

Renewable Energy in Coconino County

Cost Benefit Analysis

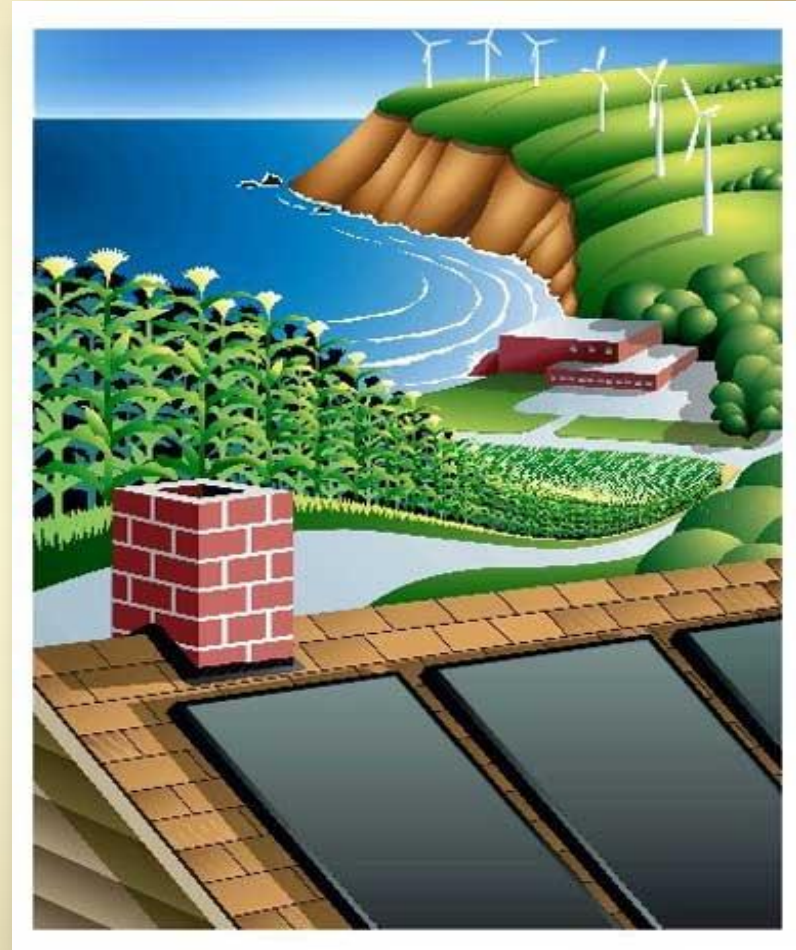


Terms and Acronyms

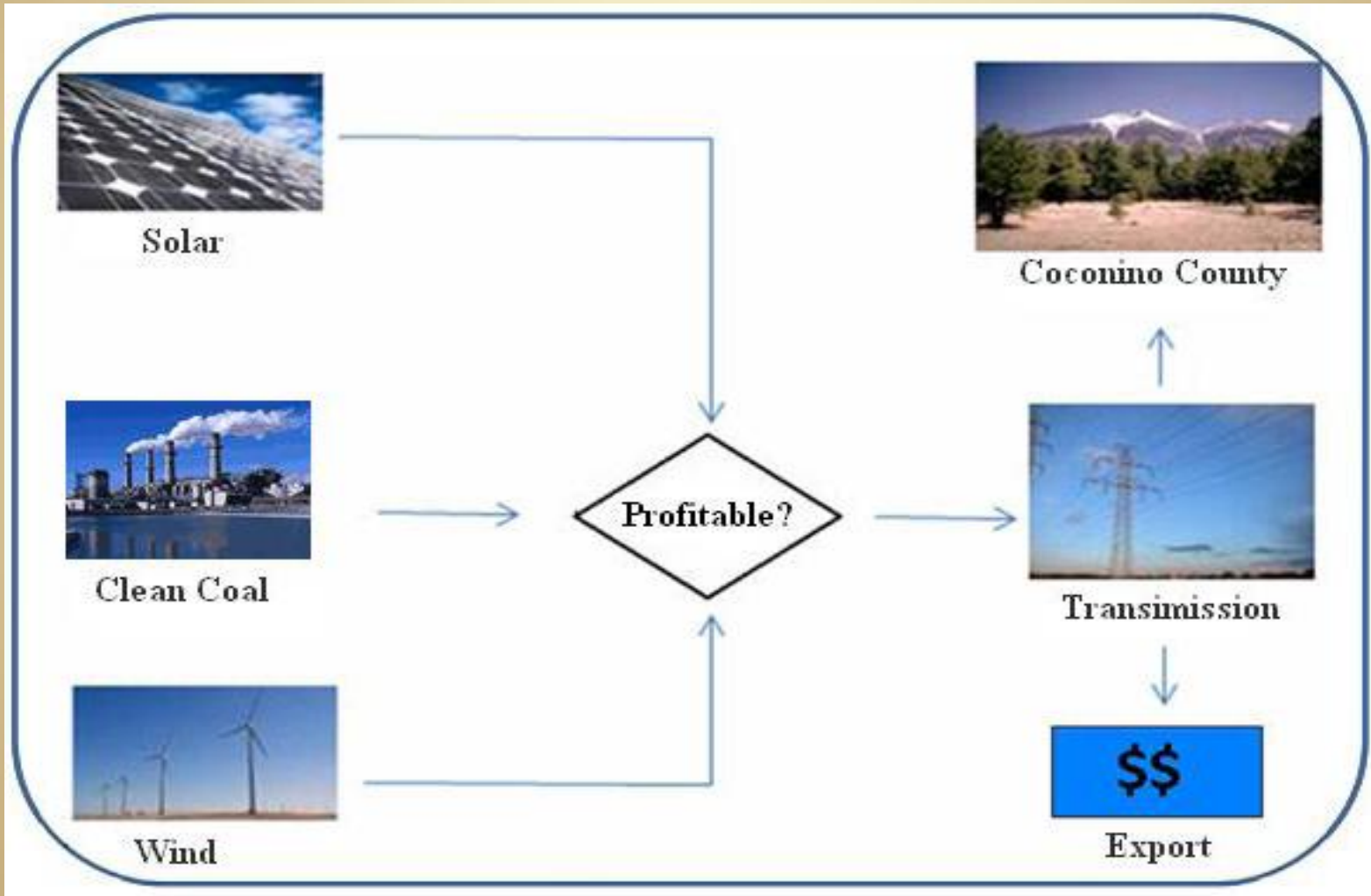
- APS- Arizona Public Service
- CCSEDI- Coconino County Sustainable Economic Development Initiative
- SES- Sustainable Energy Solutions
- NREL- National Renewable Energy Laboratory
- JEDI- Jobs and Economic Development Impact Model
- GE- General Electric
- O&M- Operation and Maintenance
- RE- Renewable Energy
- Man-Week- 40 hour work week

Team and Sponsors

- Team
 - Mindy Dyar
 - Andrews Boateng
 - Nick Everson
- Main Sponsor
 - APS
 - Steve Catanach
- Co-Sponsor
 - CCSEDI
 - Amy LeGere
 - Ron Hubert



Project Description



Approach



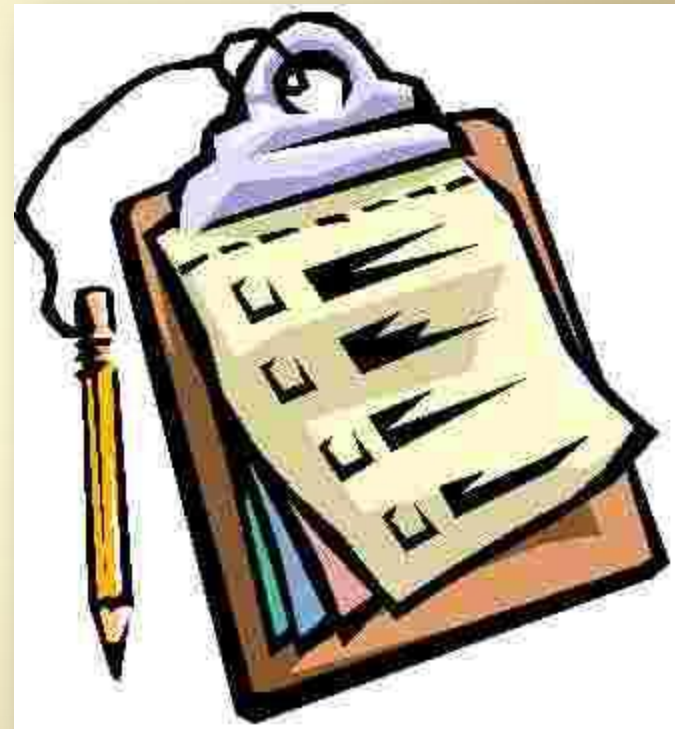
- Feasibility in Coconino County?
- Profitable in Coconino County?
 - YES
 - Studied qualified resources
 - NO
 - Dismissed resource from project
- Design Challenges
 - Limited information on Coconino County
 - Lack of software models for every resource
- Trade-offs made
 - Narrow the scope of project in order to complete it

Process

- Cost Benefit Analysis
 - Tangible Benefits
 - Costs of plant construction and maintenance
 - Costs of fuel
 - Intangible Benefits
 - Environmental opportunity costs
 - Water
 - Air Quality
 - Economic Incentives
 - Jobs created
 - Tax incentives
 - Cost per kWh comparison (kWh = kilowatt-Hour = 1000 Watts consumed in an hour)

Requirements

- Mechanical
 - Wind and Solar Technologies
 - Size and efficiency of units
- Economic Impacts
 - Jobs, Taxes, Revenues
- Environmental
 - Emissions, Water Use
- Social
 - Improved Health
 - Ranchland and Farmland Preservation



Actual Results

- Social

- Wind
 - Improved Health due to zero emissions and pollutants
 - Preserves Ranchland and Farmland
- Solar
 - Improved Health
 - Ranchland and Farmland Preservation

- Environmental

- Wind
 - Zero emissions and uses no water
- Solar
 - Emissions

Actual Results

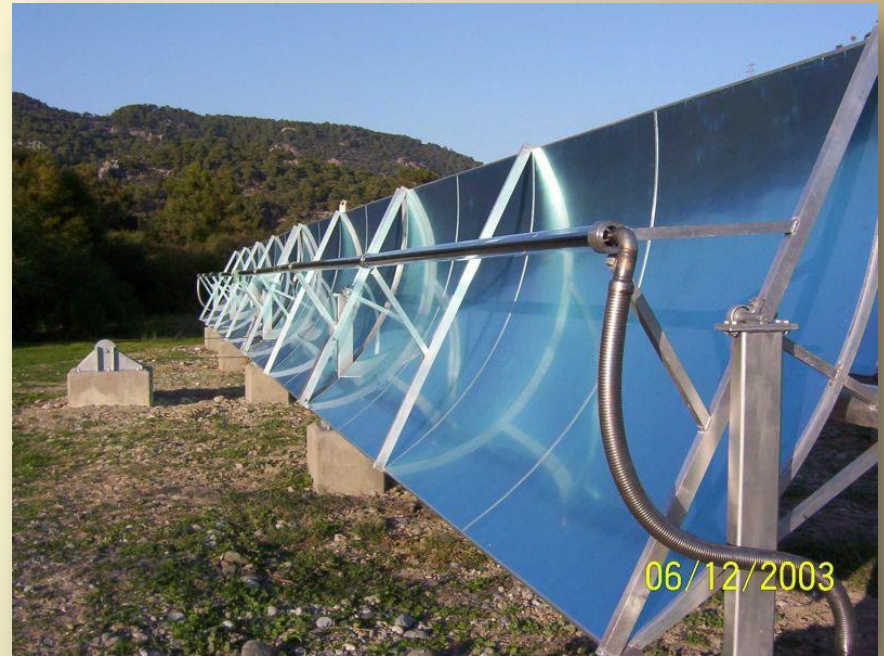
- Economic Impacts
 - Wind and Solar
 - 169 jobs (wind) , 2373 (solar) during construction and 20 jobs (wind), 57 (solar) during O&M annually for a 60MW plant
 - 1.4% - 1.8% increase in property value of the land for both wind and solar
 - Increased revenues for the Coconino County for both wind and solar

Actual Results

- Mechanical
 - Wind (1.5MW GE Wind Turbine)



- Solar (Parabolic Trough)



Actual Results

Clean Coal/Wind/Solar Cost Analysis														
Clean Coal Reducing Ash and Particulate s and Capturing CO ₂	Generation MW	Generation Cost \$/MWYr	Cost for Generation with Dirty Coal \$/Yr	Fuel Usage Tons/Yr	Water Usage Gal/Yr	Coal Cleaning \$/Ton	Pressurized Fluidized Bed Combustion Cost \$/Yr	CO2 Emissions Tons/Yr	Carbon Capture and Storage \$/Yr	Jobs Created Construction and O&M	Jobs Value to County \$/yr	Net Adjusted Generation Costs \$/Yr	Initial Assumed Cost Cents/kWh	Adjusted Assumed Cost Cents/kWh
	500	332,880	166,440,000	1,051,200	6,014,178,000	21,497,916	300,000,000	4,432,560	265,953,600	669	\$2,792,830	751,098,686	3.8	17.1
		Based on \$38/MWh ¹		Based on 120 Tons/Hr ⁵	Based on 690 Gal/MWh ⁶	Based on \$4.85/Ton ³	Based On \$600/kW ⁴	Based on 920Kg CO2/MWh ²	Based on \$60/Ton Combusted Coal ⁷					
Wind	Generation MW	Generation Cost \$/MWYr	Total Production Cost \$/Yr	Fuel Savings \$/Yr	Water Savings \$/Yr	Ash and Particulate Reduction Tons/Yr	Avoided Sox Emissions Tons/Yr	Avoided NOx Emissions Tons/Yr	Avoided CO2 Emissions Tons/Yr	Jobs Created Construction and O&M	Jobs Value to County \$/yr	Net Adjusted Generation Costs \$/Yr	Initial Assumed Cost Cents/kWh	Adjusted Assumed Cost Cents/kWh
	500	946,080	473,040,000	36,014,112	60,141,780	125,000	34,605	57,294	4,432,560	1,569	6,550,000	370,334,108	10.8	8.5
		Based on \$108/MWh ⁸		Based on \$34.26/Ton Coal ⁹	Based on \$1/100Gal ¹⁰						Based on JEDI ¹¹	Based on JEDI ¹¹		
Solar Thermal	Generation MW	Generation Cost \$/MWYr	Total Production Cost \$/Yr	Fuel Savings \$/Yr	Water Savings \$/Yr	Ash Reduction Tons/Yr	Avoided Sox Emissions Tons/Yr	Avoided NOx Emissions Tons/Yr	Avoided CO2 Emissions Tons/Yr	Jobs Created Construction and O&M	Jobs Value to County \$/yr	Net Adjusted Production Costs \$/Yr	Initial Assumed Cost Cents/kWh	Adjusted Assumed Cost Cents/kWh
	500	1,471,680	735,840,000	36,014,112	\$0	125,000	34,605	57,294	4,432,560	20,145	84,097,992	615,727,896	16.8	14.1
		Based on \$168/MWh ⁸									Based on SAM ¹²	Based on SAM ¹²		

1. Cholla Power Plant Average Total Cost of Generation; 2. Controlling Power Plant CO2 Emissions: netl.doe.gov; 3. Energy Citations: osti.gov; 4. PFBC: worldbank.org; 5. Responsibility Report: Pinnacle Corporation; 6. Renewing Arizona's Economy: PIRG Education Fund; 7. CCS: fossil.energy.gov; 8. AZ Renewable Energy Assessment: Black and Veatch; 9. World Price Index, 2007; 10. Residential Water Bill: April, 2008; 11. Jobs and Economic Impact Model: National Renewable Energy Laboratory; 12. Solar Advisor Model: National Renewable Energy Laboratory. Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California: Black & Veatch

Project Cycle

- Research
- Approach
- Analyze
- Summarize



Research Phase

- Accomplishments
 - Researched different types of proven RE technologies in the county.
 - Learned various economics concepts.
- Budget
 - No money spent in this phase.
- Time Spent
 - 3.75 Man-Weeks Spent

Approach Phase

- Accomplishments
 - Phased certain RE technologies out of project due to a lessened potential of being implemented.
 - Chose specific technologies for the renewable resources.
 - Refined requirements and specifications to focus the scope of project.
- Budget
 - No money spent in this phase.
- Time Spent
 - 5 man-weeks

Analysis Phase

- Accomplishments
 - For Wind Technologies
 - The JEDI model was used to quantify intangible benefits for wind in the county
 - Case studies and reports were used to quantify both economic and external benefits
 - For Solar Technologies
 - We used reports and case studies to determine profitability and economic impacts, both tangible and intangible.
- Budget
 - No money spent in this phase.
- Time Spent
 - 5 Man-weeks

Summarization Phase

- Accomplishments
 - Weighed the benefits of wind and solar generation to clean coal in the categories of:
 - Water Usage
 - Emissions Reduction
 - Jobs Created
 - Taxes and Revenues
 - Preservation of Ranchland
- Budget
 - No money spent in this phase.
- Time Spent
 - 7 Man-weeks

Client Deliverables

- Summary of feasibility and profitability of solar and wind generation within Coconino County
- Quantified tangible and intangible benefits
- Decision Table
- Final Project Report
- Final Presentation



Benefits to Client



- Client will have more information when proposing renewable energy generation within the county in terms of:
 - Water use
 - Emissions reduction
 - Economic Impacts
 - Health Benefits
 - Sale of Excess Power

Further Recommendation

- Biomass should be researched further because of its abundance in Northern Arizona



- Further research into the cost of emissions to the environment
- Local social impacts:
 - Environmental tourism
 - Increased revenues due to added curriculum at NAU

Website

- Please visit our website

- Go to [cens.nau.edu](http://www.cens.nau.edu)
- Departments
- EE
- EE projects
- APS Renewable

Home Page - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://www.cens.nau.edu/Academic/Design/D4P/EGR486/EE/08-Projects/APSRenewable/ world coal resource
ACL.com LOUIE

Renewable Energy in Coconino County

A Qualitative and Quantitative
Cost Benefit Analysis of Siting Renewable Energy
Generation in Northern Arizona

Problem Description

The goal of this project is develop a cost benefit model that takes into account not only the base dollar economics of this type of development, but also the net dollar impact ie, the total value of every dollar spent within the local community from direct, indirect and imputed project development and construction expenditures; new tax revenues; new land/property owner revenues (land leases, royalty payments); potential community enhancements such as ecotourism, and new university and community college research and curriculum program. Additionally, the study should provide both quantitative and qualitative values related to the social, environmental and economic impacts this type of project could have. Environmental impacts may include the offset impacts of relative to water consumption and carbon emissions for equivalent thermal generation.

Invitation to Capstone/Poster Presentation

When: April 18, 2008
Poster Session: 8am - 11am
Oral Presentation 2:30pm - 3:00pm
Where: NAU Du Bois Center (Building 64) [View Map](#)
[View Celebration of Undergraduate Research and Design Flyer](#)

Last Updated:
April 7, 2008

Done

HAU
Northern Arizona University, Department of Electrical Engineering

NORTHERN ARIZONA UNIVERSITY
College of Engineering & Natural Sciences

APS
Arizona Public Service

CCSEDI
Coconino County Sustainable Economic Development Initiative

COCONINO COUNTY
Sustainable Economic Development INITIATIVE

<http://www.cens.nau.edu/Academic/Design/D4P/EGR486/EE/08-Projects/APSRenewable>



Thank You!
Any Questions?