

Alternative Uses for Woody Biomass Feedstock in Humboldt County, California



Presented by:

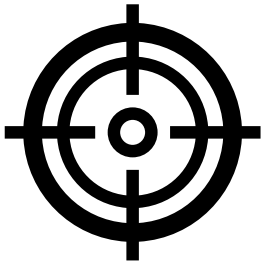
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ENGR 492, Spring 2020



(RCEA 2020)

AGENDA



Project
Objective



Project
Criteria



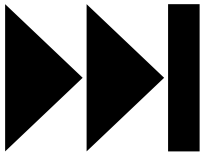
Alternatives
Analysis



Decision
Matrix



Preferred
Alternative



Next
Steps

OBJECTIVE AND SCOPE

PROJECT OBJECTIVE

Investigate alternative uses for woody biomass in Humboldt County and make recommendations for uses that best meet the interest of the community and RCEA

PROJECT SCOPE

Explore multiple uses for woody biomass without the requirement of offsetting the power currently being generated by the Fairhaven and Scotia plants

Criteria	Description	Method of Comparison	Weight
Environmental			
Particulate Matter	PM10, PM2.5	The alternative with the lowest mass of pollutant will be rated highest.	4
Greenhouse Gas Emissions	CO ₂ , CH ₄ , N ₂ O	The alternative with the lowest net GHGs will receive the highest score.	4
Required Footprint	Area required to make the project feasible	The alternative with the lowest required area will be rated the highest.	2
Economic			
Payback Period	Length of time for the project to recover the initial investment	The alternative with the shortest payback period will receive the highest score.	5
Local Job Production	Amount of Humboldt County jobs that will be sustained as a result of this project	The alternative with the highest amount of projected jobs in Humboldt County will receive the highest score.	5
Social			
Public Concerns	How the alternative might be viewed by the public	The alternative with the best public perception as obtained through public opinion surveys will be given the highest score.	7
Technical Complexity for Operation	The amount of technical training required to operate the alternative.	The alternative with the lowest employee certification time will receive the highest score.	3

MODULAR GASIFICATION

Projected Power Production = 20 MW¹

Projected GHG Emissions	3.2×10 ⁵ MT CO ₂ e/year
Projected Total Project Area	33 acres
Sustained Local Job Production	97
Operator Certification Time	0.25 years
Projected Favorability	46%
Payback Period	5.2

¹Based off case studies performed by CEC (2020)



WOODCHIP BIOREACTORS



Projected PM Rate	N/A
Projected GHG Emissions	0.04 MT CO ₂ e/year
Projected Total Project Area	5 acres
Sustained Local Job Production	10 to 20
Operator Training Period	2 years
Projected Favorability	54 %
Payback Period	0.3 years

BIOPLASTICS

Projected GHG Emissions	4.2 × 10 ⁵ MT CO ₂ e/year
Projected Total Project Area	1-2 acres
Sustained Local Job Production	40-60
Operator Certification Time	0.25 years
Projected Favorability	68 %
Payback Period	7.3



COMPOSTING

Projected PM Rate	~0 tons/year
Projected GHG Emissions	0.06 MTCO ₂ e/ton biomass
Projected Total Project Area	504 acres
Sustained Local Job Production	405
Operator Certification Time	0.01 years
Projected Favorability	77 %
Payback Period	3.7 years



(Farming and More 2020)

DECISION MATRIX

Score	1	2	3	4	5
Qualitative Rating	Very Poor	Poor	Average	Good	Very Good
Particulate Matter	> 50 tons/yr	40 to 50 tons/yr	10 to 40 tons/yr	Up to 10 tons/yr	Zero Emissions
GHG Emissions	>0.1 CO ₂ eq	0.01 to 0.1 CO ₂ eq	Up to 0.01 CO ₂ eq	Zero Emissions	Sequesters Emissions
Required Footprint	> 60 acres	40< acres <60	20< acres <40	1< acres <20	< 1 acre
Payback Period	15 + yrs	10 < yrs <15	5 < yrs < 10	1 < yrs < 5	< 1 yr
Job Production	0 to 1 Job	1 < Jobs < 40	40< Jobs < 60	60< Jobs<100	100 + Jobs
Public Opinion	0 to 20 % Approval	20 to 40% Approval	40 to 60% Approval	60-80% Approval	80-100% Approval
Required Training	8 + yrs	5 to 7 yrs	2 to 4 yrs	1 yr	< 1 yr

Criteria	Weight		Alternatives			
	(0 to 10)	Normalize	Bioplastics	Composting	Gasification	W.C. Bioreactor
Particulate Matter	4	0.93	5 20	5 20	3 12	5 20
Greenhouse Gases	4	0.93	2 8	2 8	1 4	2 8
Required Footprint	2	0.47	5 10	1 2	3 6	4 8
Payback Period	5	1.17	3 15	3 15	3 15	5 25
Job Production	5	1.17	3 15	5 25	4 20	2 10
Public Opinion	7	1.63	4 28	4 28	3 21	3 21
Required Training	3	0.70	5 15	5 15	5 15	3 9
Total:			111	125	93	101

COMPOSTING

Biomass (tons/week)	10,800
Food waste (tons/week)	16,800
Combined moisture	62%
Combined C:N	40
Combined density (kg/m³)	272

COMPOSTING – FUNCTIONS AND OPERATIONS

- Windrow Composting Facilities
 - Active Compost Design: 40 m × 3.4 m × 7.6 m
 - 2 m between piles for equipment passage
- Total land use of 504 acres divided among 4 major facilities



(Biocycle 2014)

COMPOSTING – FUNCTIONS AND OPERATIONS

Required Equipment for Each Facility:

- Windrow Pile Turners (2)
- Feedstock Grinder (1)
- Stacking Conveyor (1)
- Front End Loaders (1)
- Bulldozer (1)
- SCADA Temperature Monitoring System (1)



(Harrington 2020)

COMPOSTING – TARGET MARKET & DISTRIBUTION

- Soil amendment market valued at about 3.7 Billion USD in 2020
- Estimated to grow at about 10% per year.
- Driven by soil degradation in US agricultural areas.
- 1.7 Billion tons of farmland per year need to be replaced/amended
- High demand for soil in CA & outside Humboldt County.

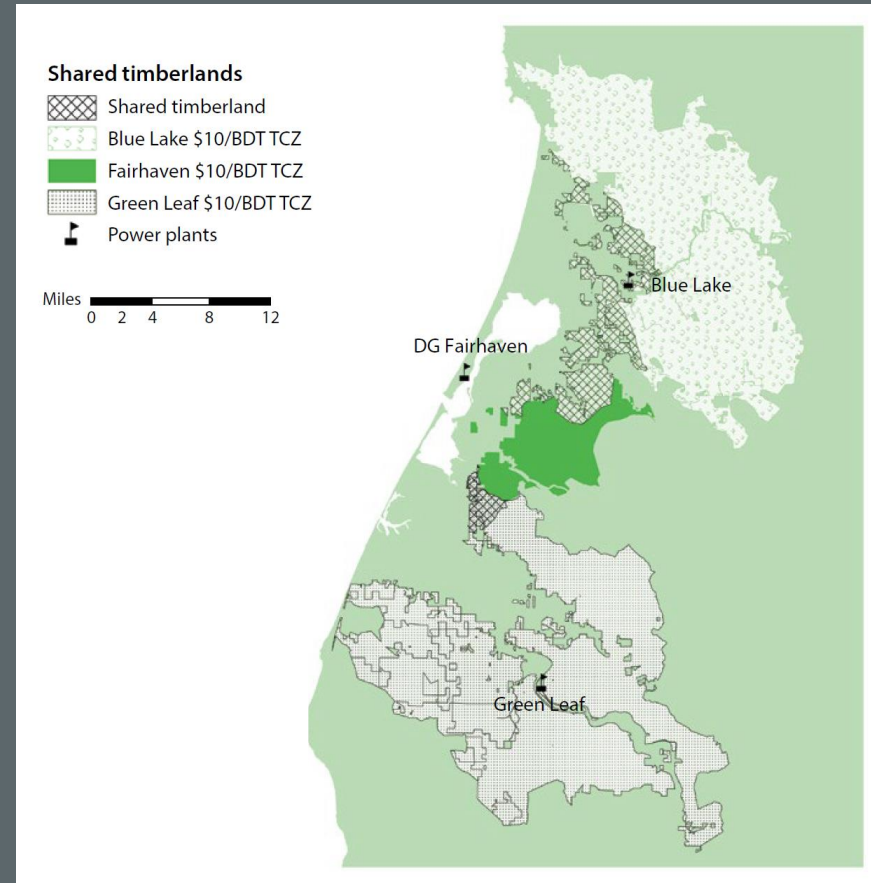
COMPOSTING – LOCATION AND SCALE

Humboldt County Sawmill Companies

Korbell Sawmill
Britt Lumber
Mad River Lumber
Sierra Pacific Industries
Schmidbauer Lumber
CW Wood Products
Redwood Lumber Company

City within Humboldt County

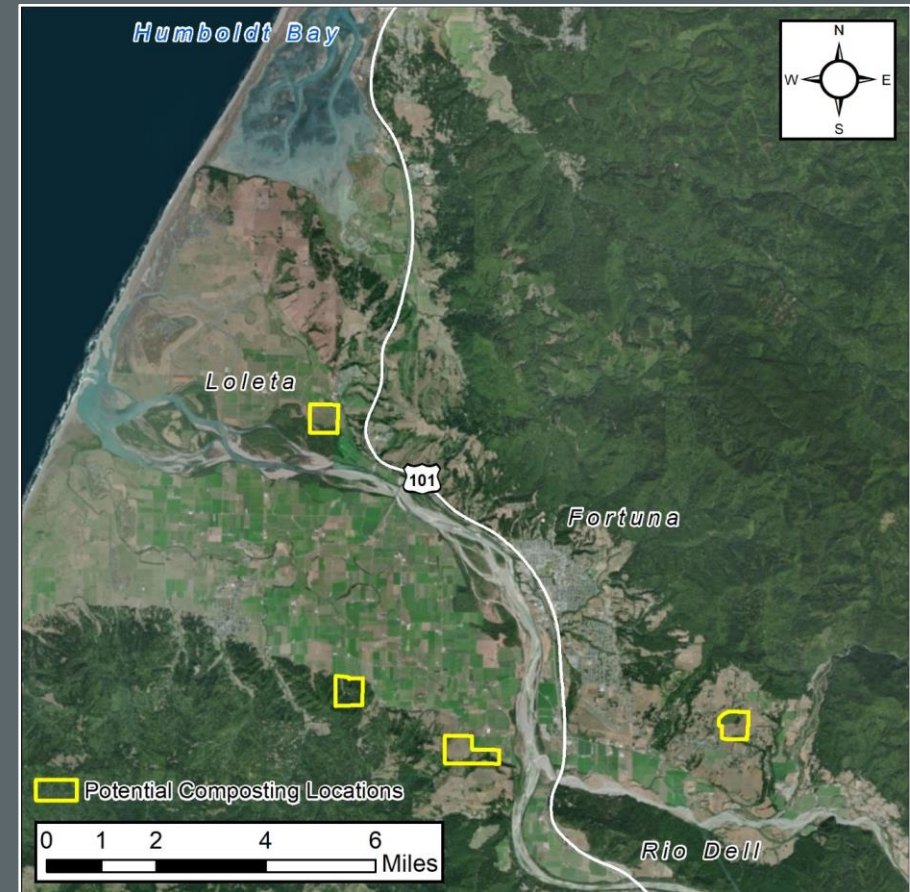
Korbell
Arcata
Arcata
Weaverville
Eureka
Fortuna
Scotia



COMPOSTING – LOCATION AND SCALE

Humboldt County APN	Area (acres)
106-081-002	161
106-111-008	240
204-391-004	153
309-251-002	168

Total Available Area: 722 acres



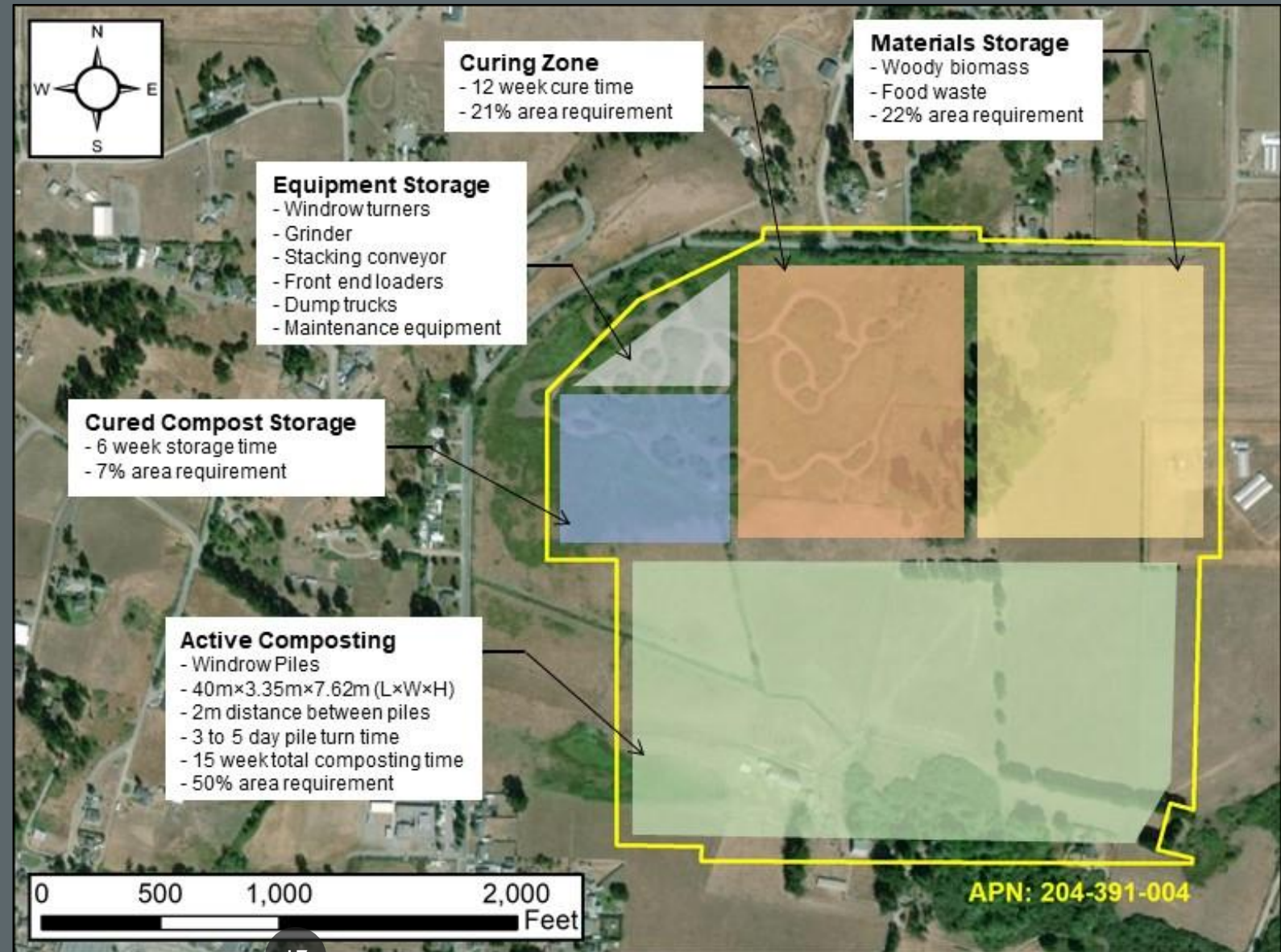
COMPOSTING – EMISSIONS AND CRITERIA POLLUTANTS

PM2.5	PM10	CO	NOx	SOx	VOC
4.4	9.0	---	---	---	47.6

Source	Emissions (MTCO2e/year)
DG Fairhaven biomass power plant ^I	-177,000
HSC Scotia biomass power plant ^I	-258,000
Landfill (food waste)	-474,000
Composting ^{II}	17,000
Carbon Sequestration ^{II}	~0
Transportation of feedstock to compost facility	4,000
TOTAL	-887,000

^IEmission values from the California Air Resources Board (CARB 2017)

CONCEPTUAL SITE MODEL

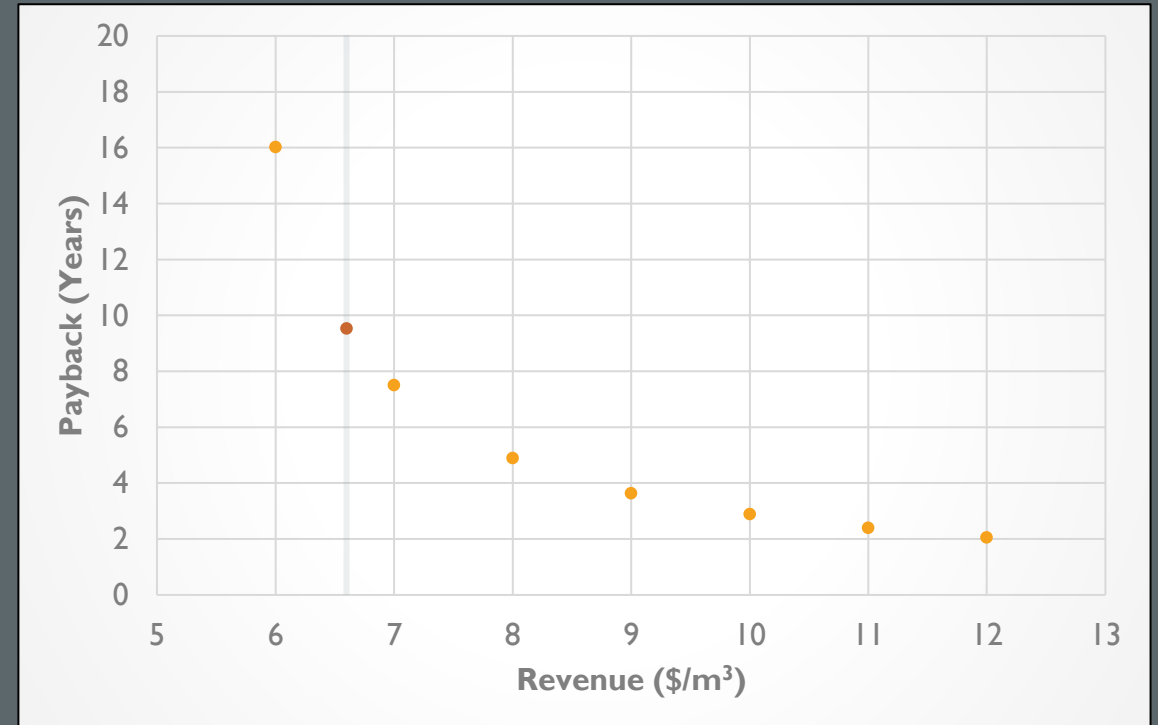
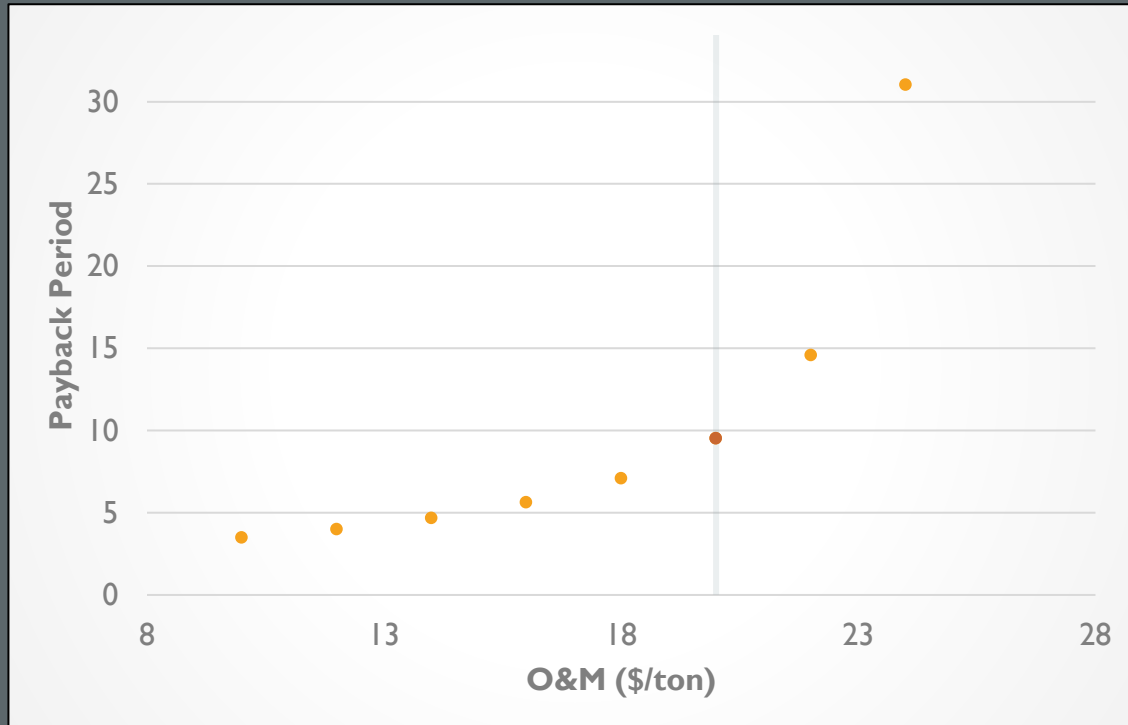


COMPOSTING – CAPITAL AND OPERATING COSTS

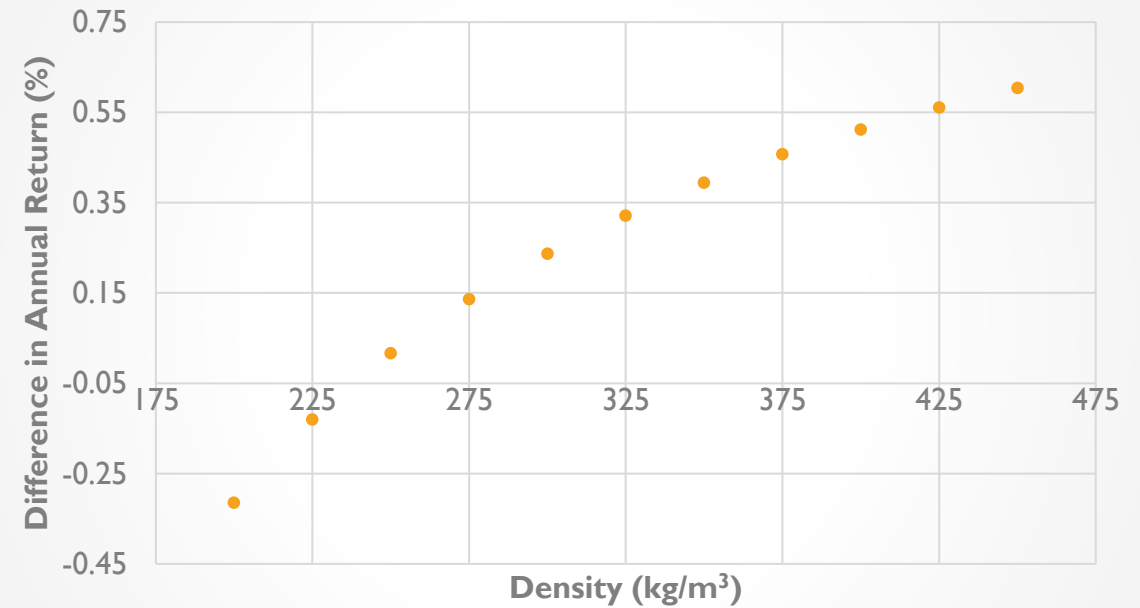
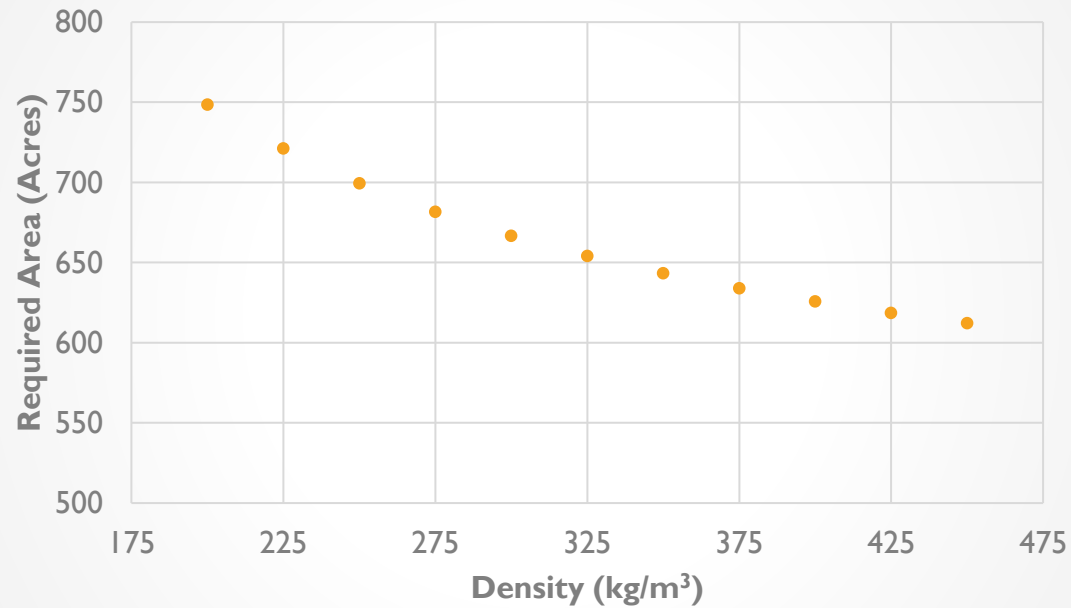
Purchase Item	Price (\$)	Unit	Quantity	Equipment Cost (\$)
Initial Land Payment	1,168,774	LS	1	1,168,774
Windrow Turner	125,000	EA	8	1,000,000
Grinder	100,000	EA	4	400,000
Stacking Conveyor	40,000	EA	4	160,000
Front-End Loader	75,000	EA	8	600,000
Bulldozer	50,000	EA	4	200,000
SCADA System	10,000	EA	4	40,000
TOTAL CAPITAL COST (\$)				3,568,774

O/M Item	Price	Quantity	O/M Cost (\$/year)
Land Payment	1,168,774 per year	1	1,168,774
Woody Biomass Residues	10 per BDT	248,000	2,480,000
Employees	30,000 per year	405	12,150,000
Equipment Maintenance	10% of Equipment Capital		240,000
TOTAL O/M COST (\$)			16,015,030

COMPOSTING – PROFIT & PAYBACK SENSITIVITY



COMPOSTING – SPECIFICATION SENSITIVITY



CONCLUSIONS AND NEXT STEPS

- ✓ Land allocation: Secure Southern Humboldt locations for composting sites
- ✓ Prepare a report of waste discharge for CA State Water Resources Control Board
- ✓ Locate largest municipal and industrial demands for food waste diversion
- ✓ Provide a competitive disposal cost to any non-local waste generators

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QUESTIONS?