



Pueblo Innovative Energy Solutions Advisory Committee

June 15, 2023
11:00 am – 2:00 pm
Colorado State University - Pueblo

AGENDA

- A. Introduction/Recap
- B. Scoring Strategy
- C. Jobs & Cost Estimates
- C. Lunch
- D. Prioritize Community Impact
- E. Next Steps

INTRODUCTION/RECAP

Committee Co-Chairs

SCORING STRATEGY

Jeffrey Stephens

Three Phases of Technology Scoring

Phase 1 - Initial Evaluation of Generation & Storage Options

- Technologies were evaluated based on their dispatchability, the fuel availability in Pueblo or at Comanche for the resource, and the maturity of the technology.

Phase 2 - Technology Suitability

- Technologies were evaluated based on their suitability to the Pueblo County region and their ability to meet the Just Transition ERP requirements.

Phase 3 – Final Evaluation of Technologies

- Technologies are being evaluated based on community impact, operational dispatchability, project schedule, environmental impacts, and customer affordability (Levelized Cost of Energy).

Phase 1 Scoring Results

	Technology	Dispatchability	Fuel Availability	Maturity	Recommend Phase 2
Generation	Solar	⊖	✓	✓	Yes
	Wind	⊖	✓	✓	Yes
	Small Modular Reactor (SMR)	✓	⊖	✓	Yes
	Geothermal	✓	⊖	⊖	Yes
	Peaker Plant w/ CC using NG	✓	⊖	✓	Yes
	Combined Cycle w/ CC using NG	✓	⊖	✓	Yes
	Burn Hydrogen as Primary Fuel	✓	⊖	✓	Yes
Storage	Lithium-Ion Battery	✓	✓	✓	Yes
	Flow Battery	✓	✓	⊖	Yes
	High-Temperature Battery Storage	✓	✓	⊖	Yes
	Compressed Air Energy Storage	✓	✓	✓	Yes
	Pumped Hydro Energy Storage	✓	✓	✓	Yes
	Thermal Energy Storage	✓	✓	⊖	Yes
	Iron Air Battery	✓	✓	⊖	Yes
	Kinetic Energy Storage	✓	✓	⊖	Yes
	Liquid Air Energy Storage	✓	✓	⊖	Yes

Phase 2 Scoring

Category	Scoring Criteria
Suitability*	0: Generation/Storage Technology is not suitable for Pueblo, i.e., geology, geography, total land availability, etc. 1: Generation Technology is suitable for Pueblo
Just Transition ERP Requirement**	0: Generation/Storage Technology cannot meet requirements, i.e., in-service by 2031, etc. 1: Generation Technology can meet requirements

**If a technology is determined to be unsuitable for the study, it will not be advanced to the next round of scoring.*

***If a technology cannot meet Just Transition ERP requirements but meets suitability requirements for the study, it will advance to the next round of scoring.*

Phase 2 Scoring Results

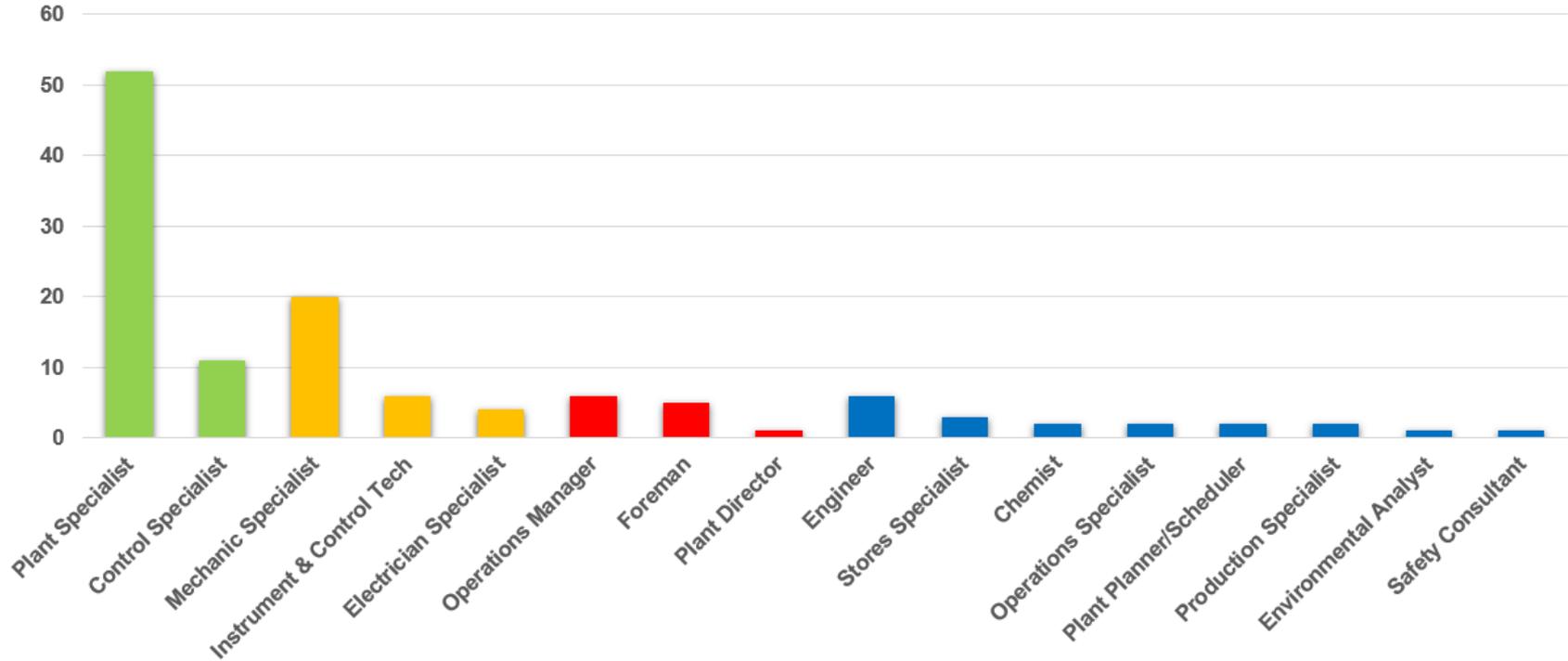
	Technology0	Suitability	Just Transition RFP	Recommend Phase 3
Generation	Solar	✓	✓	Yes
	Wind	✗	✓	No
	Small Modular Reactor (SMR)	✓	✗	Yes
	Geothermal	✓	✓	Yes
	Peaker Plant w/ CC using Natural Gas	✗	✗	No
	Combined Cycle w/ CC using Natural Gas	✓	✓	Yes
	Burn Hydrogen as Primary Fuel	✓	✓	Yes
Storage	Lithium-Ion Battery	✓	✓	Yes
	Flow Battery	✓	✓	Yes
	High-Temperature Battery Storage	✓	✓	Yes
	Compressed Air Energy Storage	✓	✓	Yes
	Pumped Hydro Energy Storage	✓	✓	Yes
	Thermal Energy Storage	✓	✓	Yes
	Iron Air Battery	✓	✓	Yes
	Kinetic Energy Storage	✓	✓	Yes
Liquid Air Energy Storage	✓	✓	Yes	

JOBS & COST ESTIMATES

1898/Xcel Energy

Comanche Jobs & Salary

Comanche Staffing Breakdown



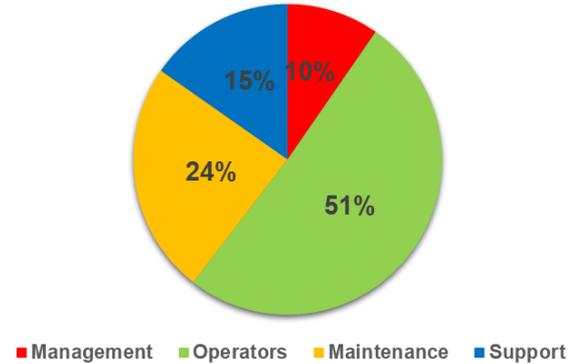
*Total Population: 124

Comanche Jobs & Salary

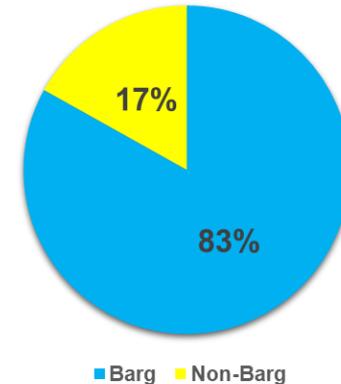
Segment	*Salary
Operators	\$90k
Maintenance	\$100k
Support	\$94k
Management	\$125k
Bargaining	\$94k
Non-Bargaining	\$111k

*Mid-Point Salaries

Population Segments



Bargaining vs. Non-Bargaining



Long Term Jobs & Salary

Technology		Number of Jobs*	Salary Range (\$1000)
Generation	Solar	5-10	35-80
	Wind	15-20	40-80
	Small Modular Reactor (SMR)	200-300	57-220
	Geothermal	25-40	53-140
	Peaker Plant w/ CC using NG	15-20	80-120
	Combined Cycle w/ CC using NG	20-25	80-120
	Burn Hydrogen as Primary Fuel	15-25	80-120
Storage	Lithium-Ion Battery	1-5	40-80
	Flow Battery	1-5	40-80
	High-Temperature Battery Storage	1-5	40-80
	Compressed Air Energy Storage	30-40	80-120
	Pumped Hydro Energy Storage	30-50	80-120
	Thermal Energy Storage	10-20	60-80
	Iron Air Battery	1-5	40-80
	Kinetic Energy Storage	1-5	40-80
	Liquid Air Energy Storage	5-15	60-100

*Number of Jobs is based on a 500MW capacity for each technology.

Construction Jobs & Salary

	Technology	Number of Jobs*	Salary Range (\$1000)
Generation	Solar	250-350	35-75
	Wind	250-350	40-75
	Small Modular Reactor (SMR)	800-1200	57-150
	Geothermal	600-1000	53-120
	Peaker Plant w/ CC using NG	200-300	50-120
	Combined Cycle w/ CC using NG	200-300	50-120
	Burn Hydrogen as Primary Fuel	250-350	50-120
Storage	Lithium-Ion Battery	50-100	60-120
	Flow Battery	50-100	60-120
	High-Temperature Battery Storage	50-100	60-120
	Compressed Air Energy Storage	600-800	60-120
	Pumped Hydro Energy Storage	300-500	60-120
	Thermal Energy Storage	100-150	60-100
	Iron Air Battery	70-120	40-120
	Kinetic Energy Storage	60-100	50-100
	Liquid Air Energy Storage	200-300	60-100

*Number of Jobs is based on a 500MW capacity for each technology.

Potential Cost Estimates

Technology		\$/kW (\$/kWh for Storage)	MW Capacity for ~\$700M Investment	Investment Required for 500MW (\$M)
Generation	Solar	\$1,471	470	\$735.5
	Wind	\$1,800	390	\$900
	Small Modular Reactor (SMR)	\$15,000	N/A	\$7,500
	Geothermal	\$43,744	16	N/A
	Peaker Plant w/ CC using NG	N/A	N/A	N/A
	Combined Cycle w/ CC using NG	\$2,600	150	\$1,300
	Burn Hydrogen as Primary Fuel	\$4,800	140	\$2,425
Storage	Lithium-Ion Battery (4hr)	\$430	410	\$860
	Flow Battery (8hr)	\$400 - \$800	100-220	\$1,600 - \$3,400
	High-Temperature Battery Storage (8hr)	\$400 - \$800	100-220	\$1,600 - \$3,400
	Liquid Air Energy Storage (8hr)	\$400 - \$800	100-220	\$1,600 - \$3,400
	Thermal Energy Storage (8hr)	\$400 - \$800	100-220	\$1,600 - \$3,400
	Compressed Air Energy Storage (8hr)	\$250	350	\$1,000
	Pumped Hydro Energy Storage (8hr)	\$300*	290*	\$1,200*
	Iron Air Battery (100hr)	\$125	65	\$6,250
	Kinetic Energy Storage (0.25hr)	\$13,800	200	N/A

Phase II ELCC Assumptions

Table 2.14-12 Phase II Average ELCC Applied to Incremental Storage

Incremental MW	2-Hour Duration	4-Hour Duration	8-Hour Duration
50	48.8%	68.1%	92.3%
100	45.9%	65.0%	90.4%
250	39.7%	58.8%	85.2%
500	32.8%	51.0%	75.1%
1,000	26.1%	39.9%	55.3%
2,000	20.0%	27.5%	35.2%
3,000	16.3%	21.3%	25.7%

Table 2.14-8: Phase II Average ELCC Applied to Incremental Wind

MW Range	ERZ-1	ERZ-2	ERZ-3	ERZ-5 (50%)	ERZ-5 (44%)
0-250	15.9%	12.8%	33.6%	24.2%	17.6%
251-500	13.1%	11.4%	28.6%	21.0%	15.8%
501-1000	10.0%	10.3%	22.6%	17.7%	13.4%
1001-2000	6.9%	8.6%	13.4%	12.9%	9.8%
2001-3000	5.0%	7.1%	6.1%	9.5%	7.5%

Table 2.14-10: Phase II Average ELCC Applied to Incremental Utility Solar

MW Range	MTN	NFR	SE	SFR	SLV	WS
0-100	21.4%	33.5%	29.3%	15.4%	28.4%	36.3%
101-250	18.4%	30.5%	26.1%	13.9%	24.7%	30.5%
251-500	14.2%	26.2%	21.2%	11.1%	18.8%	24.5%
501-1000	8.7%	16.8%	12.9%	7.6%	10.0%	14.4%
1001-2000	5.2%	7.3%	6.8%	5.2%	5.5%	6.2%
2001-3000	3.6%	3.2%	3.7%	3.7%	4.1%	2.9%

Accredited Capacity for 500MW

Technology		Investment Required for 500MW (\$MM)	ELCC (from Phase II)	Accredited Capacity (MW)
Generation	Solar	\$735.5	15.4 - 11.1%	64
	Wind	\$900	17.6 - 15.8%	84
	Small Modular Reactor (SMR)	\$7,500	100%	500
	Geothermal	N/A		
	Peaker Plant w/ CC using NG	N/A		
	Combined Cycle w/ CC using NG	\$1,300	100%	500
	Burn Hydrogen as Primary Fuel	\$2,425	100%	500
Storage	Lithium-Ion Battery (4hr)	\$860	68.1 - 51%	282
	Flow Battery (8hr)	\$1,600 - \$3,400	92.3 - 75.1%	407
	High-Temperature Battery Storage (8hr)	\$1,600 - \$3,400	92.3 - 75.1%	407
	Liquid Air Energy Storage (8hr)	\$1,600 - \$3,400	92.3 - 75.1%	407
	Thermal Energy Storage (8hr)	\$1,600 - \$3,400	92.3 - 75.1%	407
	Compressed Air Energy Storage (8hr)	\$1,000	92.3 - 75.1%	407
	Pumped Hydro Energy Storage* (8hr)	\$1,200*	92.3 - 75.1%	407
	Iron Air Battery (100hr)	\$6,250	100%	500
	Kinetic Energy Storage (0.25hr)	N/A		

LUNCH

PRIORITIZE COMMUNITY IMPACT

Jeffrey Stephens & Brock Walstad



Draft Community Impact

Draft Categories	Weighting	Scoring Criteria
Long-Term Jobs	5%	1: 1-10 employees 2: 11-30 employees 3: 30+ employees
Job Compensation	5%	1: < \$65k 2: \$65k - \$85k 3: > \$86k
Tax Base Impacts	5%	Tax Revenue Ranges (TBD in July Meeting)
Job Growth & Retention	5%	1: 1-10 employees 2: 11-25 employees 3: 26+ employees
Pre-Operations Job Creation	5%	1: 1-150 employees 2: 151-300 employees 3: 300+ employees

Jobs per MW Equivalent (Pilot Scale)

	Technology	Long Term Jobs	Weighted Score
Generation	Solar	5-10	1
	Wind	15-20	2
	Small Modular Reactor (SMR)	200-300	3
	Geothermal	25-40	3
	Peaker Plant w/ CC using NG	15-20	2
	Combined Cycle w/ CC using NG	20-25	2
	Burn Hydrogen as Primary Fuel	15-25	2
Storage	Lithium-Ion Battery	1-5	1
	Flow Battery	1-5	1
	High-Temperature Battery Storage	1-5	1
	Compressed Air Energy Storage	30-40	3
	Pumped Hydro Energy Storage	30-50	3
	Thermal Energy Storage	10-20	2
	Iron Air Battery	1-5	1
	Kinetic Energy Storage	1-5	1
	Liquid Air Energy Storage	5-15	2

Committee Voting

 2023 Pueblo Generation Study - PIESAC Community Impact Evaluation		NAME		
Long-Term Jobs	Job Compensation	Tax Base Impacts	Job Growth & Retention	Construction Jobs
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Next Steps

June 15, 2023 Meeting

Xcel Energy	Advanced Nuclear [SMR] Policy Discussion (July)
Xcel Energy + 1898	Translate technology cost estimating to potential tax base impacts (July)
PIESAC + Xcel Energy	Xcel Leadership discussion surrounding future of clean energy transition in Pueblo (July)
Technical Consultant (1898)	Finalize technical scoring of generation technologies & provide results (July)
PIESAC + Xcel Energy	Select no more than four generation resources for final evaluation (August)