for energy crop production**
- **Estimate production of targeted energy crops based on modeled yields (ton/acre) and scenarios of land and water availability**
- **Estimate ethanol potential (gal/yr) based on energy crop production and selected ethanol conversion technologies**



Availability of Agricultural Lands

- **Geographic information systems (GIS) based approach using layers available from SOH**
- **Categories of land considered**
 - **Land zoned for agriculture (1,928,034 acres)**
 - **Land owned by the State of Hawaii (SOH) (430,000 acres)**
 - **Land owned by large land owners (LLO)**
 - **Agricultural land of importance to the State of Hawaii (ALISH) (977,043 acres)**



Crops Selected for Ethanol Feedstocks

- **Sugarcane (sugar and fiber)**
 - Water requirements: >78" per year
 - Sugarcane soils less than 20% slope
- **Banagrass (fiber)**
 - Water requirements: >78" per year
 - Sugarcane soils less than 20% slope
- ***Eucalyptus* (fiber)**
 - Water requirements: >40" per year
 - Sugarcane, pineapple, or woodland soils less than 20% slope
- ***Leuceana* (fiber)**
 - Water requirements: >20" per year
 - Sugarcane, pineapple, or woodland soils less than 20% slope

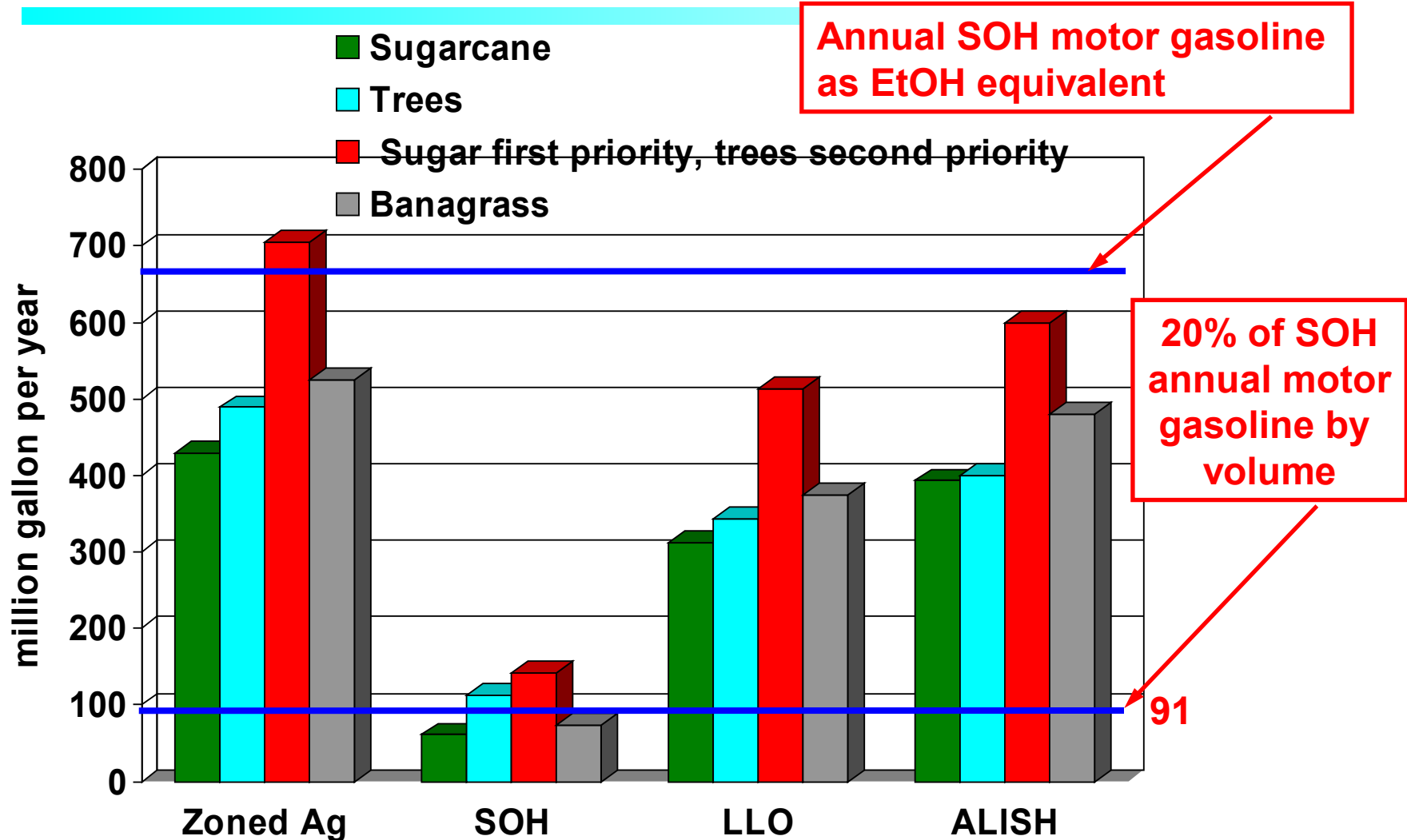


Ethanol Conversion Technologies

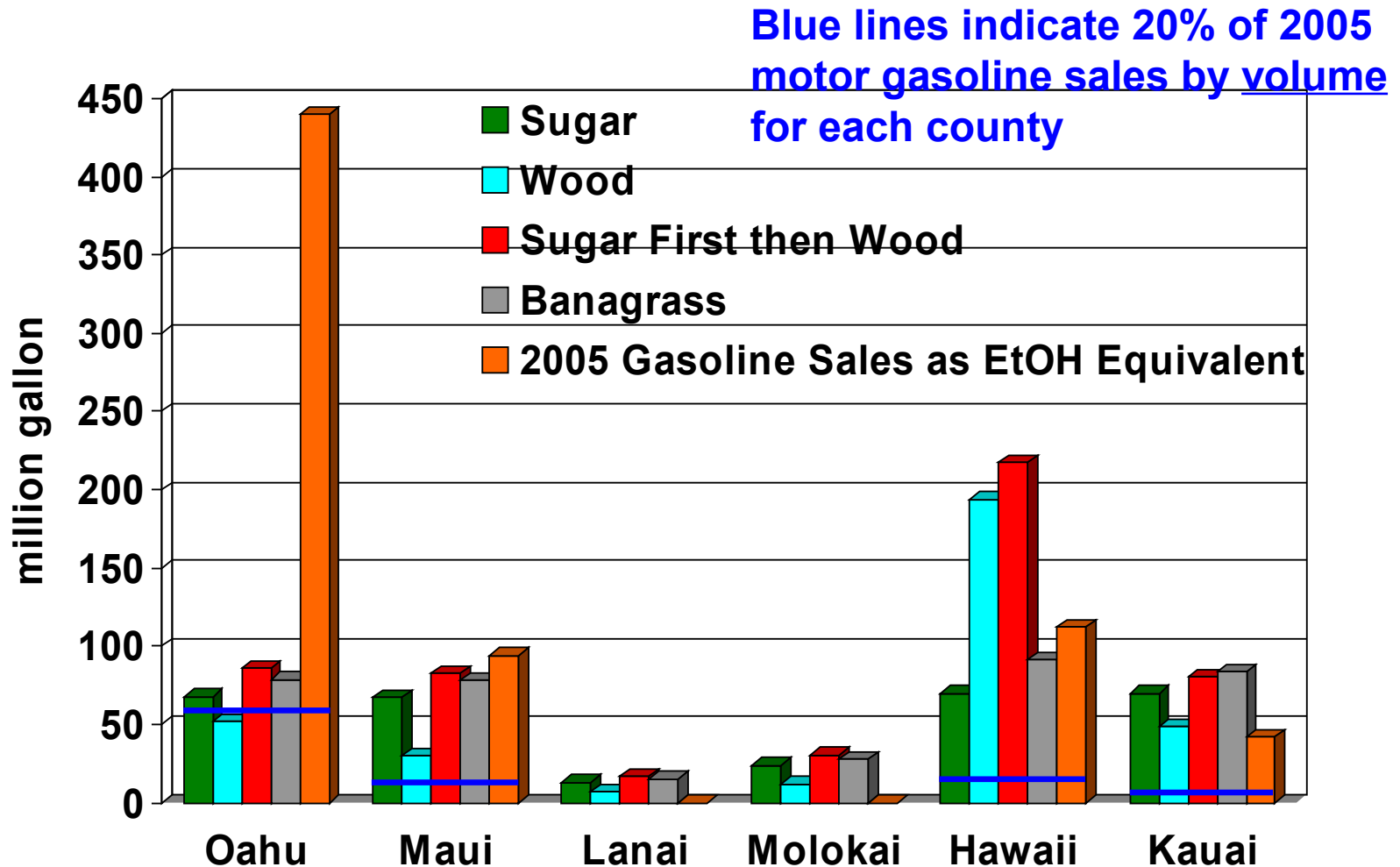
- **Sugarcane**
 - Sugar fermentation by yeast with yield of 141 gallon per ton fermentable sugars
 - 0.9 tons of fiber per ton of fermentable sugars are required to service the energy demand of the process leaving 0.6 ton fiber per ton of fermentable sugars for additional ethanol production
 - No attempt to integrate ethanol production from fermentable sugars with that from fiber production
- **Fiber**
 - Hydrolysis of cellulose and hemicellulose to simple five and six carbon sugars with subsequent conversion yielding 70 gallon per ton of fiber
 - Lignin fraction of fiber used to service energy requirements and yields surplus electricity, 2.3 kW hr per gallon of ethanol



Potential Ethanol Production



Potential Ethanol Production by Large Landowners by Island



Summary

	Zoned Ag	Zoned Ag, State Owned	Zoned Ag, Large Land Owners	Zoned Ag, ALISH
1) Sugar cane				
Acres	360,324	50,828	252,145	329,520
Ethanol (mil gal/yr)	429	61	312	393
2) Trees				
Acres	698,632	160,360	491,040	571,060
Ethanol (mil gal/yr)	489	112	344	400
3) Sugar cane first priority, trees second priority				
Sugar Acres	360,324	50,828	252,145	329,520
Wood Acres	394,136	115,488	288,105	294,564
Ethanol (mil gal/yr)	705	142	513	599
4) Banagrass				
Acres	360,324	50,828	252,145	329,520
Ethanol (mil gal/yr)	525	74	374	480

Note: All assume the availability of land, water, and cellulose to ethanol technology



Full report, *Potential for Ethanol Production in Hawaii*, available at:
<http://hawaii.gov/dbedt/info/energy/publications/ethanol-hnei-06.pdf>

