Framing the Vision for 2030, 2040 and 2050

New Mexico Grid Modernization Retreat Dr. Dan E. Arvizu December 12, 2019 Chancellor, New Mexico State University System



BE BOLD. Shape the Future.

Transition to a Low Carbon Energy Future

... an imperative: but challenges and opportunities abound

- Elements of a Transition in NM to a Clean Energy Economy
- High Penetration Renewable Energy
- Power Grid Operational Challenges
- Parting Thoughts



New Mexico's Electric Energy Mix: June 2018





New Mexico Has Abundant Renewable Resources



Sourced from the Wind Integration National Dataset (WIND) Data provided by the National Renewable Energy Laboratory for the U.S. Department of Energy

Direct Normal Solar Resource of New Mexico



2005-2012 annual average daily total solar resource averaged over surface cells of 0.038 degrees in both latitude and longitude, or, nominally, 4 km in size.



LUL /m 2/D a
KWN/m²/Da
8.0 to 8.5
7.5 to 8.0
7.0 to 7.5
6.5 to 7.0
6.0 to 6.5
5.5 to 6.0
5.0 to 5.5
4.5 to 5.0
0.5 to 4.5



Created using PATMOS-X algorithms, the MMAC radiative transfer model, and SASRAB model Data provided by the National Renewable Energy Laboratory for the U.S. Department of Energy



The Southwest region leads tight oil production growth in the United States in the reference case

Lower 48 onshore crude oil production by region (reference case)

Million Barrels per day





U.S Energy Information Administration

www.eia.gov/aeo



Dry natural gas production from oil formations trillion cubic feet



Source: US Energy Information Administration | eia.gov/aeo



Grid Operational Challenges Grid Modernization Overall Results



RANK	+/-	STATE LE	ADERSHIP SCORE
1	0	California	81.5
2	0	Illinois	73.0
3	0	Texas	64.6
4	0	Maryland	57.5
5	2	Oregon	56.8
6	3	Arizona	55.5
7	-2	District of Co	lumbia 53.5
8	8	New York	51.0
9	5	Nevada	50.1
10	-4	Delaware	48.5
11	1	Hawaii	46.0
12	8	Massachuset	ts 44.8
13	-5	Pennsylvania	44.0
14	-4	Georgia	43.5
15	-4	North Carolir	na 43.3
16	-1	Michigan	41.7
17	12	Washington	40.5
18	17	Colorado	40.0
19	-6	Vermont	39.6
20	2	Missouri	39.0
21	-2	Minnesota	38.8
22	3	Ohio	36.3
23	25	Rhode Island	34.0
24	2	New Jersey	32.3
25	-8	Florida	30.1

RANK	+/-	STATE I	EADERSHIP SCORE
26	-5	Maine	29.5
27	-9	Oklahoma	29.0
28	-4	Indiana	27.0
29	4	Louisiana	24.4
30	2	Idaho	23.9
31	-8	Virginia	23.4
32	-2	Arkansas	23.3
33	1	South Caro	lina 23.1
34	-6	New Hamp	shire 21.6
35	-4	Connecticu	it 21.4
36	7	Mississippi	21.3
37	-10	Alabama	21.0
38	-1	West Virgin	nia 19.0
39	1	Wisconsin	15.1
40	-4	Kansas	14.4
41	3	Tennessee	13.2
42	-3	Wyoming	11.9
43	2	Kentucky	11.6
44	-3	New Mexic	° 11.0
45	1	lowa	10.7
46	-8	Utah	10.5
47	0	Alaska	10.3
48	-6	South Dake	ota 9.0
49	1	Nebraska	8.5
50	-1	Montana	6.3



BE BOLD. Shape the Future.



Global Electricity Supply "is being rapidly transformed by the rise of **renewables**"



Increased Complexities in providing reliable, resilient, secure & affordable electricity



Need to address many technical challenges to transform our energy system







Grid Operational Challenges – Opportunity Rich!

- Distributed energy resources
- Net energy metering
- Renewable portfolio standards
- Variable and uncertain generation
- Fast ramping requirements
- Distributed storage
- Community solar
- Community choice aggregators
- Need for flexibility
- Autonomous microgrids
- Grid defection
- Self-generation

- Stagnant or declining demand
- Aging infrastructure
- Negative ISO clearing prices
- Physical and cyber threats
- Transmission right-of-way access
- Confused regulators
- Confused investors
- Electric vehicle loads
- Carbon
- Retail choice
- Virtual power plants
- Reduced grid inertia

