

APPENDIX E  
Evaluation Matrices

**EVALUATION MATRICES ON  
WASTE REDUCTION AND RECYCLING ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b>    | <b>Capital Costs</b>   | <b>Operating Costs (Annual)</b>  | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>  | <b>Ownership/Operation Responsibilities</b>   |
|----------------------------------|--|--|---------------------|--|---|
| <b>Expanded Drop-Off Centers</b> | <p><b>\$500,000</b><br/>for all existing stations.</p> <p>\$24,000 to \$40,000 for minimal improvements at individual (unmanned) transfer stations or other locations.</p> <p>for extensive improvements including fences and facilities for attendants could add \$500,000 per station.</p> | <p><b>\$500,000</b><br/>for existing transfer stations.</p> <p>Approximately \$25,000 per drop-off center at locations other than transfer stations.</p> | <b>Varies</b>       | <p>Permit requirements may include:</p> <ul style="list-style-type: none"> <li>• Modifications to existing solid waste facility permits for the transfer stations</li> <li>• Solid waste facility permits for drop-off centers at other facilities</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Fire, health and business permits and licenses</li> <li>• Intergovernmental agreements.</li> </ul> | <p>Options include:</p> <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• State owned (schools) and private contract operated</li> <li>• County owned and operated.</li> </ul> |

| <b>MANAGEMENT ALTERNATIVE</b>    | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>   | <b>Risks</b>  | <b>Effectiveness of Reduction of East Hawaii Waste Stream</b>  |
|----------------------------------|---|--|---|--|
| <b>Expanded Drop-Off Centers</b> | <p>Drop-off centers at transfer stations should not significantly change the environmental impacts except to benefit the environment by diverting wastes from disposal facilities.</p> <p>Drop-off centers at schools would involve small increases in traffic and possibly litter, although proper maintenance should include litter control.</p> <p>Drop-off centers may promote increased public participation in recycling programs and encourage citizens to share responsibility for waste management.</p> <p>Drop off centers at schools can be operated to provide modest revenue from material sales for the schools and providing a community incentive to recycle.</p> | <p>Separated green waste could be managed by the county by chipping separated green waste at transfer stations as is now done at Hilo Transfer Station and Kailua Transfer Station.</p> <p>Recyclable product marketing is a critical consideration. See cell regarding Risks.</p> <p>Implementation of drop-off centers should be accompanied by enhanced public education.</p> | <p>The cooperation of residents in source separation is required to obtain a clean material stream. Many markets will not accept materials such as paper that is contaminated. Or market prices may be low due to lower quality. Without secure and well-paying markets the economics of the facilities could be compromised.</p> | <p><b>5 to 30%</b></p> <p>The potential diversion rate for drop-off centers varies widely due to differences of materials targeted for recovery (see White Paper on Dirty MRFs) and markets.</p> |

**EVALUATION MATRICES ON  
WASTE REDUCTION AND RECYCLING ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b>    | <b>Capital Costs</b>  | <b>Operating Costs (Annual)</b>   | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>  | <b>Ownership/Operation Responsibilities</b>  |
|----------------------------------|---|---|---------------------|--|--|
| <b>Recycling / Reuse Centers</b> | <p><b>\$3M to \$5M</b></p> <p>Facilities vary considerably in size and generally the larger the throughput the smaller is the capital cost per annual ton processed, which ranges from \$20-170. For a facility to recover recyclables, at east Hawaii scale, \$40-60 would be typical.</p> | <p><b>\$2M</b></p> <p>Operating costs are generally proprietary, vary widely depending on materials processed, and are difficult to obtain.</p> <p>As an indicator of the variability of operating costs, the number of full time employees per 1000 tpy throughput varies from 0.1 to nearly 2.</p> <p>A typical operating cost has been quoted at \$2M annually, assuming about 40 employees, or \$25 per ton processed, plus cost of residue disposal. The amount of residue depends on how well residents source-separate, but is generally just a few percent.</p> | <b>Varies</b>       | <p>A comprehensive siting study to identify preferred locations could be conducted by either County or vendor.</p> <p>Permit requirements may include:</p> <ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | <p>Options include:</p> <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |

| <b>MANAGEMENT ALTERNATIVE</b>    | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>   | <b>Risks</b>   | <b>Effectiveness of Reduction of East Hawaii Waste Stream</b>   |
|----------------------------------|---|--|--|---|
| <b>Recycling / Reuse Centers</b> | <p>Waste processing is a net energy consumer, since it utilizes process energy, however recycling materials saves energy and natural resources. Hazardous materials in the waste must be managed.</p> <p>Potential environmental impacts include:</p> <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | <p>A recycling facility can be a nuisance to nearby residents due to noise and traffic and so should be located accordingly.</p> <p>Recyclable product marketing is a critical consideration. See cell regarding Risks.</p> <p>Facilities should be developed in cooperation with existing recycling operations, so as to not compete with or undermine existing operations.</p> | <p>The marketability of recovered materials is a major consideration because recycling markets are weak and fluctuate considerably. Without secure and well-paying markets the economics of the facility could be compromised.</p> <p>Some MSW processing facilities have been shut down due to neighborhood complaints regarding odor.</p> <p>Kauai County built a recycling / reuse center several years ago, but it is not yet operational.</p> | <p><b>5 to 60%</b></p> <p>The diversion rates vary widely due to differences of materials targeted for recovery (see White Paper on Dirty MRFs), the effectiveness of motivating residents to source-separate, and markets.</p> |

**EVALUATION MATRICES ON  
WASTE REDUCTION AND RECYCLING ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Capital Costs</b>  | <b>Operating Costs (Annual)</b> | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>  | <b>Ownership/Operation Responsibilities</b>   |
|-------------------------------|---|---------------------------------|---------------------|--|---|
| <b>C&amp;D Waste Recovery</b> | Builders could recycle some wastes within projects sites and could separate and transport other recyclable materials to a processing facility with no significant capital costs to the county.<br><br>The cost of a central processing facility for C&D waste is not available. | <b>Not available.</b>           | <b>Varies</b>       | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include: <ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include: <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>   | <b>Risks</b>   | <b>Effectiveness of Reduction of East Hawaii Waste Stream</b>  |
|-------------------------------|---|--|--|--|
| <b>C&amp;D Waste Recovery</b> | Dust and noise can be problems. Waste processing is a net energy consumer, since it utilizes process energy; however recycling materials saves energy and natural resources. Hazardous materials in the waste must be managed.<br><br>Potential environmental impacts include: <ul style="list-style-type: none"> <li>• Water and air quality and dust</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | A C&D processing facility can be a nuisance to nearby residents due to dust, noise and traffic and so should be located accordingly. | The marketability of recovered materials is a major consideration especially with limited potential uses in the county. Without secure and well-paying markets the economics of the facility could be compromised. | <b>12%</b><br><br>Approximately 18% of the waste stream entering South Hilo Landfill is classified as C&D waste. Treated lumber is not recoverable and is about 3% of the waste stream. Therefore at an 80% recovery rate, there is potential for reduction of approximately 12% of the waste stream.<br><br>Some innovative uses have been proposed for treated lumber, and if they are effective, the recovery rate may rise to 14%. |

**EVALUATION MATRICES ON  
TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| MANAGEMENT ALTERNATIVE                               | Capital Costs   | Net Operating Costs (Annual)  | Cost Per Ton | Siting, Design, Permitting and Construction Requirements  | Ownership/Operation Responsibilities   |
|--|---|---|--------------|---|--|
| <b>Mixed Waste Processing Facility - "Dirty MRF"</b> | <b>\$6M</b><br>or \$90 per annual ton of capacity.<br>Facilities vary considerably in size and capital cost per annual ton processed, which ranges from \$20-170. | <b>\$4M</b><br>or \$60 per ton.<br>Operating costs are generally proprietary, vary widely depending on materials processed, and are difficult to obtain.<br>As an indicator of the variability of operating costs, the number of full time employees per 1000 tpy throughput varies from 0.1 to nearly 2.<br>A typical operating cost has been quoted at \$2M annually, assuming about 40 employees, or \$25 per ton processed, plus cost of residue disposal, which can be 50-60% of waste received. | <b>\$73</b>  | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include:<br><ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include:<br><ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |
| <i>EWMCE</i>   | \$160 per annual ton of capacity  | \$50 per ton  |              |   |  |

| MANAGEMENT ALTERNATIVE                               | Environmental & Social Impacts   | Implementation Roles and Considerations   | Risks   | Effectiveness of Reduction of East Hawaii Waste Stream  |
|--|--|---|---|---|
| <b>Mixed Waste Processing Facility - "Dirty MRF"</b> | Odor can be a problem. Waste processing is a net energy consumer, since it utilizes process energy, however recycling materials saves energy and natural resources. Hazardous materials in the waste must be managed.<br><br>Potential environmental impacts include:<br><ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | An MSW processing facility such as a dirty MRF can be a nuisance to nearby residents due to odors, noise and traffic and so should be located accordingly.<br><br>Recyclable product marketing is a critical consideration. See cell regarding Risks. | The marketability of materials recovered from mixed waste is a major consideration. Many markets will not accept materials such as paper that is contaminated with food and other residues. Or market prices may be low due to lower quality. Without secure and well-paying markets the economics of the facility could be compromised.<br><br>Some MSW processing facilities have been shut down due to neighborhood complaints regarding odor. | <b>40%</b><br><br>Estimated amount of residual wastes: 110 tons per day.<br><br>The diversion rate from dirty MRFs varies widely due to differences of materials targeted for recovery (see White Paper on Dirty MRFs) and markets. They vary from as low as 5% to as high as 60% for facilities that target special waste substreams such as C&D or commercial-only waste. |

**EVALUATION MATRICES ON  
TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Capital Costs</b>   | <b>Operating Costs (Annual)</b> | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>   | <b>Ownership/Operation Responsibilities</b>  |
|-------------------------------|--|---------------------------------|---------------------|---|--|
| <b>Combustion Facility</b>    | <b>\$25M</b><br>or \$375 per annual ton of capacity.<br><br>This assumes 4 modular units with capacities of 35 tons per day. | <b>\$2M</b><br>or \$30 per ton. | <b>\$63</b>         | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements include:<br><ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include:<br><ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>  | <b>Risks</b>   | <b>Effectiveness of Reduction of East Hawaii Waste Stream</b>  |
|-------------------------------|---|---|--|--|
| <b>Combustion Facility</b>    | Combustion of MSW generally produces less greenhouse gas emissions than landfilling and open composting, but more than thermal gasification. Controls toxic and NOX emissions.<br><br>Produces energy that can replace imported fossil fuel.<br><br>Potential environmental impacts include:<br><ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | An MSW combustion facility can be a nuisance to nearby residents due to odors, noise and traffic and so should be located accordingly.<br><br>Some environmentally sensitive sectors of the U.S. population have an aversion to combustion technology because of fear of airborne emissions and degraded air quality. | A high-capital costs facility would entail financial uncertainties and risks for the vendors and, depending on the financing arrangements, possibly for the County.<br><br>Permitting and environmental reviews could delay implementation significantly.<br><br>Changes in government regulations could impose more stringent operating requirements. | <b>68 to 86%</b><br><br>Estimated amount of residual wastes: 27 to 68 tons per day.<br><br>It is estimated that 70% to 95% of total waste stream could be processed depending on other diversion and recycling efforts.<br><br>Reduction of the processed (combustible) portion of the waste stream could be as high as 85%. |

**EVALUATION MATRICES ON  
TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| MANAGEMENT ALTERNATIVE             | Capital Costs  | Operating Costs (Annual)   | Cost Per Ton | Siting, Design, Permitting and Construction Requirements  | Ownership/Operation Responsibilities   |
|------------------------------------|--|--|--------------|---|--|
| <b>MSW Composting</b>              | <b>\$11M</b><br>or \$165 per annual of capacity.<br>In vessel systems to process the east Hawaii waste stream could cost as high as \$25M. Windrow systems are far less expensive. | <b>\$4M</b><br>or \$60 per ton.<br>In vessel systems have been estimated at \$40-45 per ton; windrow systems at \$35-45. | <b>\$73</b>  | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include:<br><ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> Mixed organic processing, including food waste, require high level environmental and odor controls. | Options include:<br><ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |
| <i>Wright County, MN (windrow)</i> | \$1.30M or \$26 per annual ton of capacity for 49,400 tpy.   | \$1.65M or \$33 per ton  |              |   |  |
| <i>Sevierville, TN (windrow)</i>   | \$1.35M or \$24 per annual ton of capacity for 57,200 tpy  | \$0.90M or \$16 per ton  |              |   |  |
| <i>EWMCE</i>                       | \$180 per annual ton of capacity   |  |              | 61 acres of land for 900-tons-per-day system.   |  |
| <i>Real Earth U.S.Enterprises</i>  | \$30M or \$137 per annual ton of capacity for 175,000 tpy  | \$55 to \$75 per ton   |              | 20 acres of land for 500-tons-per-day system.   |  |

| MANAGEMENT ALTERNATIVE | Environmental & Social Impacts   | Implementation Roles and Considerations   | Risks  | Effectiveness of Reduction of East Hawaii Waste Stream  |
|------------------------|--|---|--|---|
| <b>MSW Composting</b>  | Odor can be a problem. Composting is a net energy consumer, since it utilizes process energy and generates no usable energy itself. Hazardous materials in the feedstock are not degraded.<br><br>Produces a beneficial soil amendment.<br><br>Composting generates somewhat less global warming gases than landfilling and approximately the same as incineration.<br><br>Potential environmental impacts include:<br><ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | A composting facility can be a nuisance due to odors and so should be located accordingly.<br><br>Due to the lack of universal control on exclusion of hazardous and other inappropriate materials from the waste disposed at transfer station, an MSW composting system would need to carefully monitor incoming waste for rejection of inappropriate materials. | Some composting facilities on the mainland have been shut down due to public complaints regarding odor and technical management problems.<br><br>Hazardous substances could end up in the compost product unless incoming waste is carefully monitored.<br><br>Marketing of compost product could be difficult due to potential contaminants, such as plastic, which can discourage use in landscaping, and due to limited agricultural markets on the island. | <b>52%</b><br><br>Estimated amount of residual wastes: 88 tons per day.<br><br>The entire east Hawaii waste stream, with the exception of bulky and C&D waste, could be processed, however, the inorganic components would be removed for disposal. Consequently approximately 54 percent of the waste stream could be diverted in an ideal configuration, though some of that material such as recyclable paper, may be diverted to recycling. |

**EVALUATION MATRICES ON TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| MANAGEMENT ALTERNATIVE   | Capital Costs   | Operating Costs (Annual)        | Cost Per Ton  | Siting, Design, Permitting and Construction Requirements   | Ownership/Operation Responsibilities   |
|--|---|---------------------------------|---|--|--|
| <b>Thermal Gasification</b>  | <b>\$22M</b><br>or \$330 per annual ton of capacity.              | <b>\$3M</b><br>or \$45 per ton. | <b>\$75</b>   | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include: <ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include: <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> </ul> Since these are proprietary and only-recently implemented technologies (for MSW), County operation does not seem feasible. |
| <i>Case Example: Thermostelect facility in Italy</i>                           | \$237M for 525,000 tpy facility.<br>\$451 per annual-ton capacity | \$86/ton                        | Tipping fees are very project specific, including consideration of scale, land costs, labor rates, specific feedstock received, financing methods, etc. |  |  |
| <i>Case Example: ThermoChem demonstration and pilot facilities<sup>2</sup></i> | \$92M for 340,000 tpy facility.<br>\$270 per annual-ton capacity. | \$40/ton                        |   |  |  |
| <i>Brightstar Environmental</i>  | Not divulged  | Not divulged                    | Not divulged  | At least 7 acres.<br>At least 150,000 ton of MSW per year.   | Private owned and operated   |

| MANAGEMENT ALTERNATIVE      | Environmental & Social Impacts  | Implementation Roles and Considerations   | Risks   | Effectiveness of Reduction of East Hawaii Waste Stream  |
|-----------------------------|---|---|---|---|
| <b>Thermal Gasification</b> | Reduces greenhouse gas emissions over landfilling, open composting, or incineration. Controls toxic and NOX emissions in comparison to landfilling or open composting. Product gas can be used as an energy source.<br><br>Potential environmental impacts include: <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | A critical factor is the developing maturity of the technology for MSW.<br><br>A potential policy approach would be to identify the County’s intention to procure a technology when it has demonstrated a reasonable track record, as defined by X years of commercial-scale implementation in North America. | Since the technology is not well established at a commercial scale for processing of MSW in the United States, there is a risk that the technology could have difficulties, causing interruption of service, or even general failure.<br><br>A high-capital costs facility would entail financial uncertainties and risks for the vendors and, depending on the financing arrangements, possibly for the County.<br><br>East Hawaii’s waste stream may be too small to interest vendors – some vendors have a minimum plant size. | <b>58%</b><br><br>Estimated amount of residual wastes: 78 tons per day if output is not suitable to use as aggregate.<br><br>Different vendor thermal gasification technologies process somewhat different waste streams, but generally they process the organic fraction as does mass burn and will have similar reduction effectiveness.<br><br>Some technologies claim to produce an inert residue that is vitrified and safe for use as aggregate.<br><br>Thermal gasification facilities can exceed the reduction effectiveness of non-thermal organic processing due to the processing of plastics, wood, and other materials that may be unacceptable in composting. |

**EVALUATION MATRICES ON TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| MANAGEMENT ALTERNATIVE   | Capital Costs   | Operating Costs (Annual)        | Cost Per Ton  | Siting, Design, Permitting and Construction Requirements  | Ownership/Operation Responsibilities  |
|--|---|---------------------------------|---------------|---|---|
| <b>Anaerobic Digestion</b>   | <b>\$9M</b><br>or \$135 per annual ton of capacity.<br><br>Capital costs are 1.2 – 1.5 higher than for aerobic composting. However, net cost per ton is comparable to aerobic composting due to energy revenue.<br><br>One source cites \$260 - \$280 per one-ton per year capacity, but said to be rapidly dropping. | <b>\$3M</b><br>or \$45 per ton. | <b>\$59</b>   | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include:<br><ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include:<br><ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> </ul> Since these are proprietary and only-recently implemented technologies (for MSW), County operation does not seem feasible. |
| <i>Case Example: CCI organic waste processing facility Newmarket, Ontario</i>    | \$18 - \$20M for 150,000 tpy facility<br>\$133 per annaul-ton of capacity   | \$16 - \$20/ton                 | \$37          |   |   |
| <i>Case Example: Pinnacle Biotechnology, based on Stanton, CA pilot facility</i> | \$8 - \$9M for 73,000 tpy facility<br>\$110 - \$125 per annual-ton of capacity.   | Not available                   | Not available |   |   |

| MANAGEMENT ALTERNATIVE     | Environmental & Social Impacts  | Implementation Roles and Considerations   | Risks   | Effectiveness of Reduction of East Hawaii Waste Stream  |
|----------------------------|---|---|---|---|
| <b>Anaerobic Digestion</b> | Reduces greenhouse gas emissions over landfilling, composting, or incineration. Controls toxic and NOX emissions. Methane can be used as an energy source.<br><br>Potential environmental impacts include:<br><ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Public safety</li> <li>• Noise</li> <li>• Traffic</li> </ul> | May also incorporate sewage sludge and/or agricultural residue.<br><br>A critical factor is the developing maturity of the technology for MSW.<br><br>A potential policy approach would be to identify the County's intention to procure a technology when it has demonstrated a reasonable track record, as defined by X years of commercial-scale implementation in North America | Since the technology is not well established at a commercial scale for processing of MSW in the United States, there is a risk that the technology could have difficulties, causing interruption of service, or even general failure.<br><br>An anaerobic digestion facility on Oahu was shut down due to neighbor complaints and land use permit problems. | <b>52%</b><br><br>Estimated amount of residual wastes: 88 tons per day.<br><br>The organic portion of the east Hawaii waste stream could be processed, consequently approximately 54 percent of the waste stream could be diverted in an ideal configuration, though some of that material such as recyclable paper, may be diverted to recycling.<br><br>Much of the inorganic material must be removed from the incoming stream either through a dirty MRF or through an organics-only collection system. The later approach does not appear feasible in Hawaii due to the transfer station system. |

**EVALUATION MATRICES ON TECHNOLOGIES FOR REDUCTION OF THE EAST HAWAII WASTE STREAM**

**D R A F T  
FOR DISCUSSION**

| MANAGEMENT ALTERNATIVE  | Capital Costs  | Operating Costs (Annual)                             | Cost Per Ton  | Siting, Design, Permitting and Construction Requirements  | Ownership/Operation Responsibilities  |
|---|--|--|---|---|---|
| <b>Biorefining</b>  | Not available  | Not available  | All tipping fees are very project specific, including consideration of scale, land costs, labor rates, specific feedstock received, financing methods, etc. | A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.<br><br>Permit requirements may include:<br><ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use review</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> | Options include: <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> </ul> <p>Since these are proprietary and only-recently implemented technologies (for MSW), County operation does not seem feasible.</p> |
| <i>Case Example: Masada Resource Group integrated biorefining and recycling facility in Middletown, NY.<sup>3</sup></i> | \$150M for 230,000 tpy capacity.<br><br>\$650 per annual-ton capacity. | Unknown --<br>However, plant will employ 200 workers | \$65 per ton tip fee will be paid by participating municipalities to the City of Middleton.   |   |   |
| <i>Case Example: Arkenol, Inc.<sup>4</sup></i>  | \$76M for 260,000 tpy capacity<br><br>\$292 per annual-ton capacity.   | \$11.7M for 260,000 tpy<br><br>\$45 per ton          | \$30/ton tip fee.<br><br>(Assumes selling price of \$1.62 per gallon for ethanol)   |   |   |

| MANAGEMENT ALTERNATIVE | Environmental & Social Impacts  | Implementation Roles and Considerations  | Risks   | Effectiveness of Reduction of East Hawaii Waste Stream   |
|------------------------|---|--|---|--|
| <b>Biorefining</b>     | Reduces greenhouse gas emissions over landfilling, open composting, or incineration. Controls toxic and NOX emissions in comparison to landfilling or open composting. Ethanol can be used as a fuel or as an anti-knock additive to gasoline to replace lead and MTBE.<br><br>Potential environmental impacts include: <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Traffic</li> <li>• Public safety</li> </ul> | May also incorporate sewage sludge and/or agriculture residue.<br><br>A critical factor is the developing maturity of the technology for MSW. A potential policy approach would be to identify the County’s intention to procure a technology when it has demonstrated a reasonable track record, as defined by X years of commercial-scale implementation in North America. | Since the technology is not well established at a commercial scale for processing of MSW in the United States, there is a risk that the technology could have difficulties, causing interruption of service, or even general failure.<br><br>To be feasible the facility would need to find sources of required chemicals in Hawaii and markets for products. | <b>52%</b><br><br>Estimated amount of residual wastes: 88 tons per day.<br><br>The organic portion of the east Hawaii waste stream could be processed; consequently approximately 54 percent of the waste stream could be diverted in an ideal configuration, though some of that material, such as recyclable paper, may be diverted to recycling.<br><br>Much of the inorganic material must be removed from the incoming stream either through a dirty MRF or through an organics-only collection system. The later approach does not appear feasible in HI due to the transfer station system. |

**EVALUATION MATRICES ON  
LANDFILL DISPOSAL ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b>                                    | <b>Capital Costs</b>  | <b>Operating Costs (Annual)</b>  | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>   | <b>Ownership/Operation Responsibilities</b>   |
|--|---|--|---------------------|---|---|
| <b>East Hawaii Transfer Station and Long-Haul to Pu'uanahulu</b> | <b>\$2M</b><br>or \$30 per annual ton of capacity for minimal modifications of Hilo Transfer Station and purchase of long haul equipment. | <b>\$4M</b><br>or \$63 per ton including tipping fees at Pu'uanahulu Landfill. | <b>\$73</b>         | Probably could use existing Hilo Transfer Station with minor improvements and alterations.<br><br>Permit requirements include:<br><ul style="list-style-type: none"> <li>• Amendment of Solid waste facility permit</li> <li>• Local building and construction permits</li> </ul> | Options include:<br><ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> County ownership and operation would be consistent with current county operations. |

| <b>MANAGEMENT ALTERNATIVE</b>                                    | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>   | <b>Risks</b>  | <b>Impacts on Residents and Local Businesses</b>   |
|--|---|--|---|--|
| <b>East Hawaii Transfer Station and Long-Haul to Pu'uanahulu</b> | <p>Increased cross-island traffic with associated increase in vehicle emissions. When the Saddle Road is improved, transfer of wastes may be more economical and more acceptable to the public.</p> <p>Increased resentment of West Hawaii residents to disposal of east Hawaii waste in West Hawaii.</p> <p>State government and EPA prefer source reduction, recycling, and bioconversion to landfilling.</p> <p>Produces greenhouse gas emissions, including methane and NOX.</p> <p>Other potential environmental impacts include:</p> <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Noise</li> <li>• Public safety</li> </ul> | Implementation will require major public relations initiatives to mobilize public support or else risk public rejection. | Public opposition may interfere with implementation or operation. | <p>Much longer hauling distance for commercial haulers and self-haulers.</p> <p>Increased resentment of West Hawaii residents to disposal of east Hawaii waste in West Hawaii.</p> |

**EVALUATION MATRICES ON  
LANDFILL DISPOSAL ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b>   | <b>Capital Costs</b>   | <b>Operating Costs (Annual)</b> | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>  | <b>Ownership/Operation Responsibilities</b>  |
|---------------------------------|--|---------------------------------|---------------------|--|--|
| <b>New East Hawaii Landfill</b> | <b>\$32M</b><br>or \$480 per annual ton of capacity, including closure and post-closure costs. | <b>\$6M</b><br>or \$88 per ton. | <b>\$128</b>        | <p>A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.</p> <p>At least 50 acres would be required.</p> <p>Permit requirements include:</p> <ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> <p>Implementation would take at least 5 years, and with strong public opposition, it could take considerably longer.</p> | <p>Options include:</p> <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> <p>Both options 1 and 3 above would be consistent with current county operations.</p> |

| <b>MANAGEMENT ALTERNATIVE</b>   | <b>Environmental &amp; Social Impacts</b>  | <b>Implementation Roles and Considerations</b>  | <b>Risks</b>  | <b>Impacts on Residents and Local Businesses</b>   |
|---------------------------------|--|---|---|--|
| <b>New East Hawaii Landfill</b> | <p>State government and EPA prefer source reduction, recycling, and bioconversion to landfilling.</p> <p>Produces greenhouse gas emissions, including methane and NOX.</p> <p>Potential environmental impacts include:</p> <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Public safety</li> <li>• Noise</li> <li>• Traffic</li> </ul> | <p>Implementation will require major public relations initiatives to mobilize public support or else risk public rejection.</p> | <p>Public opposition could derail implementation of a new landfill or interrupt operation.</p> <p>Landfills have an inherent risk of releases of leachate, which if detected in the underlying groundwater could trigger a requirement for corrective action.</p> | <p>Neighbors of a proposed landfill site can be expected to strenuously oppose such a project.</p> |

**EVALUATION MATRICES ON  
LANDFILL DISPOSAL ALTERNATIVES**

**D R A F T  
FOR DISCUSSION**

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Capital Costs</b>   | <b>Operating Costs (Annual)</b> | <b>Cost Per Ton</b> | <b>Siting, Design, Permitting and Construction Requirements</b>  | <b>Ownership/Operation Responsibilities</b>  |
|-------------------------------|--|---------------------------------|---------------------|--|--|
| <b>Bioreactor Landfill</b>    | <b>\$25M</b><br>or \$375 per annual ton of capacity, including closure and post-closure costs. | <b>\$5M</b><br>or \$75 per ton. | <b>\$110</b>        | <p>A comprehensive siting study to identify a preferred location could be conducted by either County or vendor.</p> <p>At least 50 acres would be required.</p> <p>Permit requirements may include:</p> <ul style="list-style-type: none"> <li>• Solid waste facility permit</li> <li>• Local building and construction permits</li> <li>• Land use permit and/or conditional use permit</li> <li>• Regional air quality permits</li> <li>• Fire, health and business permits and licenses</li> </ul> <p>Mixed organic processing, including food waste, require high level environmental and odor controls.</p> | <p>Options include:</p> <ul style="list-style-type: none"> <li>• County owned and private contract operated</li> <li>• Private owned and operated</li> <li>• County owned and operated.</li> </ul> |

| <b>MANAGEMENT ALTERNATIVE</b> | <b>Environmental &amp; Social Impacts</b>   | <b>Implementation Roles and Considerations</b>   | <b>Risks</b>  | <b>Impacts on Residents and Local Businesses</b>   |
|-------------------------------|---|--|---|--|
| <b>Bioreactor Landfill</b>    | <p>State government and EPA prefer source reduction, recycling, and bioconversion to landfilling.</p> <p>Produces greenhouse gas emissions, including methane and NOX. However, methane is usually captured and can used as fuel.</p> <p>Potential environmental impacts include:</p> <ul style="list-style-type: none"> <li>• Water and air quality and odors</li> <li>• Biological and cultural resources</li> <li>• Public safety</li> <li>• Noise</li> <li>• Traffic</li> </ul> | <p>The Hawaii Department of Health would have to agree to special relaxation of landfill regulations to allow construction and operation of a bioreactor landfill.</p> | <p>Since the technology is not well established at a commercial scale for processing of MSW, there is a risk that the technology may not perform as expected, causing interruption of service, or even general failure.</p> <p>Gas collection and sale may not be practical because of poor economies of scale and lack of user infrastructure.</p> | <p>Neighbors of a proposed landfill site can be expected to strenuously oppose such a project.</p> |