Gila River Indian Community Renewable Energy Feasibility Study

Presented by:

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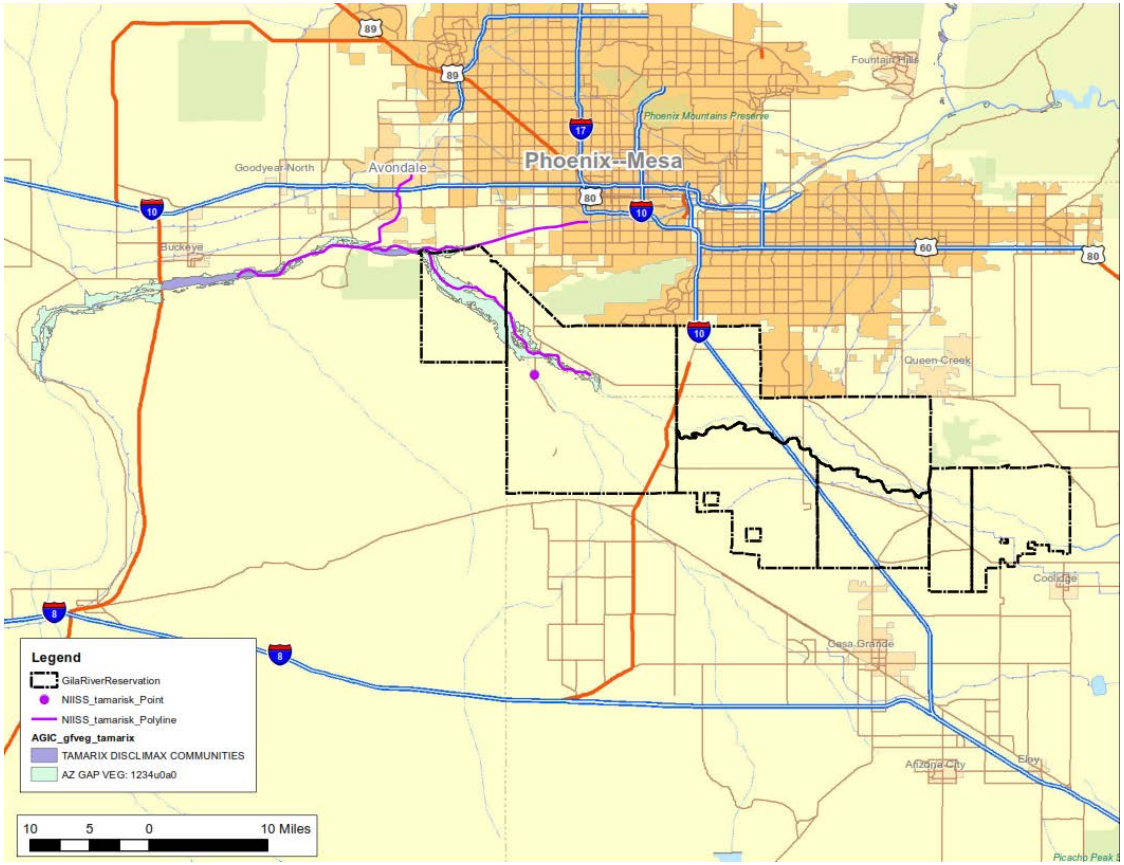
ANTARES Group Incorporated

Presentation Outline

- Summary of Gila River Indian Community
- Project overview
- Summary of feasibility study assessment
  - Solar projects
  - Biomass resource assessment
  - Biomass projects
- Project status and future plans

Gila River Indian Community



- Central Arizona; Maricopa & Pinal Counties
- Akimel O'odham & Pee Posh
- Reservation established 1859
- 374,000 acres
- 23,000 members (17,000 on GRIC)

Project Introduction

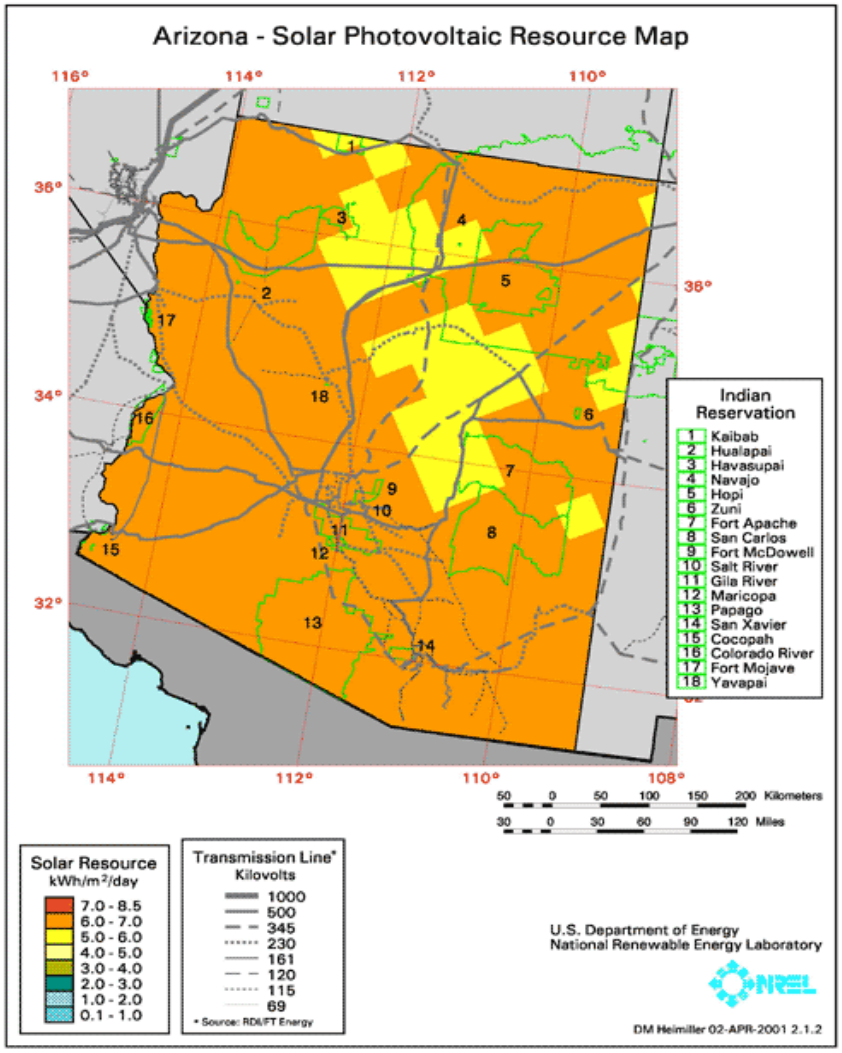
- Solar and biomass energy feasibility study
- Location: Evaluated projects at multiple locations within Gila River community
- Key Participants
  - ANTARES (Tim Rooney, Ali Schmidt, Billy Broas)
  - GRIC DEQ (Janet Bollman, Dale Anderson)
  - GRICUA (Lenny Gold)

Project Objectives

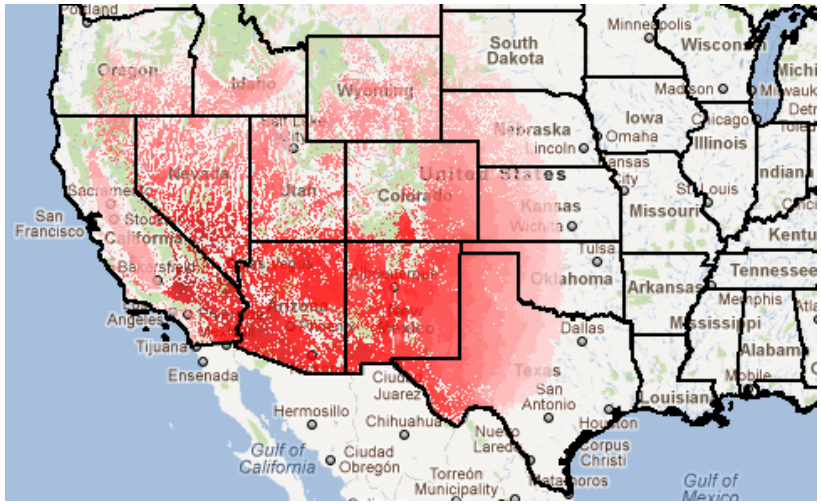
- Feasibility study project goals
  - Identify available solar and biomass energy resources
  - Characterize solar and biomass energy technologies
  - Conduct detailed technical and economic analysis of potentially viable projects.
- Renewable energy for improved self-sufficiency
  - On-site energy generation as hedge against rising natural gas prices (direct tie to GRICUA electric prices)
  - Environmental and economic benefits

GRIC Solar Feasibility Study

Solar Resources



- **High solar resource: 6 – 7 kWh/m²/day**
- **Direct sunlight, good for PV and concentrating solar technologies**



Concentrating Solar Potential (NREL map)

Solar Technology Overview

- Technology
  - Photovoltaics (PV)
    - Crystalline Silicon (c-Si)
    - Thin film
  - Concentrating solar power (CSP)
- Location/mounting method
  - Roof-mounted
  - Ground mounted
- Tracking capability
  - Fixed tilt
  - Single-axis (1-X) tracking

Fixed Tilt Roof mounted PV

Carport PV

1-X Tracking Ground Mount PV

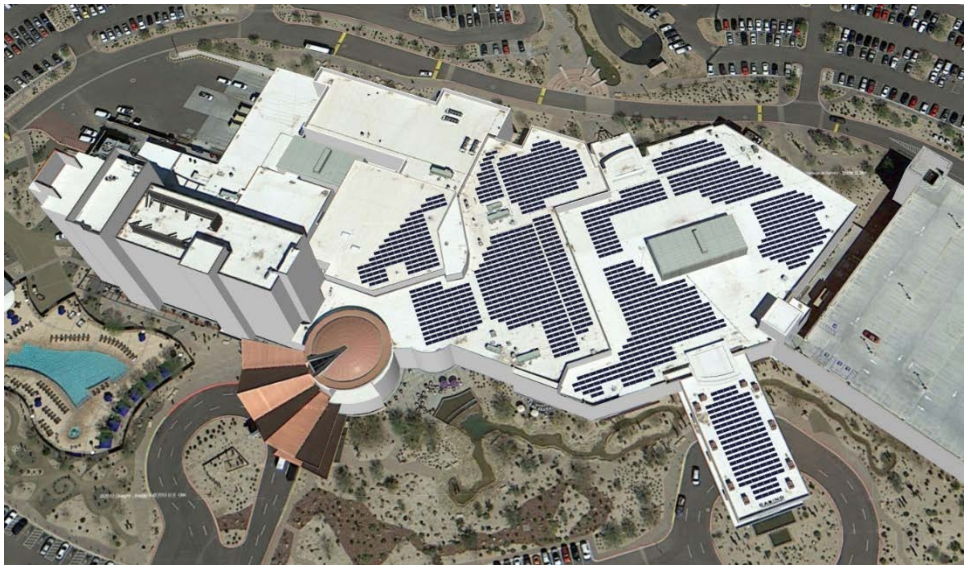
CSP Power

Solar Projects Evaluated

Option		Location / Description	Module Type	Mounting Configuration	Tilt Angle (degrees)	Orientation* (degrees)	Capacity (kWDC)
1	A	Tribal Governance Center, roof mount	p-Si	Ballasted racking	10	180	491
	B		CdTe	Ballasted racking	5	180	458
2	A	Wild Horse Pass Hotel & Casino, roof mount	p-Si	Ballasted racking	10	162	437
	B		CdTe	Ballasted racking	5	162	450
3	A	San Tan Brownfield, ground mount	CdTe	Fixed Tilt Racks	25	180	1,109
	B		CdTe	Fixed Tilt Racks	25	180	5,544
4	A	Lone Butte Substation, ground mount	CdTe	Fixed Tilt Racks	25	180	5,544
	B		CdTe	1-X tracking (E-W)	-	-	5,638

Example Project Renderings

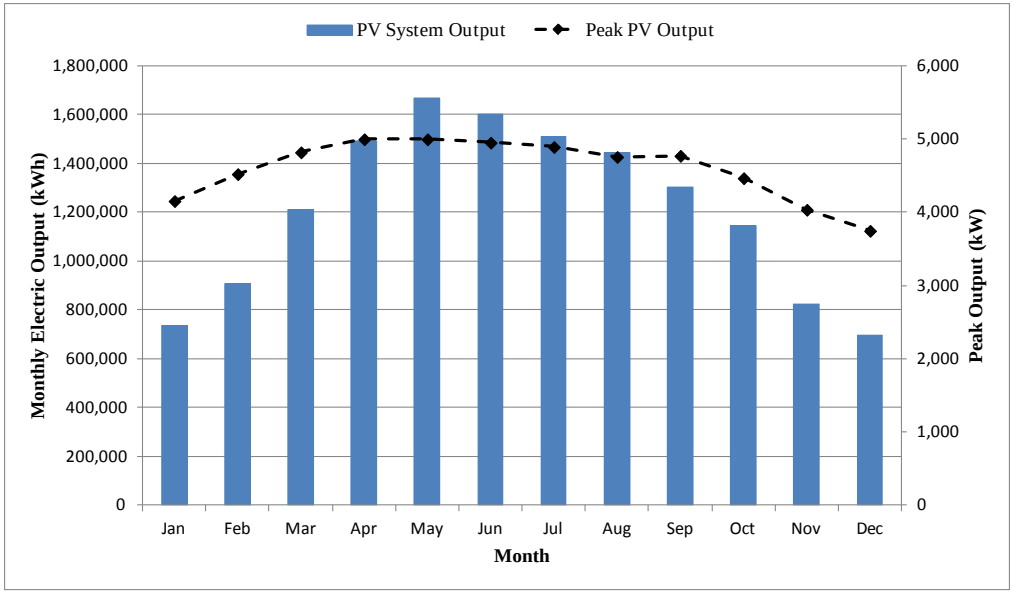
Option 2A: Wild Horse Pass Hotel and Casino (491 kW_{DC}, p-Si)



Option 4B: Lone Butte Substation Ground Mount, 1-X tracking (5.6 MW_{DC}, Thin film - CdTe)

Technical Analysis Results

- Thin film slightly better performance due to temperature and dust tolerance
- Higher tilt angle improved annual generation, but more variable throughout the year
- Tracking significantly increased annual generation

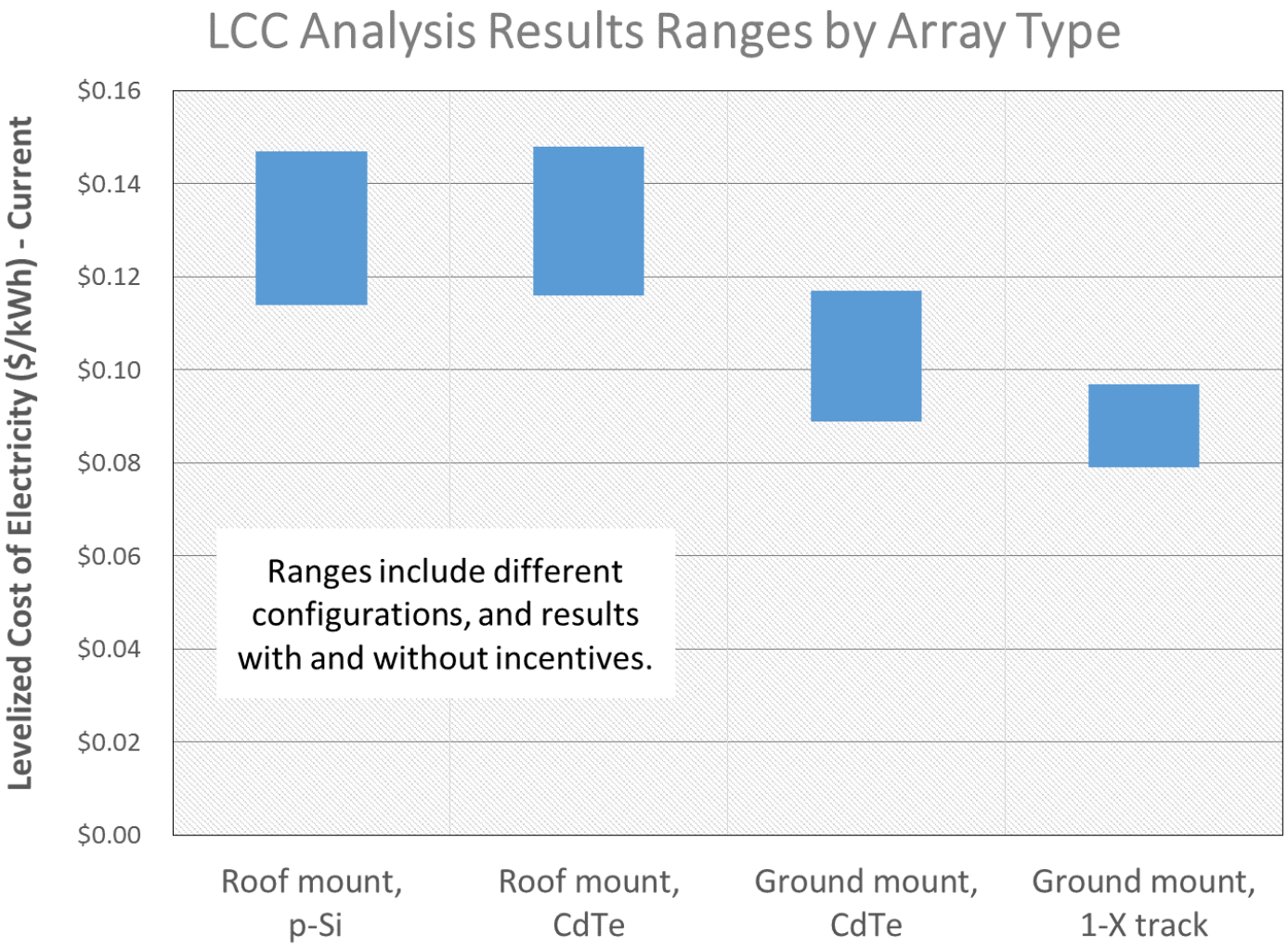


Option 4B: Lone Butte Substation
5.6 MW$_{DC}$, 1-X tracking, CdTe
Annual Output 14,533 MWh

Project Concepts and Considerations

- Off-take agreement with GRICUA
- Interconnection GRICUA distribution system
- Regulatory/permitting needs
- Availability of incentives (federal, state, local)
- Business and ownership structure
  - Financing options
  - Tribal ownership and operation
    - GRICUA or other tribal entity
  - Private developers ownership or leasing

Economic Analysis



GRIC Biomass Feasibility Study

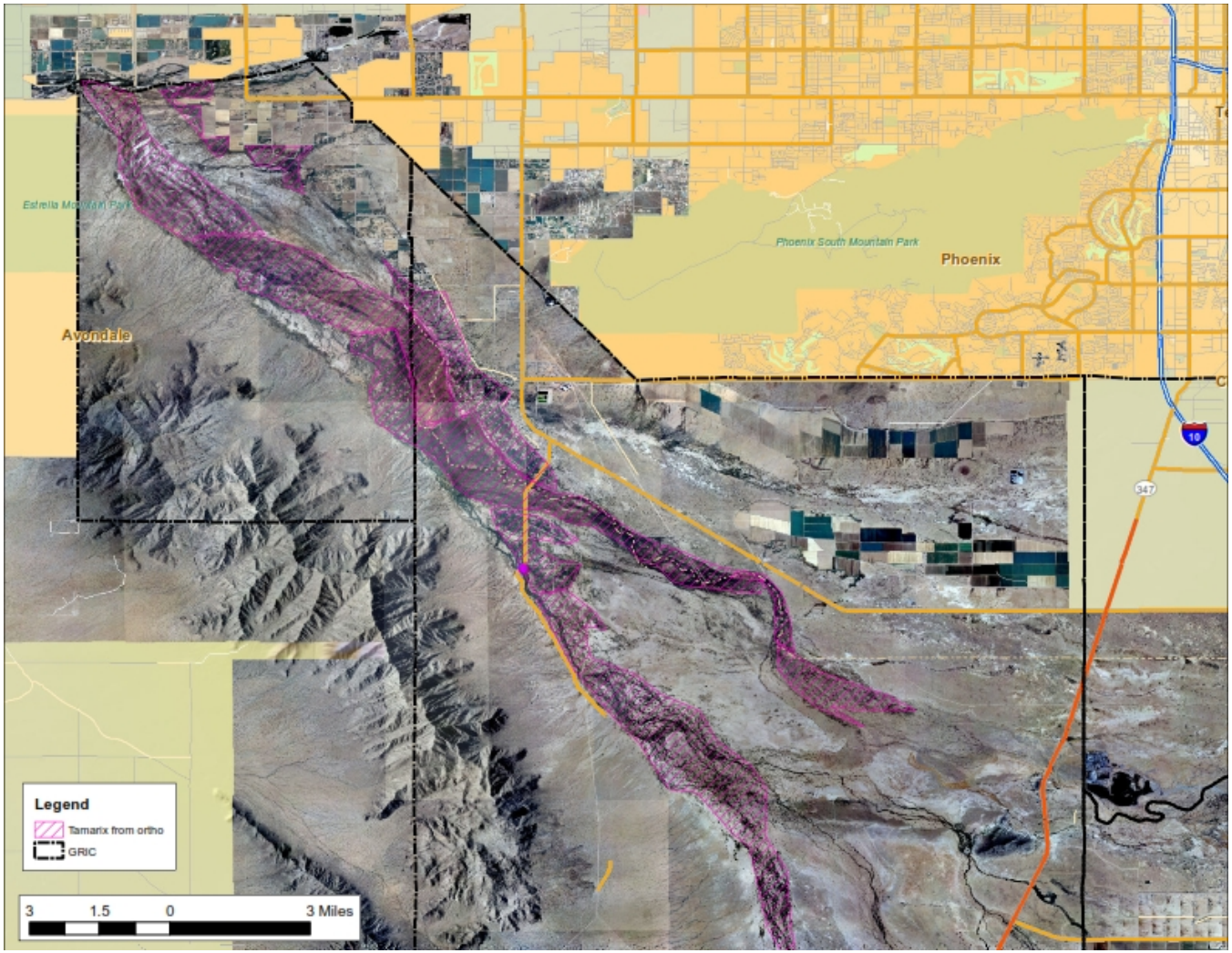
Biomass Resources

- Rubber plant (guayule) processing debris
- Urban wood
  - Pallets, yard debris, and clean untreated construction wood
- Saltcedar removal
- Pellet fuels

Saltcedar removal

Urban wood waste

Saltcedar (Tamarix) Distribution



Resource Assessment Results

Description	Estimated Quantity (tons / year)	Estimated Cost, Delivered ($/ton)
Urban wood	20,000	$44/ton
Guayule bagasse	5,000	$45/ton
Saltcedar	90-120	$100/ton *

* Cost to offset a portion of the overall cost to treat and restore heavily infested areas (~$15,000 to $20,000 per acre).

Urban Resources

- One likely supplier identified
- Approval needed to bring on GRIC land

Yulex (guayule)

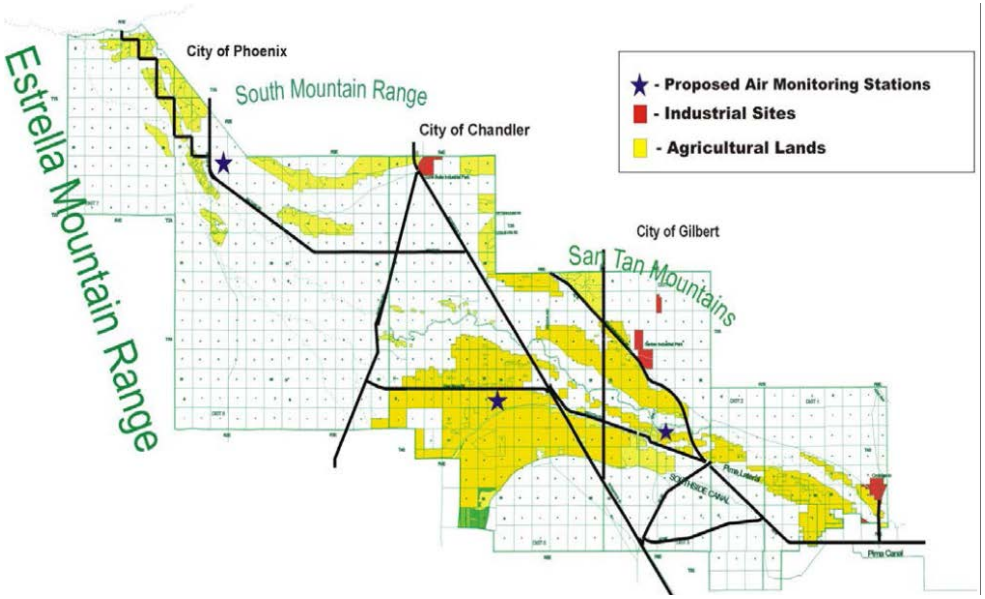
- Yulex considering higher-value uses
- Lab results showed high alkali and ash

Saltcedar

- Environmental benefits outweigh value for bioenergy
- Restoration field trials are ongoing (Charles Enos, GRIC DEQ)
- Lab results showed high ash; chlorine and sulfur beyond recommended limits for biomass boiler

Biomass Project Concept Development

- Industrial: CHP, thermal
- Commercial: heating/cooling
- Technology selection (combustion, gasification)
- Site requirements
  - Heating/cooling loads
  - Power use
  - System layout
  - Fuel storage needs
  - Interconnection needs
  - Water needs



Gila River Industrial Site Locations (Rudy Mix, presentation to DOE Tribal Energy Program)

Biomass Project at Lone Butte Industrial Park

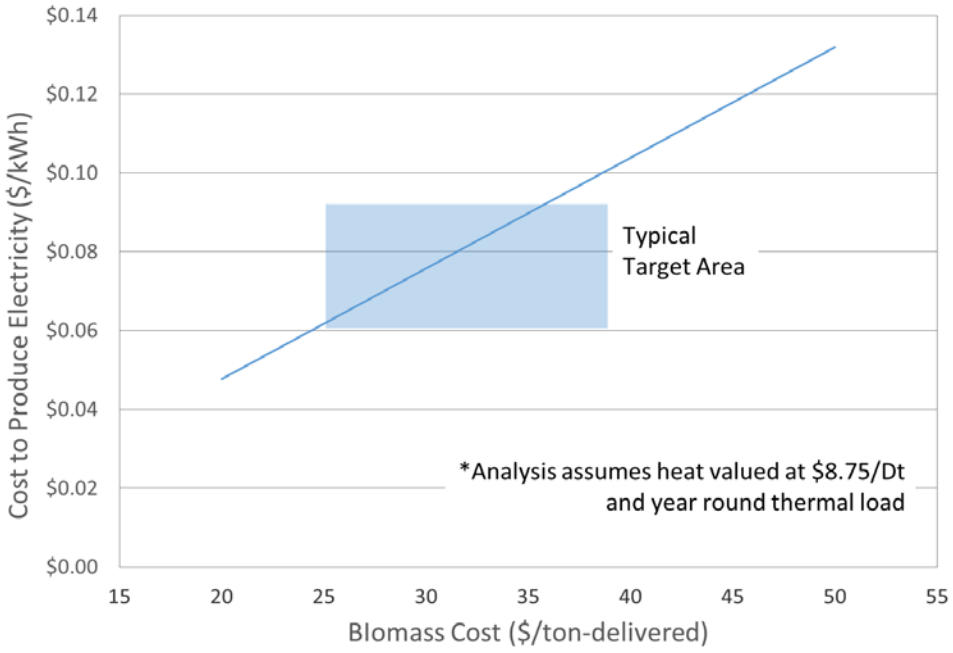
- Power (no suitable thermal loads)
- Sized based on biomass availability
- Relatively low conversion efficiency (no heat use)
- Small system - No benefit from economies of scale
- High fuel costs and low incentives

Output Description	Quantity
Gross Power (kW)	2,010
Net Power (kW)	1,757
Annual Net Energy Output (MWh)	14,056
Annual Biomass Fuel Input (tons/yr)	25,000*
Net Electric Efficiency (HHV)	14.4%
Constant LCOE - no incentives ($/kWh)	$0.24
Constant LCOE - incentives ($/kWh)	$0.22

* Wood chips & guayule bagasse

Biomass Project Considerations

- Project success factors
  - Low (<$30/ton) fuel cost
  - Use for thermal energy (year round load best)
  - Displacement of high cost fuel (e.g., propane)
- Biogas (AD/engine genset) power prices are the lowest
  - Requires suitable wastewater treatment site
  - If treated sludge is sold, power price must compensate for lost revenue



Project Status and Lessons Learned

- Feasibility Study completed in October 2013
- Solar
  - Lone Butte Substation ground mount 5.6 MW_{DC} CdTe PV array (1-X tracking) performed best (LCOE ~ $0.09-$0.10/kWh, no incentives)
  - LCOE still higher than current electricity price
  - As PV costs decline and electricity costs escalate, PV may be more cost-competitive
  - PV power improves tribal energy self-sufficiency and provides a hedge against future natural gas price increases
  - GRICUA must work with affected utilities for large PV

Project Status and Lessons Learned – Cont'd

- Biomass
  - Limited biomass resource and high cost suggests biomass energy not economically viable now
  - Saltcedar has technical challenges as fuel and is costly
  - However, if sustained funding obtained for riparian area restoration, efforts could yield environmental and employment benefits

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