SOUTHWESTERN PUBLIC SERVICE COMPANY
2023 New Mexico Integrated Resource Plan

August 29, 2023

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IRP Modeling Sensitivities

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Key Modeling Takeaways
Sensitivity Analyses

- SPS's sensitivity analyses demonstrates that critical modeling inputs such as transmission network upgrade costs and natural gas & market energy price forecasts can fundamentally change the results of IRP Analyses
- The total cost and selected resources in each portfolio differs under sensitivity analyses
- However, the dispatchable and variable energy resources selected under the sensitivity analyses fall within the range of resources SPS presented in its base IRP modeling
- SPS is not proposing any changes to its statement of need based on its sensitivity analyses

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Sensitivity Takeaways

SPS Sensitivity Analysis – $600/kW Transmission Network Upgrade Costs

- Unsurprisingly, the cost of all scenarios increases under a higher transmission network upgrade cost assumption
- The increase in costs ranges from $578M to $1.3B, on a PVRR basis
- The selected resources for each scenario remains relatively close to the $400/kW Transmission Network Upgrade case with the notable changes being:
  - Fewer solar generating resources selected in the long-duration storage case through 2030
  - Fewer wind generating resources in all cases between 2031 and 2040
  - Minor increase in new BESS *(Note: BESS was modeled without transmission network upgrade costs)*

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – $600/kW Transmission Network Upgrade Costs

				Resources Added 2028-2030 (Nameplate Capacity)						
	PVRR DELTA			Dispatchable				Variable Energy Resources		
	2024-2030 NPV $(M)	2024-2040 NPV $(M)	2024-2043 NPV $(M)	Firm Peaking	CC	Storage	Total	Wind	Solar	Total
Planning Forecast										
15% PRM										
Multi-Jurisdictional Baseline*	$0	$0	$0	700	837	100	**1,637**	3,500	1,301	**4,801**
Existing Technologies	$381	$2,753	$4,149	-	-	2,220	**2,220**	3,500	1,021	**4,521**
Long Duration Storage	$320	$1,348	$1,629	-	-	1,980	**1,980**	3,500	1,831	**5,331**
Hydrogen Conversion	$240	$1,630	$2,255	933	837	170	**1,940**	3,500	1,071	**4,571**
18%/20% PRM										
Existing Technologies	$479	$3,156	$4,577	-	-	2,530	**2,530**	3,500	1,021	**4,521**
Long Duration Storage	$433	$1,709	$2,000	-	-	2,310	**2,310**	3,500	1,771	**5,271**
Hydrogen Conversion	$316	$1,982	$2,667	933	837	360	**2,130**	3,500	1,021	**4,521**
Planning Forecast $600/kW TNU (Compared to $400/kW)										
15% PRM										
Existing Technologies	$31	$397	$578	-	-	-	**-**	-	-	**-**
Long Duration Storage	$124	$812	$1,208	-	-	90	**90**	-	(810)	**(810)**
Hydrogen Conversion	$87	$668	$847	-	-	-	**-**	-	(50)	**(50)**
18%/20% PRM										
Existing Technologies	$87	$779	$986	-	-	(310)	**(310)**	-	-	**-**
Long Duration Storage	$145	$852	$1,264	-	-	90	**90**	-	(750)	**(750)**
Hydrogen Conversion	$112	$709	$885	-	-	(190)	**(190)**	-	-	**-**

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – $600/kW Transmission Network Upgrade Costs

	PVRR DELTA			Resources Added 2028-2040 (Nameplate Capacity)						
				Dispatchable				Variable Energy Resources		
	2024-2030 NPV $(M)	2024-2040 NPV $(M)	2024-2043 NPV $(M)	Firm Peaking	CC	Storage	Total	Wind	Solar	Total
Planning Forecast										
15% PRM										
Multi-Jurisdictional Baseline*	$0	$0	$0	3,966	837	200	**5,003**	5,450	3,589	**9,039**
Existing Technologies	$381	$2,753	$4,149	-	-	8,430	**8,430**	8,600	2,429	**11,029**
Long Duration Storage	$320	$1,348	$1,629	-	-	4,920	**4,920**	9,160	3,239	**12,399**
Hydrogen Conversion	$240	$1,630	$2,255	933	837	5,230	**7,000**	8,130	2,479	**10,609**
18%/20% PRM										
Existing Technologies	$479	$3,156	$4,577	-	-	8,970	**8,970**	8,660	2,429	**11,089**
Long Duration Storage	$433	$1,709	$2,000	-	-	5,350	**5,350**	9,130	3,179	**12,309**
Hydrogen Conversion	$316	$1,982	$2,667	933	837	5,810	**7,580**	8,170	2,429	**10,599**
Planning Forecast $600/kW TNU (Compared to $400/kW)										
15% PRM										
Existing Technologies	$31	$397	$578	-	-	40	**40**	(170)	-	**(170)**
Long Duration Storage	$124	$812	$1,208	-	-	170	**170**	(750)	(810)	**(1,560)**
Hydrogen Conversion	$87	$668	$847	-	-	20	**20**	(200)	(50)	**(250)**
18%/20% PRM										
Existing Technologies	$87	$779	$986	-	-	50	**50**	(230)	-	**(230)**
Long Duration Storage	$145	$852	$1,264	-	-	150	**150**	(660)	(750)	**(1,410)**
Hydrogen Conversion	$112	$709	$885	-	-	20	**20**	(40)	-	**(40)**

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – High Natural Gas & Market Energy Prices

- As expected, the cost of all scenarios increases through 2040
- Under the existing technologies case, the total system cost decreases between 2041 and 2043 (compared to the base assumptions), presumably due to the increased revenue from market sales
- The increase in costs through 2040 ranges from $29M to $306M, on a PVRR basis
- Each scenario selects:
  - Fewer wind generating resources
  - Fewer battery energy storage resources and
  - Substantially more solar generating resources

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – High Natural Gas & Market Energy Prices

	PVRR DELTA			Resources Added 2028-2030 (Nameplate Capacity)						
				Dispatchable				Variable Energy Resources		
	2024-2030 NPV $(M)	2024-2040 NPV $(M)	2024-2043 NPV $(M)	Firm Peaking	CC	Storage	Total	Wind	Solar	Total
Planning Forecast										
15% PRM										
Multi-Jurisdictional Baseline*	$0	$0	$0	700	837	100	**1,637**	3,500	1,301	**4,801**
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Existing Technologies	$479	$3,156	$4,577	-	-	2,530	**2,530**	3,500	1,021	**4,521**
Long Duration Storage	$433	$1,709	$2,000	-	-	2,310	**2,310**	3,500	1,771	**5,271**
Hydrogen Conversion	$316	$1,982	$2,667	933	837	360	**2,130**	3,500	1,021	**4,521**
Planning Forecast High Natural Gas & Market Prices (Compared to base gas)										
15% PRM										
Existing Technologies	$242	$89	($215)	-	-	(150)	**(150)**	-	1,280	**1,280**
Long Duration Storage	$177	$169	$29	-	-	(200)	**(200)**	-	1,650	**1,650**
Hydrogen Conversion	$229	$306	$280	-	-	(170)	**(170)**	-	910	**910**
18%/20% PRM										
Existing Technologies	$197	$75	($133)	-	-	(150)	**(150)**	-	1,320	**1,320**
Long Duration Storage	$165	$157	$39	-	-	(220)	**(220)**	-	1,750	**1,750**
Hydrogen Conversion	$218	$296	$259	-	-	(140)	**(140)**	-	950	**950**

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – High Natural Gas & Market Energy Prices

	PVRR DELTA			Resources Added 2028-2040 (Nameplate Capacity)						
				Dispatchable				Variable Energy Resources		
	2024-2030 NPV $(M)	2024-2040 NPV $(M)	2024-2043 NPV $(M)	Firm Peaking	CC	Storage	Total	Wind	Solar	Total
Planning Forecast										
15% PRM										
Multi-Jurisdictional Baseline*	$0	$0	$0	3,966	837	200	**5,003**	5,450	3,589	**9,039**
Existing Technologies	$381	$2,753	$4,149	-	-	8,430	**8,430**	8,600	2,429	**11,029**
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Hydrogen Conversion	$316	$1,982	$2,667	933	837	5,810	**7,580**	8,170	2,429	**10,599**
Planning Forecast High Natural Gas & Market Prices (Compared to base gas)										
15% PRM										
Existing Technologies	$242	$89	($215)	-	-	(20)	**(20)**	(340)	1,280	**940**
Long Duration Storage	$177	$169	$29	-	-	(150)	**(150)**	(480)	1,590	**1,110**
Hydrogen Conversion	$229	$306	$280	-	-	(10)	**(10)**	(160)	860	**700**
18%/20% PRM										
Existing Technologies	$197	$75	($133)	-	-	(20)	**(20)**	(370)	1,320	**950**
Long Duration Storage	$165	$157	$39	-	-	(160)	**(160)**	(390)	1,750	**1,360**
Hydrogen Conversion	$218	$296	$259	-	-	(50)	**(50)**	(90)	950	**860**

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – Low Natural Gas & Market Energy Prices

- As expected, the cost of all scenarios decreases under a low natural gas and market energy price assumption
- The decrease in costs ranges from $30M to $378M, on a PVRR basis
- Each scenario selects:
  - 200MW or less of incremental battery energy storage resources
  - Fewer wind generating resources
- The long duration storage scenario also selects less solar resources

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – Low Natural Gas & Market Energy Prices

				Resources Added 2028-2030 (Nameplate Capacity)						
	PVRR DELTA			Dispatchable				Variable Energy Resources		
	2024-2030 NPV $(M)	2024-2040 NPV $(M)	2024-2043 NPV $(M)	Firm Peaking	CC	Storage	Total	Wind	Solar	Total
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Planning Forecast High Natural Gas & Market Prices (Compared to base gas)										
15% PRM										
Existing Technologies	($246)	($281)	($197)	-	-	-	**-**	-	-	**-**
Long Duration Storage	($229)	($277)	($41)	-	-	140	**140**	-	(810)	**(810)**
Hydrogen Conversion	($257)	($374)	($378)	-	-	30	**30**	-	(50)	**(50)**
18%/20% PRM										
Existing Technologies	($282)	($325)	($256)	-	-	-	**-**	-	-	**-**
Long Duration Storage	($239)	($281)	($30)	-	-	100	**100**	-	(740)	**(740)**
Hydrogen Conversion	($264)	($330)	($335)	-	-	(10)	**(10)**	-	10	**10**

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Sensitivity Modeling Takeaways

SPS Sensitivity Analysis – Low Natural Gas & Market Energy Prices

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15% PRM										
Existing Technologies	($246)	($281)	($197)	-	-	140	**140**	(390)	-	**(390)**
Long Duration Storage	($229)	($277)	($41)	-	-	200	**200**	(840)	(810)	**(1,650)**
Hydrogen Conversion	($257)	($374)	($378)	-	-	140	**140**	(580)	(50)	**(630)**
18%/20% PRM										
Existing Technologies	($282)	($325)	($256)	-	-	120	**120**	(350)	-	**(350)**
Long Duration Storage	($239)	($281)	($30)	-	-	190	**190**	(710)	(740)	**(1,450)**
Hydrogen Conversion	($264)	($330)	($335)	-	-	130	**130**	(510)	10	**(500)**

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Stakeholder Requests

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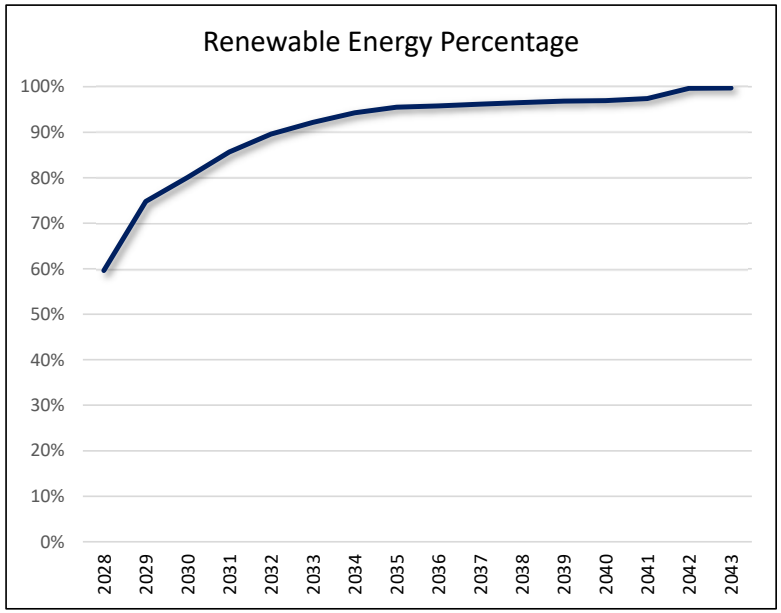
IRP Stakeholder Requests

Early Compliance

- SPS was requested to evaluate accelerated compliance with the Energy Transition Act including '80% carbon-free resources by 2030 and 95% by 2035 on the pathway to 2040 zero carbon target.'
- SPS was requested to evaluate this case under the 'long-duration storage' case assuming the 'planning load'

Results

- SPS's base analysis achieved 80% by 2030, 96% by 2035, and 97% by 2040, and 99.6% by 2042 without constraining the model
- To meet the 2040 zero carbon target, SPS will be required to accelerate the retirement of its remaining existing combustion turbine generators



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IRP Stakeholder Requests

Virtual Power Plant

- SPS evaluated a scenario in which ~5% of SPS's existing NM residential and small C&I energy sales could be served by 113.3MW of distributed solar and 56.7MW of distributed battery energy storage
- As requested, this scenario was compared against the 'existing technologies' case under the 'electrification and emerging technologies' load assumption
- As the Hybrid solar and battery energy storage resource was not initially selected, SPS ran an additional case where the resources were 'forced' into the model

Results

- The additional hybrid resource avoided 30MW of battery energy storage and 50MW of solar resources, and
- Increased the overall cost of the portfolio by $82M on a PVRR basis

Comments

The economic viability of a distributed solar and battery energy storage is ultimately driven by the cost and technical capabilities of resources modeled. Additional, project specific, details are required to further evaluate the potential benefits and costs.

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IRP Stakeholder Requests

Dynamic Load Shifting

- SPS evaluated a scenario in which ~5% of SPS's existing NM residential and small C&I can be shifted from 'net on-peak' to 'net off-peak'
- The program was sized at 119.3MW and could be called up once per day, 365 days a year, for a duration of no more than 4 hours
- The accredited capacity of the program (i.e., resource) was grossed up 15% to 137.2MW on the assumption SPS would avoid carrying planning reserves
- The program was evaluated at 'zero-cost'
- The program was compared against the 'existing technologies case' under the 'electrification and emerging technologies' load assumption

Results

- The program avoided 30MW of wind, 10MW of solar, and 250MW of lithium-ion battery energy storage through 2043, and reduced costs by $294M on a PVRR basis.

Comments

As the program was evaluated at 'zero-cost', it is not surprising the program shows costs savings. The costs savings should be evaluated against the potential cost of implementing such a program

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IRP Stakeholder Requests

Demand Response

- SPS evaluated a scenario which included an additional 200MW demand response program
- The program was sized at 200MW and could be called upon once per day, 365 days per year, for a duration of no more than 4 hours
- The program was evaluated at 'zero-cost'
- The program was compared against the 'long duration storage' case under the 'planning' load assumption

Results

- The additional DR program avoided 400MW of storage, 170MW of wind, and *added* 120MW of solar
- Total system costs were reduced by $439M on a PVRR basis

Comments

As the program was evaluated at 'zero-cost', it is not surprising the program shows costs savings. The costs savings should be evaluated against the potential cost of implementing such a program. Furthermore, projected savings are based on a DR program that is callable 365 days per year.

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IRP Stakeholder Requests

Increased Hydrogen Blending

- SPS incorporated the following assumptions as part of its own Hydrogen Conversion analysis (conforming with potential EPA requirements):
  - 30% Hydrogen (by volume) by 2032, 96% Hydrogen (by volume) by 2038

- As requested SPS evaluated an increased Hydrogen Blending case using the following assumptions:
  - ***50%*** Hydrogen (by volume) by 2032, 96% Hydrogen (by volume) by 2028

- The program was compared against the 'Hydrogen Conversion' case under the electrification and emerging technologies load assumption

Results

- Under the increased hydrogen blending case, the portfolio of resources essentially remained the same (the only difference being an additional 10MW of battery energy storage).
- The portfolio cost increased by $16M on a PVRR basis

Comments

The increase in portfolio cost does not assume any changes for the cost of hydrogen infrastructure (e.g., pipeline) compared to the base case. Project specific information is required to calculate the cost impact of increased hydrogen blending

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IRP Stakeholder Requests

Reciprocating Engines – Without Sub-hourly Credit

- SPS added Reciprocating Engines to the list of resources available for selection
- Wartsila provided the cost and technical characteristics for the resources
- The program was compared against the 'Hydrogen Conversion' case under the 'planning load' assumption
- SPS limited the addition of Reciprocating Engines to 2 new resources (consisting of 3 units each) per year

Results

- EnCompass replaced 3,390MW of battery energy storage and 940MW of wind generation with 1,807 MW of RICE (the maximum available) and an incremental 690MW of solar
- The scenario decreased costs by $519M, on a PVRR basis

Comments

SPS did not include any incremental hydrogen delivery costs (i.e., pipeline) for the additional RICE resources. Any additional costs will lower the calculated savings

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IRP Stakeholder Requests

Reciprocating Engines – With Sub-hourly Credit

- SPS re-ran the RICE stakeholder request to include a credit for resources with a sub-hourly start time
- The sub-hourly credit was calculated by Wartsila and was incorporated as a negative fixed cost to BESS, RICE, and CTG
  - As an 'instantaneous' resource, the sub-hourly credit was highest for BESS
  - RICE resources received the second highest sub-hourly credit
  - Fast-start CTs received the lowest sub-hourly credit

Results

- EnCompass replaced all CTs and most RICE resources with new BESS and adds additional wind. EnCompass also selects fewer wind resources.
- As this sensitivity fundamentally changes the cost of all new dispatchable resources, SPS cannot compare the cost impact

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QUESTIONS ?

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