Agriculture as a Base for a New Green Economy

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Chief Executive Officer & President

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Hawaiian Biomass-to-Energy is an Economic Imperative

• Hawaii is the most geographically remote island chain in the world
  – Center of Pacific trade
  – Strategic military base for operations and command of Pacific Theatre forces

• Hawaii imports 90+% of its energy consumption
  – Of all US States, Hawaii is the most dependent on and vulnerable to oil imports
  – Hawaii imported 17m barrels of oil in the first half of 2008 to feed our power and transportation sectors
  – In doing so, Hawaii spent more than $7.1 billion in 2008 (on an annualized basis) out of HI – that’s more than $800,000 every hour of every day

• Hawaii also imports nearly $5 billion in food every year

• $12 billion out of a roughly $60 billion economy is a remarkable drag on our economic well being
  – Jeopardizes job creation
  – Creates strong economic shocks waves as energy and food prices rise and fall
  – Jeopardizes military strength and strategic deployment
Collapse:
How Societies Choose to Fail or Succeed
Jared Diamond
A Coalition to Support the Economic, Environmental and Community Integrity of Hawai`i through Improved Energy and Food Security through contributions to a Green Economy

Maui Land and Pineapple, Inc.
Khosla Ventures
Ohana Holdings
Finistere Partners

Kamehameha Schools
Grove Farm
“One thing is sure: the Earth is more cultivated and developed now than ever before; there is more farming but fewer forests, swamps are drying up and cities springing up on an unprecedented scale. We have become a burden to our planet. Resources are becoming scarce and soon Nature will no longer be able to satisfy our needs.”

- Quintus Septimius Tertullianus (Roman politician) 200 BC

How have we avoided disaster?

• Opening new lands
• Technology
“Amid the current panic about gas prices many people are embracing ethanol. But that's not such a good idea”

• All available cropland will be needed to feed a growing population… biomass will compete for valuable farmland
• Energy crops will erode arable land productivity or require the conversion of environmentally important land to agronomic uses
• More energy is required to produce ethanol than you receive from it
  – Corn ethanol provides no CO2 mitigation relative to petrol
• You will never generate enough biomass to make a significant contribution to total fuel demand
### Increased Land Productivity through Innovation and Integration
(*per acre back of the envelop estimates*)

<table>
<thead>
<tr>
<th>Current Sugar Focus</th>
<th>Current Energy Focus</th>
<th>Future Energy Focus with advanced varieties and advanced processing</th>
<th>Future Energy Focus with advanced varieties and advanced processing integrated with algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8 tons sugar</td>
<td>1100 gallons ethanol</td>
<td>2500 gallons ethanol (or 1750 gallons of other advanced fuels)</td>
<td>2500 gallons ethanol</td>
</tr>
<tr>
<td>5000 kwh power</td>
<td>5500 kwh power</td>
<td>9,000 kwh power</td>
<td>10,000 kwh power</td>
</tr>
<tr>
<td>1x CO₂</td>
<td>1.5x CO₂</td>
<td>2.5x CO₂</td>
<td>1.5x CO₂</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 2500 gallons ethanol</td>
<td>• 1000 gallons oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 9,000 kwh power</td>
<td>• 2 tons protein</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 5500 kwh power</td>
<td>• 0.1x CO₂</td>
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<td></td>
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<td></td>
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New Crop Cultivars: Changing Goals Allows us to Change Tools
Energy cane vs Conventional Cane

<table>
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<tr>
<th>Fraction</th>
<th>Conventional tons/acre (DW)</th>
<th>Fiber Cane tons/acre (DW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>7.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Fiber</td>
<td>7.5</td>
<td>17.0</td>
</tr>
<tr>
<td>Total</td>
<td>15.0</td>
<td>26.4</td>
</tr>
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...or new hybrid Sorghum varieties (eg. CERES – Thousand Oaks, CA)
**Increased Land Productivity through Innovation and Integration**

(“per acre back of the envelop estimates”)

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<td></td>
<td></td>
<td></td>
<td>• revenue $3450</td>
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<td></td>
<td></td>
<td></td>
<td>• land “footprint” = X per gallon fuel</td>
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<tr>
<td></td>
<td></td>
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<td>• revenue $10,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• land footprint = 1/3X per gallon fuel</td>
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How much energy on 100,000 acres? 275 million gallons of diesel, 1000 GWh’s of firm, green power and 200,000 tons of protein.
Challenge: How Do You Put Low Cost Biomass in Your Car (or your Jet Plane) without Taking Food off Your Table?
Challenges to Green Energy and a Green Economy

Hawaii’s size and location limit options under conventional wisdom scenarios

- Productive use of relatively small, isolated and expensive parcels of land
  - Must find a way to work at “smaller” scale and to produce a variety of products beyond just ethanol and power – they are “starter” fuels
  - Renewable energy must align itself with local food production in order to contribute to the productive use of a limited land base
  - Efficient use of water and recycling of “waste” streams
  - Production agriculture has “died” in Hawaii…it needs to be resuscitated in an appropriate form

- Hawaii’s appropriate business models and technical solutions
  - Aligning the “form” of energy with the local demand
  - Developing a “green” collar workforce

- Providing as much of the supply chain as possible from local resources
  - Integration and alignment with other local businesses

- Financing in an uncertain economic environment
  - Especially for solid concepts that haven’t yet been proven at scale
  - Dealing with a volatile global energy market

- Lots of room for improvement but its time to implement the advances we have. The “size-of-the-prize” is substantial:
  - Enriched energy and food security
  - Capital retained in the local economy
  - Revitalized rural communities
Mahalo