

FEASIBILITY ASSESSMENT FOR A COMMERCIAL SCALE BIOMASS CONVERSION FACILITY IN CENTRAL ARIZONA



UVRWPC Board
Meeting

Oct 24, 2018

Tad Mason, CEO
TSS Consultants



PRESENTATION OVERVIEW

- Overview of Assessment Objectives
- Target Site Review
- Feedstock Supply Chain Analysis
- Conversion Technology Review
- Economic Analysis
- Observations
- Recommendations
- Questions



TARGET SITE REVIEW

SITE ATTRIBUTES

- 10 sites reviewed. Total of nine siting attributes considered:
 - Current land use zoning.
 - Environmental permitting ease.
 - Space and property availability.
 - Community support.
 - Transportation systems adjacent to site (e.g., rail, highways, forest roads).
 - Proximity to forest/range biomass feedstock.
 - Proximity to watersheds at risk.
 - Water availability.
 - Electrical power and natural gas availability.

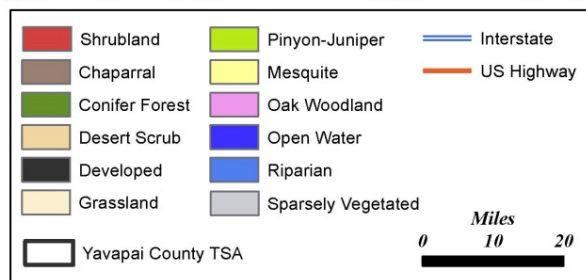
TARGET SITES RANKED

Site	Score	Ranking
Drake Cement	25	1
Big Sky Industrial Park	24	2
Eastridge Property	23	3
Grapevine Industrial Park	22	4
Yavapai-Prescott Indian Reservation	22	4
Adjacent to Ruger Factory	21	5
Sundog Transfer	21	5
Old Santa Fe Lumber	20	6
Southwest Forest Products	18	7
Wishing Well	15	8

FEEDSTOCK SUPPLY CHAIN ANALYSIS

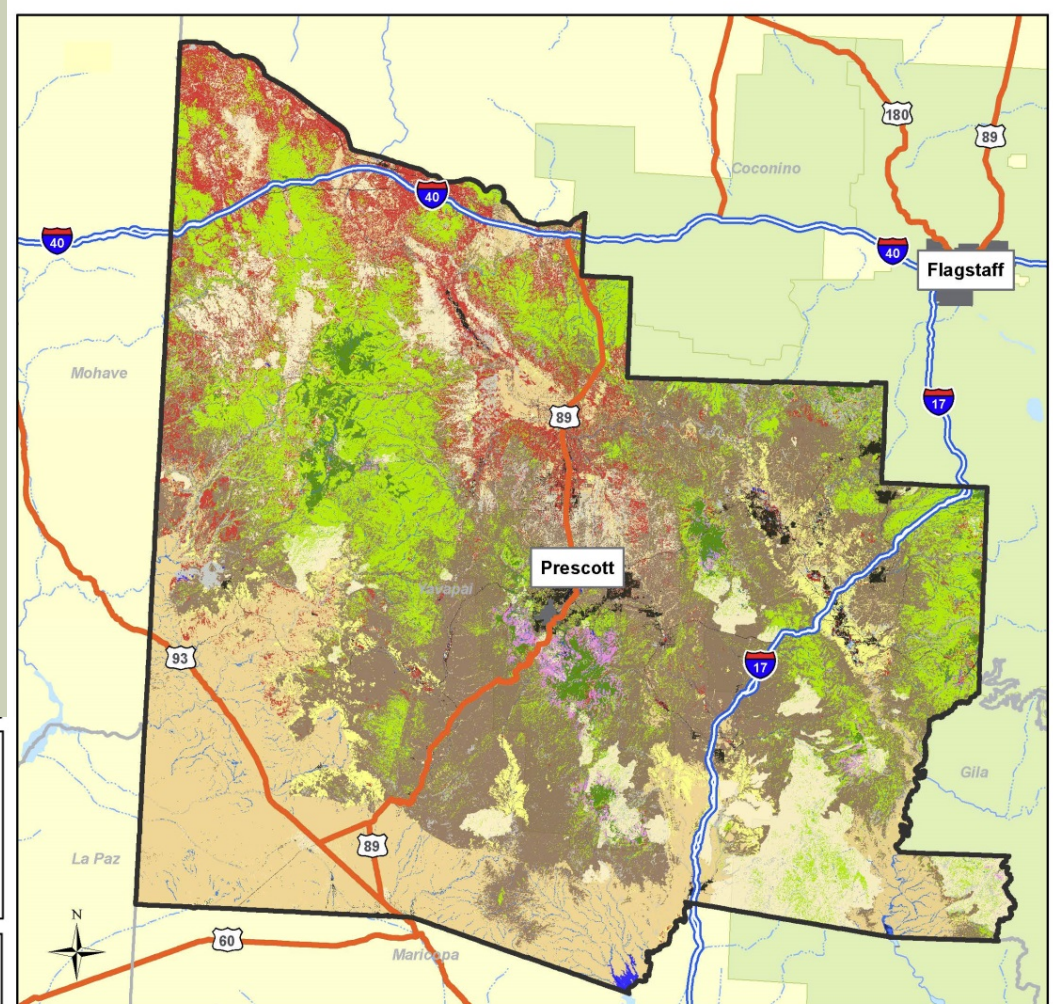
VEGETATION COVER MAP

- Vegetation cover types include: tree-covered - conifer forest, pinyon-juniper grassland, juniper woodland, oak woodland; shrub-covered - shrubland, chaparral, mesquite, desert scrub; and grass-covered - native grasslands and grassland-steppe
- Pinyon-Juniper grasslands lie mostly in the northern and eastern portions of the county.

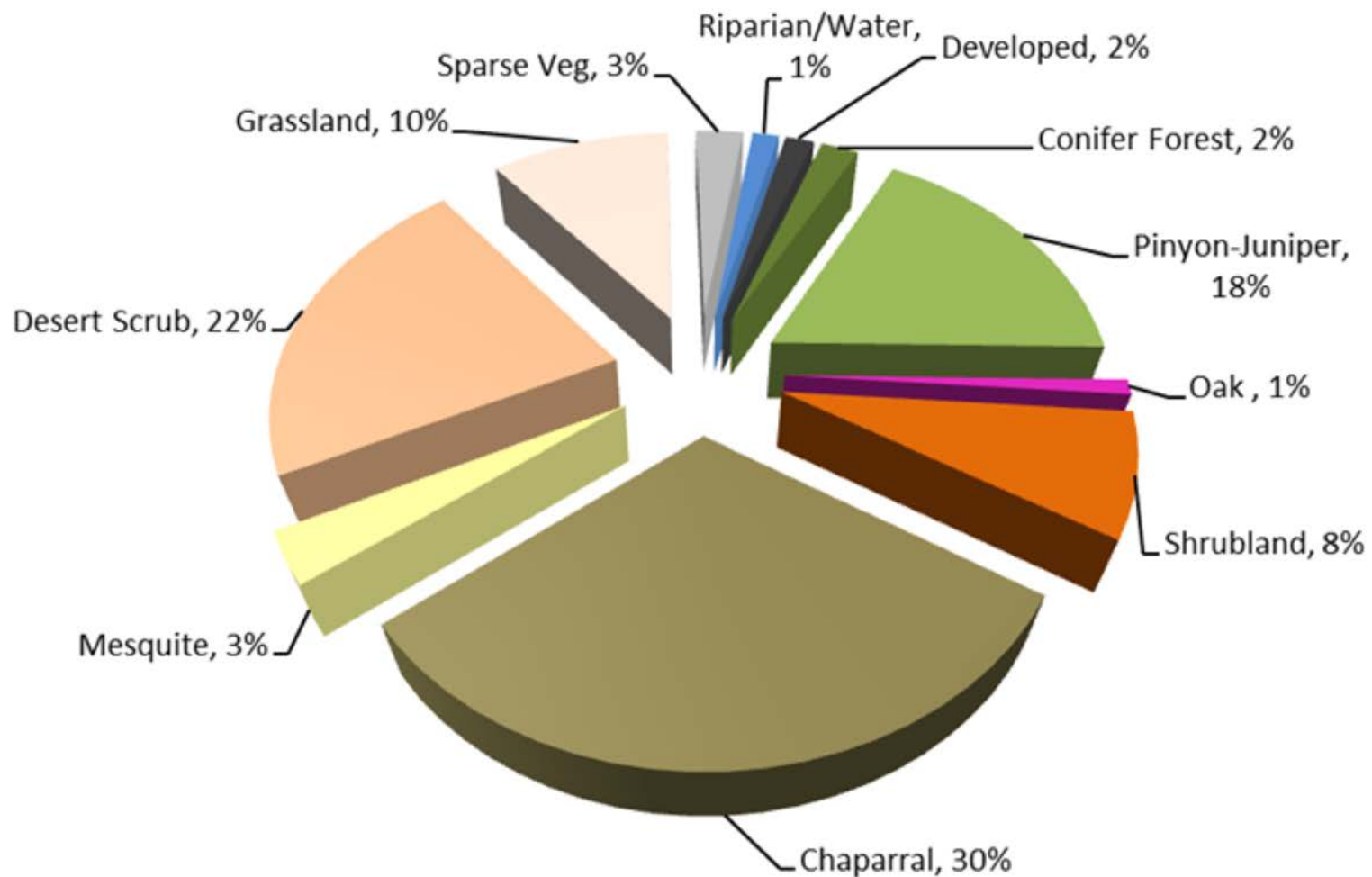


*UVRWPC
Biomass Supply Analysis
Target Study Area*

*VEGETATION
USGS Landfire Data*

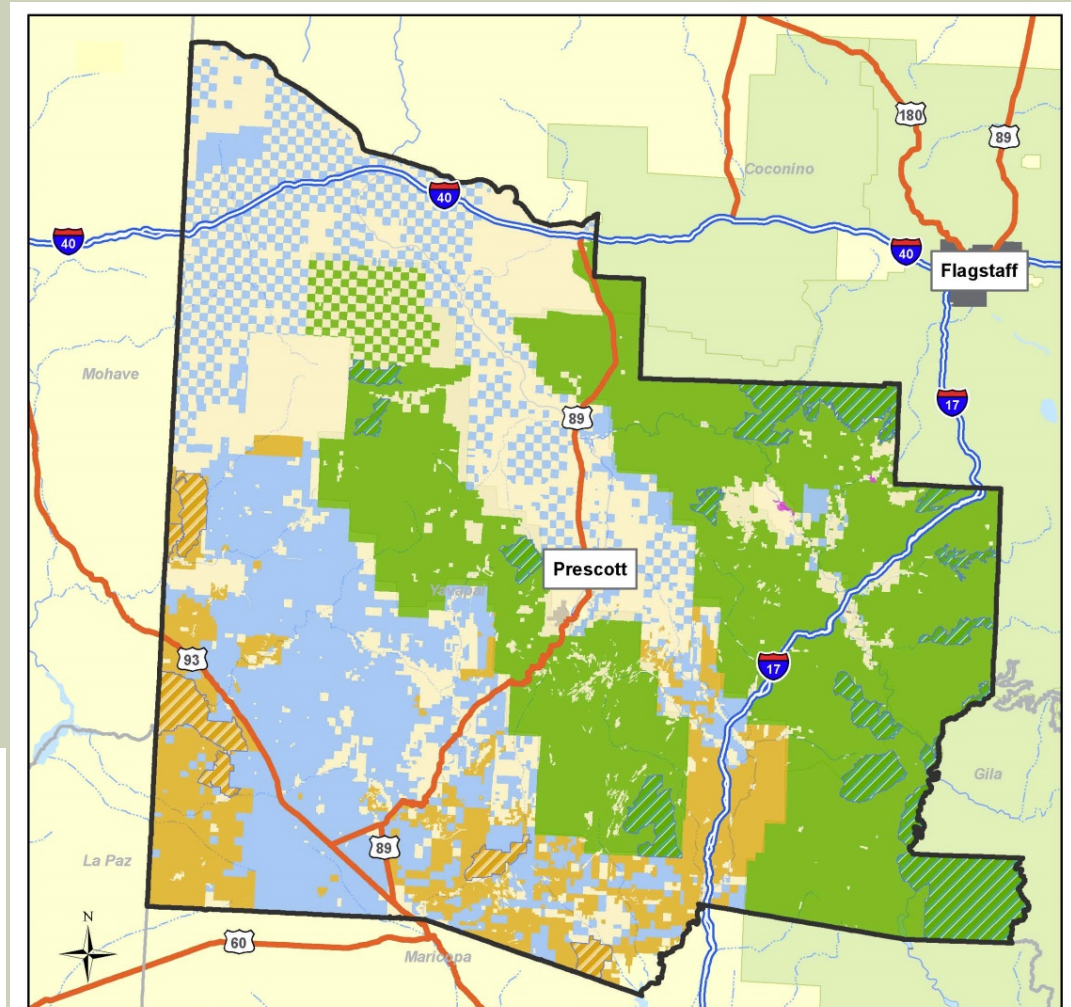
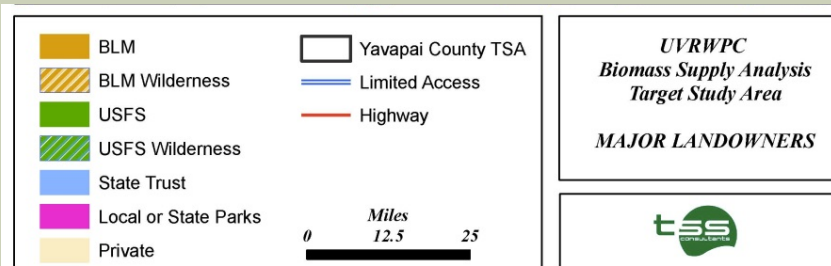


VEGETATION COVER FINDINGS



LANDOWNERSHIP MAP

- Major Landowners are the USFS, BLM, Arizona State Trust Lands and Private
- In the TSA landownership is dominated by federal and state managed public lands



VEGETATION BY LANDOWNER

- Land ownership of vegetation types with biomass potential - pinyon-juniper grasslands and conifer forest

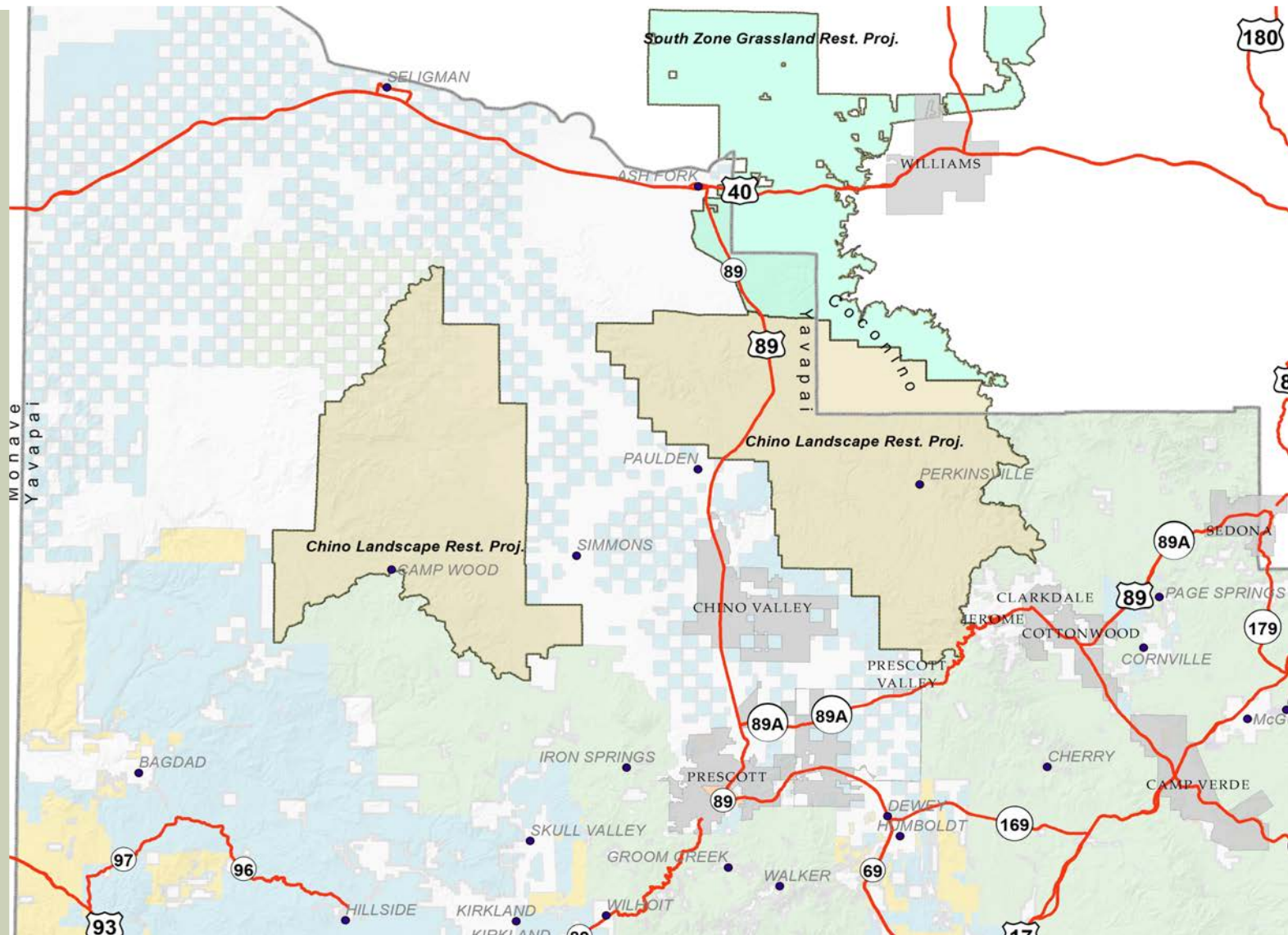
Ownership	Pinyon-Juniper Woodlands		Conifer Forest	
	Acres	%	Acres	%
BLM	14,984	1.6%	11	<0.1
USFS	546,247	56.8%	85,094	76.4%
Private	247,848	25.8%	24,256	21.8%
State Trust	148,299	15.4%	1,780	1.6%
Totals	957,377	99.5%	111,142	99.9%

* PERCENT calculation:

Using the total vegetation type acres in the TSA, what percent is found in specified ownership class.

FEEDSTOCK SUPPLY CHAIN ANALYSIS

KEY LANDOWNERSHIPS



FEEDSTOCK SUPPLY CHAIN ANALYSIS

KEY FINDINGS

■ PJ Processing and Transport Contractors

- None currently operating in TSA. However, local contractors are willing to purchase necessary equipment if PJ biomass market existed. Sustainable volume between 25,000 and 100,000 BDT/year could be available (primarily biomass residuals from PJ grassland restoration activities).

■ Land Ownership

- Private lands are the most significant opportunity. Many large ranches are currently restoring PJ grasslands. Much of the State Trust lands are interspersed with private lands and should be treated in conjunction with private lands and current grazing leases.

■ Feedstock Pricing

- Some cost share available for PJ grassland restoration. But funding can be inconsistent and over subscribed.

■ Feedstock Cost Forecast

- PJ Restoration Material: \$55 to \$75/BDT
- Timber Harvest Residuals: \$45 to \$50/BDT

■ Stewardship Contracts

- No plans for the USFS to implement stew contracts in the TSA.

■ Feedstock Purchase Agreements

- Opportunity for multiple year contracts is with private landowners.

VALUE-ADDED CONVERSION REVIEW

■ Six technologies reviewed:

- Industrial-grade fuel pellets
- Torrefied fuels
- Bio-coal (Enginuity Process)
- Biochar and activated carbon
- Fuel bricks
- Storm water wattles with wood chips and w/o biochar (selected)

■ Eight assessment criteria were considered:

- Commercial Availability
- Feedstock Requirements
- Job Creation
- Market Potential
- Water Supply and Wastewater Disposal
- Noise
- Relative Air Emissions
- Commercial Production

WATTLES DEPLOYED FOR SLOPE STABILIZATION



ECONOMIC ANALYSIS WOOD CHIP WATTLE PRODUCTION

■ Wood Chip Wattle Production Economic Analysis Findings:

System Components	25,000 BDT/Yr Capacity	100,000 BDT/Yr Capacity
Conversion System	\$4,750,000	\$10,500,000
Building	\$1,500,000	\$6,000,000
Feedstock Storage & Processing	\$250,000	\$500,000
Construction/Installation	\$1,000,000	\$3,000,000
Totals	\$7,500,000	\$20,000,000

ECONOMIC ANALYSIS WOOD CHIP WATTLE MARKET PRICING

■ Wood Chip Wattle Market Pricing Findings:

25,000 BDT/Yr Production:

Wattle Market Price (\$/Ft)	Internal Rate of Return	Simple Payback Period (Yr)
\$2.51	0%	20
\$2.75	14.8%	6.1
\$3.00	26.5%	3.5
\$3.50	47.7%	1.9
\$4.00	67.9%	1.3

100,000 BDT/Yr Production:

Wattle Market Price (\$/Ft)	Internal Rate of Return	Simple Payback Period (Yr)
\$2.00	0	20
\$2.25	20.9%	4.4
\$2.50	37.3%	2.5
\$3.00	68.0%	1.3
\$3.50	97.7%	0.6

ECONOMIC ANALYSIS BIOCHAR PRODUCTION

■ Biochar Production Facility Economic Analysis Findings:

System Components	25,000 BDT/Yr Capacity	100,000 BDT/Yr Capacity
Conversion System	\$4,250,000	\$14,750,000
Building	\$1,500,000	\$2,000,000
Feedstock Storage & Processing	\$500,000	\$750,000
Construction/Installation	\$1,250,000	\$3,500,000
Totals	\$7,500,000	\$21,000,000

ECONOMIC ANALYSIS BIOCHAR MARKET PRICING

■ Biochar Market Pricing Findings:

25,000 BDT/Yr Production:

Biochar Market Price (\$/BDT)	Internal Rate of Return	Simple Payback Period (Yr)
\$708	0%	20
\$800	16.4%	5.5
\$1,000	42.8%	2.2
\$1,400	91.0%	1.0

100,000 BDT/Yr Production:

Biochar Market Price (\$/BDT)	Internal Rate of Return	Simple Payback Period (Yr)
\$527	0	20
\$600	18.0%	5.2
\$800	54.7%	1.7
\$1,000	89.0%	1.0

OBSERVATIONS

- Juniper and PJ veg covers 960,000 acres in Yavapai County. This amounts to just over 18% of the County. Producing 25,000 BDT (3,300 acres treated) to 100,000 (13,100 acres treated) per year is very sustainable.
 - Contractors expressed an interest in removal of juniper if a long-term market existed.
- Biochar as a commercial product represents an emerging market, one with varied market pricing models.
 - In AZ, target markets should be mine reclamation and commercial agriculture.
 - Activated carbon should also be considered as it is in high demand at waste water treatment facilities.
- Wood Chip Wattles as a commercial product will need to stress the advantages of wood chip wattles compared to straw wattles as straw wattles have an attractive market price of \$.70 - \$1.30/ft.
 - There will need to be compelling reasons for resource managers to procure wood chip wattles at \$3/ft.

RECOMMENDATIONS

- Both wood chip wattle and biochar markets are not well defined in AZ. There are potential opportunities for providing services to the mine reclamation market sector. The State Mine Inspector reports that over 10,000 mines within the state have been abandoned.
- Strongly recommend implementing proof of concept field trials (as currently funded by USFS Wood Innovation Grant) for deployment of wood chip wattles with and without biochar in several settings:
 - Mine reclamation
 - Wildfire rehabilitation
 - New road construction
- A critical first step in achieving long-term debt financing is securing long-term offtake agreements for the commodities produced. Should consider a comprehensive market study.
- Monitor bioenergy initiatives within the state:
 - APS and SRP Request for Proposals regarding new bioenergy projects.
 - Camp Navajo initiative to site a bioenergy facility at Bellemont.

QUESTIONS or COMMENTS?



Tad Mason, Forester

TSS Consultants

916.600.4174

tmason@tssconsultants.com

www.tssconsultants.com