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# Overview of Xcel Energy and SPS in New Mexico and Texas

**Brian Fleming**
**Analyst – Resource Planning**

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# Overview of SPS

- Southwestern Public Service Company (SPS) is registered in New Mexico
- Electric investor-owned electric utility operating in Texas & New Mexico
- SPS is a wholly-owned subsidiary of Xcel Energy Inc.
- SPS does business under the ‘Xcel Energy’ brand

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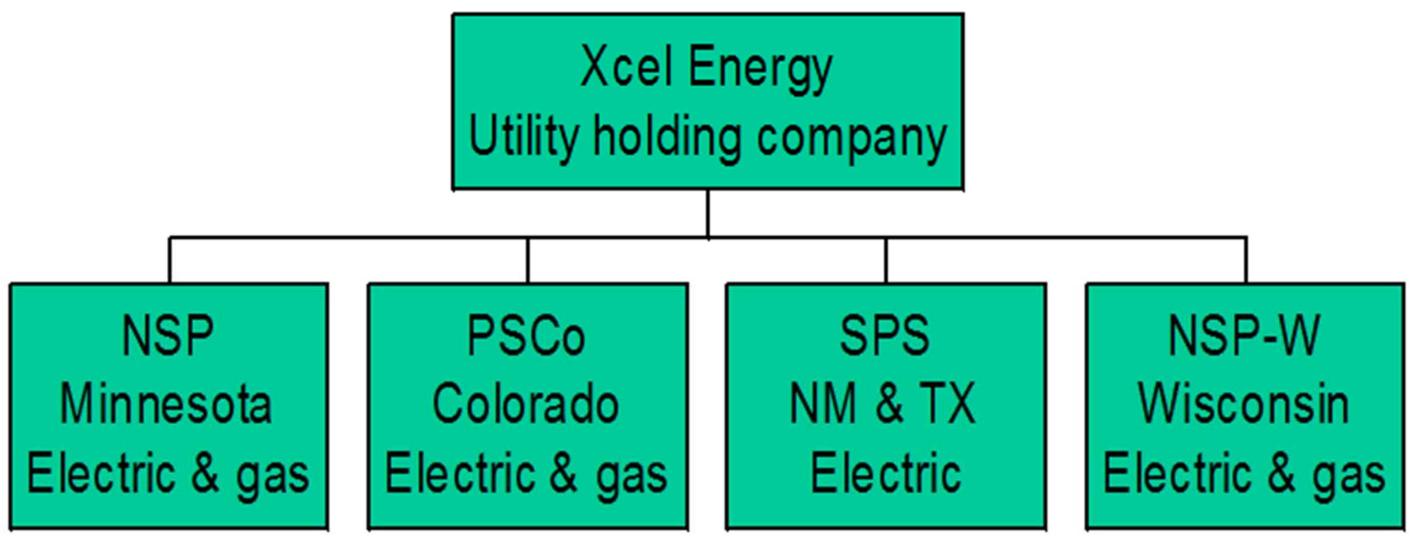
# Corporate Structure



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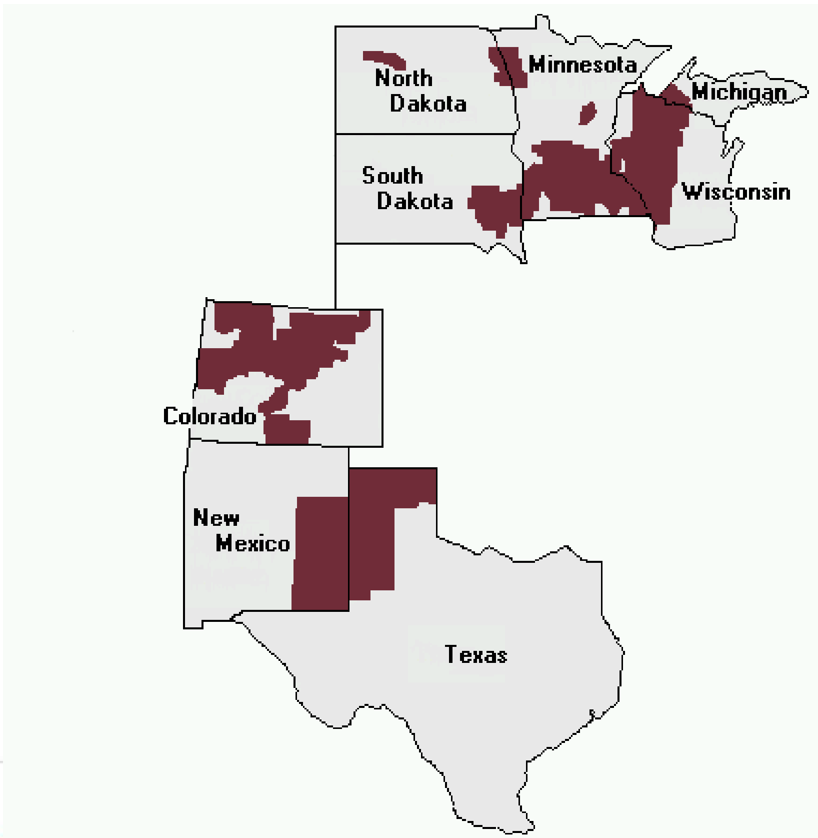
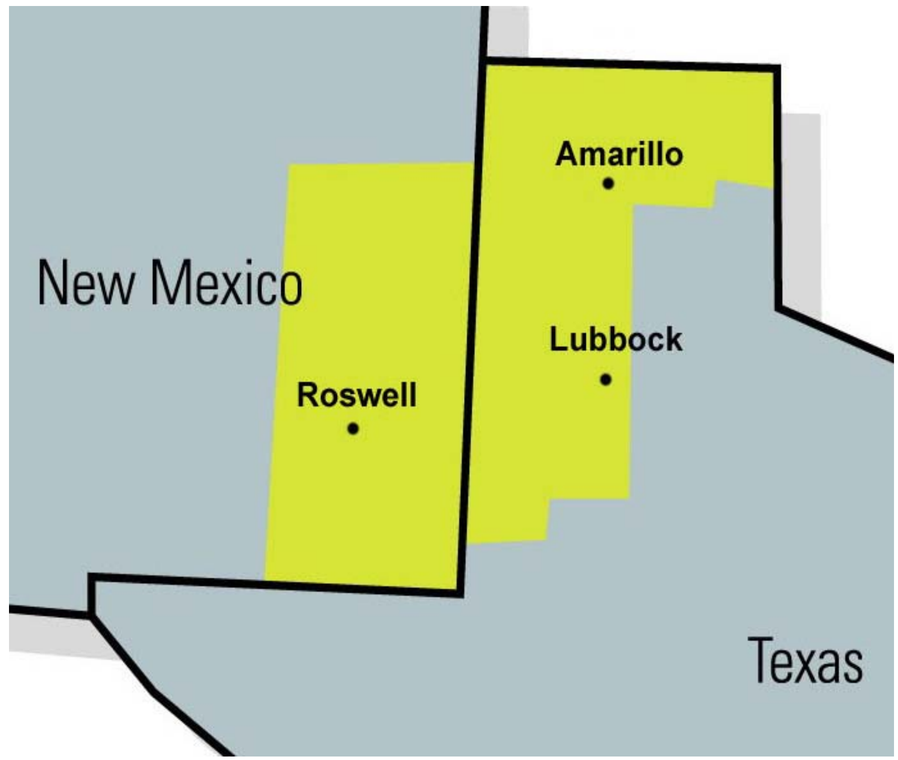
# Xcel Energy Operations




| XCEL ENERGY | |
|---|---|
| Electric Customers | 3.4 million |
| Gas Customers | 1.9 million |

# SPS Today

- Customers: 383,000
  - 267,000 in Texas
  - 116,000 in New Mexico
- Employees: 1,000
- Communities Served:
  - 80 in Texas
  - 14 in New Mexico
- Low Rates
- High Reliability



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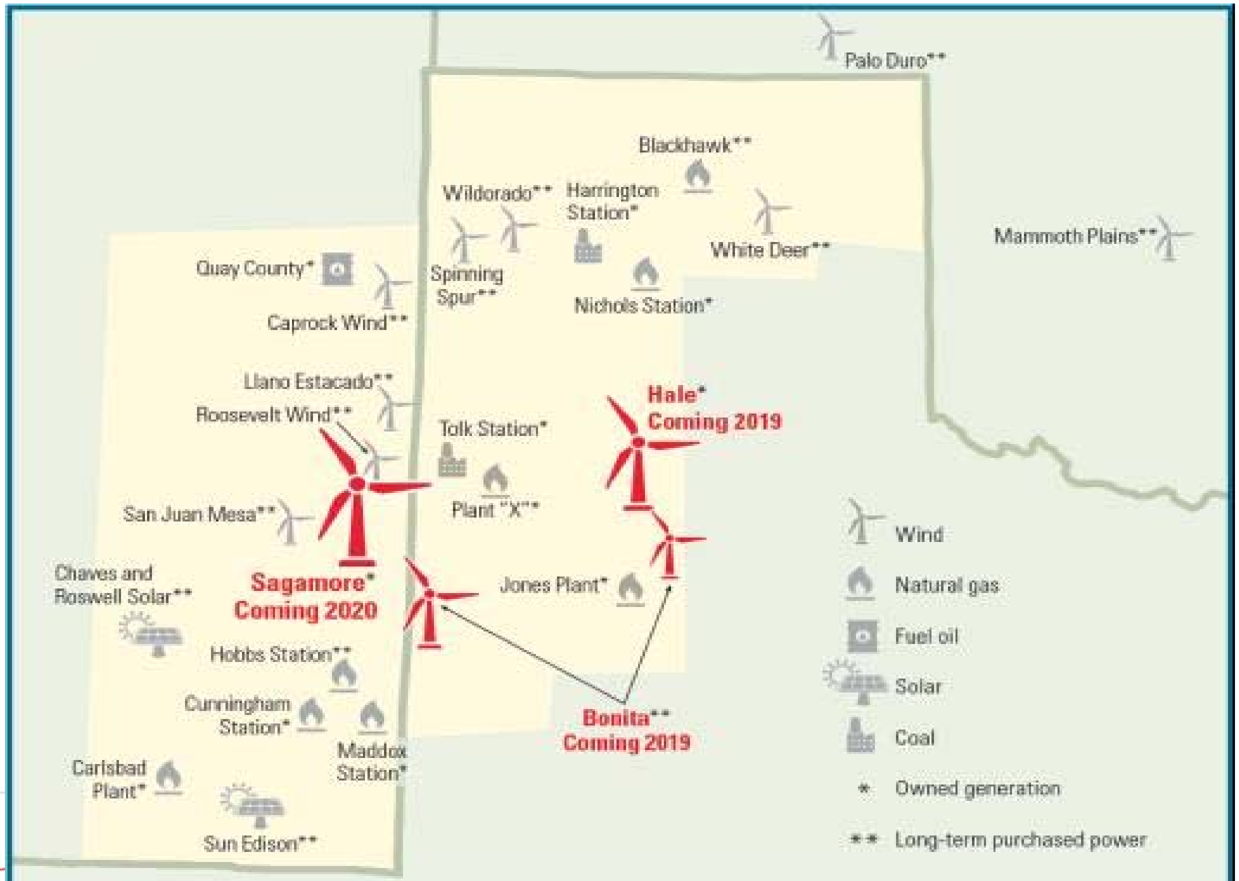
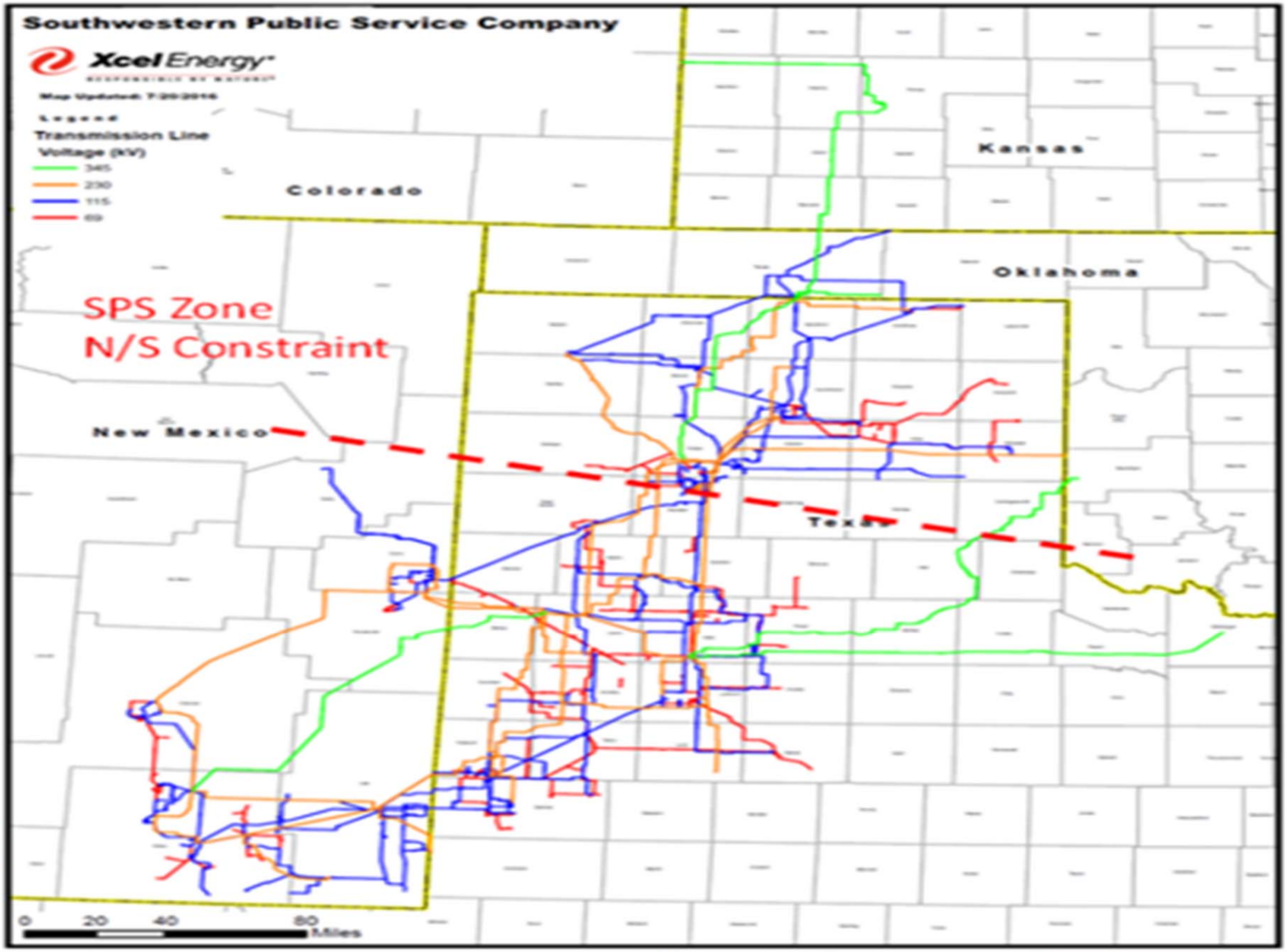
# Jurisdictional Composition

- SPS operates its production and transmission system as an integrated whole and allocates costs to all system customers
- New Mexico distribution activities are assigned to New Mexico
- SPS serves in three customer jurisdictions:
  - Texas retail – 50.8%
  - Wholesale – 29.8%
  - New Mexico retail – 19.4%
- SPS is substantially reducing its wholesale power sales in accordance with the settlement in NM Case No. 10-00074-UT

# Power Plants/Renewable Energy



# SPS Transmission System



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# SPS Sources of Renewable Energy

**New Mexico**

- **80 MW Caprock Wind – Quay Co, NM**
- **120 MW San Juan Mesa Wind – Chaves Co, NM**
- **250 MW Roosevelt Wind – Roosevelt Co, NM**
- **50 MW SunEd Solar – Lea Co & Eddy Co, NM**
- **140 MW NextEra Solar Facilities – Chaves Co, NM**
- **1.5 MW FERC Qualifying Facility Wind**

Total New Mexico renewable – 641.5 MW

**Texas & Oklahoma**

- **160 MW Wildorado Wind – Oldham Co, TX**
- **160 MW Spinning Spur Wind – Oldham Co, TX**
- **250 MW Palo Duro Wind – Hansford Co, TX**
- **200 MW Mammoth Plains Wind – Dewey Co, OK**
- **281.5 MW FERC Qualifying Facility Wind**

Total Texas & Oklahoma renewable – 1,051.5 MW

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# SPS Landscape

**Bennie Weeks**
**Manager – Resource Planning**

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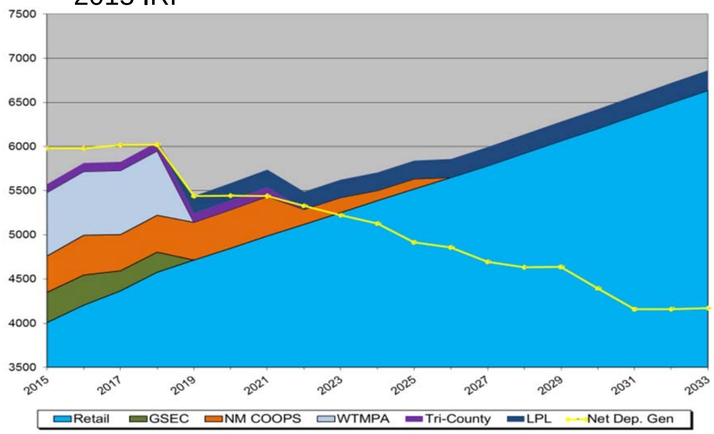
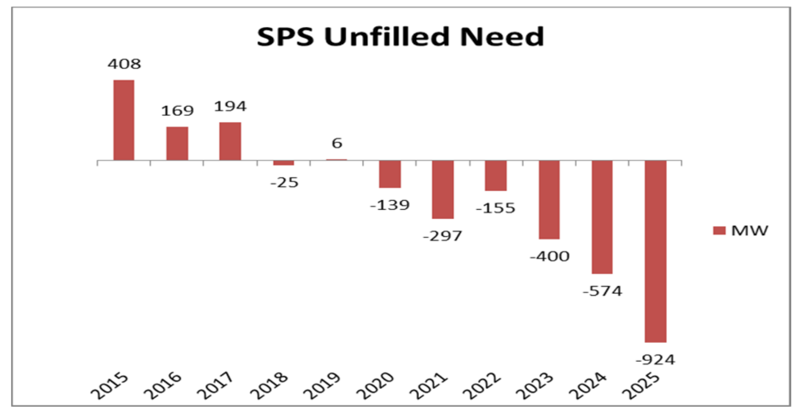
# Updates Since 2015 IRP

- Decreased Load Growth Rate
  - Load heavily dependent on industrial activity which is volatile based on commodity prices
- Production Tax Credit (“PTC”) extended
- Approval of solar PPAs
- Clean Power Plan has been stayed
- No current need for new combustion turbine generator in the 2018-2020 timeframe
- SPS filed an update to it IRP Action Plan in March 2017.

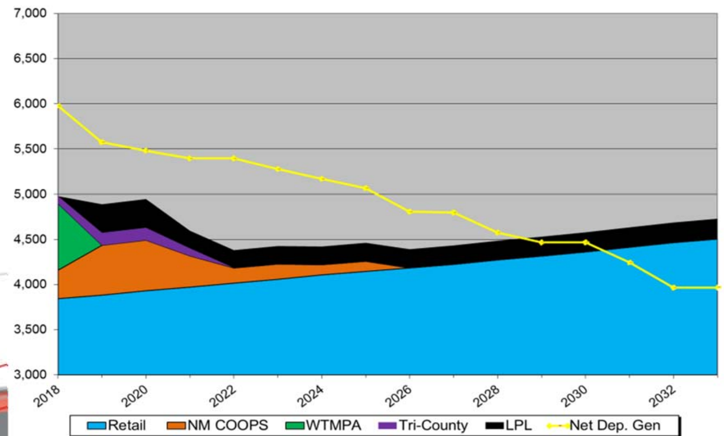
# SPS Load and Resources

2015 IRP

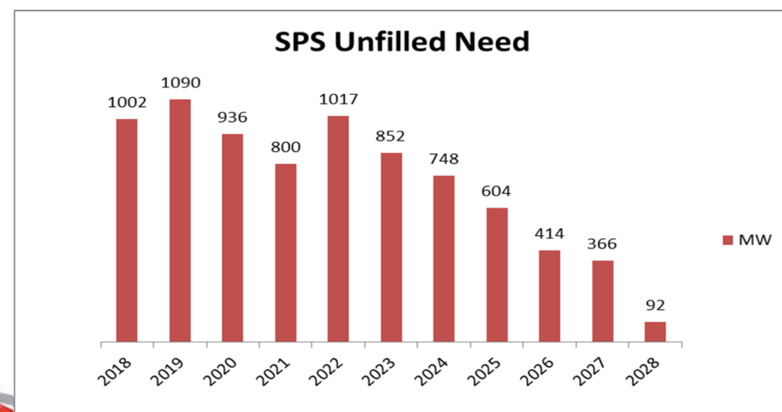



Current




**SPS can actively manage the volatility if loads start increasing**



# SPS Generation Fleet

| Steam Units | | |
|---|---|---|
| **Unit** | ***Emergency Capability (Net - MW)*** | **Total by Plant (MW)** |
| Cunningham 1 | 71 | |
| Cunningham 2 | 192 | 263 |
| Harrington 1 | 340 | |
| Harrington 2 | 340 | |
| Harrington 3 | 351 | 1031 |
| Jones 1 | 243 | |
| Jones 2 | 243 | 486 |
| Maddox 1 | 112 | 112 |
| Nichols 1 | 113 | |
| Nichols 2 | 111 | |
| Nichols 3 | 249 | 473 |
| Plant X 1 | 41 | |
| Plant X 2 | 90 | |
| Plant X 3 | 95 | |
| Plant X 4 | 190 | 416 |
| Tolk 1 | 537 | |
| Tolk 2 | 539 | 1076 |
| **Steam Subtotal** | **3857** | |

| Simple Cycle CT Units | | |
|---|---|---|
| **Unit** | ***Emergency Capability (Net - MW)*** | |
| Carlsbad | 0 | 0 |
| Cunningham 3 | 106 | |
| Cunningham 4 | 106 | 212 |
| Jones 3 | 168 | |
| Jones 4 | 170 | 338 |
| Maddox 2 | 61 | 61 |
| Quay Co | 17 | 17 |
| **CT Subtotal** | **628** | |

**SPS System Total Capability – 4485 MW**

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# SPS Landscape

- System length due to slower load growth; resource need in 2028
  - Declining wholesale firm power sales
  - Decreasing oil and gas load growth rates until world supply rebalances
- Water availability and environmental regulations
  - Regional Haze, CPP, NAAQS
  - Tolk Station base load groundwater input constraint

# SPS Landscape (cont'd)

- Coal plant situation
  - All five coal generating units do not have scrubbers
    - Harrington has NAAQS monitor installed by the Texas Commission on Environmental Quality
    - Tolk has been designated under regional haze.  The regional haze case has been stayed
  - Harrington uses city affluent for cooling water; Tolk uses groundwater
  - Units were originally planned and certificated for a 35-year life; extended to 60 years in rate case settlements

| Coal Generation | Year Installed | NDC | Book Retirement |
|---|---|---|---|
| Harrington 1 | 1976 | 339 MW | 2036 |
| Harrington 2 | 1978 | 339 MW | 2038 |
| Harrington 3 | 1980 | 340 MW | 2040 |
| Tolk 1 | 1982 | 521 MW | 2042 |
| Tolk 2 | 1985 | 524 MW | 2045 |

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# SPS Landscape (cont'd)

- Market Structure & Transmission Planning/Ownership
  - Transmission investment dependent upon SPP
  - Increasing wind in northern sub-zone impacts Harrington coal plant operations
  - Congested market, long in generation

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# SPS Landscape (cont'd)

- Managed operation of two coal plants
  - Harrington is now in last third of life
    - No major pollution control investment
  - Tolk Station is now 32-35 years old
    - Groundwater operational considerations
    - No major pollution control investment

- Managed decline of old high heat-rate NG units
  - Minimized capital investment
  - Minimized O&M closer to retirement date

- Substantial generation expansion required in the late 2020's

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# Renewable Energy Landscape

- Significant merchant renewable investment (older QF market wind winding down as PTC's expire)

| Existing renewable generation | MW |
|---|---|
| wind in SPS footprint | 2,586 |
| PPA wind outside SPS footprint | 550 |
| solar in SPS footprint | 217 |
| TOTAL | 3,353 |

| New renewables under study in SPS | MW |
|---|---|
| wind in SPS footprint | 1,230 |
| wind by others | 2,224 |
| solar by others | 1,211 |
| TOTAL | 4,665 |

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# SPS Generation Transition Opportunities

- Complete SPS Wind Initiative
  - Develop other renewable opportunities
- Explore Tolk Station operating plan given groundwater costs
- Develop environmental plan for Harrington dependent on NAAQS determination
- Mindful of long-term environmental pressure

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# Summary of SPS's 2017 RPS Filing
# Filed July 3, 2017

Ruth Sakya
Manager, Regulatory Policy

# 2016 Compliance Position

| Line No. | Description | Solar | Other | DG | Wind - Remaining | Total |
|---|---|---|---|---|---|---|
| 1 | 2016 NM Retail Sales | | | | | 5,279,147 |
| 2 | Less Qualifying Large Customer Sales (Total) | | | | | 2,231,085 |
| 3 | Adjusted NM Retail Sales (L1 - L2) | | | | | 3,048,062 |
| 4 | Overall RPS Requirement (%) | | | | | 15% |
| 5 | RPS Obligation, Excluding Qualifying Large Customers (L3 * L4) | | | | | 457,209 |
| 6 | Qualifying Large Customer MWh for the RPS (Appendix F) | | | | | 137,632 |
| 7 | Final RPS Obligation (L5 + L6) | | | | | 594,842 |
| 8 | Diversity Requirement (% of RPS) | 20.0% | 5.0% | 3.0% | 72.0% | 100.0% |
| 9 | RPS Obligation (L7 * L8) | 118,968 | 29,742 | 17,845 | 428,287 | 594,842 |
| 10 | | | | | | |
| 11 | Beginning REC Balance | - | - | | 1,515,699 | 1,515,699 |
| 12 | | | | | | |
| 13 | Caprock Wind Generation | - | - | - | 324,238 | 324,238 |
| 14 | San Juan Wind Generation | - | - | - | 397,581 | 397,581 |
| 15 | Mesalands Wind Generation | - | - | - | 2,990 | 2,990 |
| 16 | SunEdison Solar Generation | 108,879 | - | - | - | 108,879 |
| 17 | Company Owned Solar Generation | - | - | 154 | - | 154 |
| 18 | SolarRewards (Distributed Generation) Generation | - | - | 13,102 | - | 13,102 |
| 19 | Total Annual Generation (Sum L13:L18) (Page 3) | 108,879 | - | 13,256 | 724,808 | 846,943 |
| 20 | Less Transfers to Wholesale Customers | - | - | - | 157,820 | 157,820 |
| 21 | Less REC Sales (all vintages) (Page 2) | - | - | - | - | - |
| 22 | Less Expiring RECs | - | - | - | - | - |
| 23 | Less Annual RPS Obligation (L9) | 118,968 | 29,742 | 17,845 | 428,287 | 594,842 |
| 24 | REC Adjustments from Prior Years | - | - | 102 | (3) | 99 |
| 25 | Annual Excess/(Deficiency) (L19 - L20 - L21 - L22 - L23 + L24) | (10,089) | (29,742) | (4,487) | 138,699 | 94,380 |
| 26 | | | | | | |
| 27 | Cumulative Excess/(Deficiency) (L11 + L25) | (10,089) | (29,742) | (4,487) | 1,654,398 | 1,610,079 |
| 28 | Replace Solar, DG & Other with Wind for Overall RPS Compliance1 | 10,089 | 29,742 | 4,487 | (44,318) | - |
| 29 | Impact of Replacements (Ending REC Balance) | - | - | - | 1,610,079 | 1,610,079 |

# Forecasted RPS Need & Position - 2018

| Line No. | Description | Solar | Other | DG | Wind /Remaining | Total |
|---|---|---|---|---|---|---|
| 1 | 2018 NM Retail Sales | | | | | 5,396,067 |
| 2 | Less Qualifying Large Customer Sales (Total) | | | | | 2,231,085 |
| 3 | Adjusted NM Retail Sales (L1 - L2) | | | | | 3,164,982 |
| 4 | Overall RPS Requirement (%) | | | | | 15% |
| 5 | RPS Obligation, Excluding Qualifying Large Customers (L3 * L4) | | | | | 474,747 |
| 6 | Qualifying Large Customer MWh for the RPS (Page 3) | | | | | 80,554 |
| 7 | Final RPS Obligation (L5 + L6) | | | | | 555,302 |
| 8 | Diversity Requirement (% of RPS) | 20% | 5% | 3% | 72% | 100% |
| 9 | RPS Obligation (L7 * L8) | 111,060 | 27,765 | 16,659 | 399,817 | 555,302 |
| 10 | | | | | | |
| 11 | Beginning REC Balance | - | - | - | 1,709,301 | 1,709,301 |
| 12 | | | | | | |
| 13 | Caprock Generation | - | - | - | 311,122 | 311,122 |
| 14 | San Juan Generation | - | - | - | 400,407 | 400,407 |
| 15 | Mesalands Generation | - | - | - | - | - |
| 16 | SunEdison Solar Generation | 108,556 | - | - | - | 108,556 |
| 17 | Company Owned Solar Generation | - | - | 151 | - | 151 |
| 18 | SolarRewards (Distributed Generation) | - | - | 13,866 | - | 13,866 |
| 19 | Total Annual Generation (Sum L13:L18) | 108,556 | - | 14,017 | 711,529 | 834,102 |
| 20 | Less Transfers to Wholesale Customers | - | - | - | 140,955 | 140,955 |
| 21 | Less REC Sales (all vintages) | - | - | - | - | - |
| 22 | Less Expiring RECs | - | - | - | - | - |
| 23 | Less Annual RPS Obligation (L9) | 111,060 | 27,765 | 16,659 | 399,817 | 555,302 |
| 24 | REC Adjustments from Prior Years | - | - | - | - | - |
| 25 | Annual Excess/(Deficiency) (L19 - L20 - L21 - L22 - L23 - L24)1 | (2,504) | (27,765) | (2,642) | 170,756 | 137,845 |
| 26 | | | | | | |
| 27 | Cumulative Excess/(Deficiency) (L11 + L25) | (2,504) | (27,765) | (2,642) | 1,880,057 | 1,847,146 |
| 28 | Replace Solar, Other, & DG with Wind for Overall RPS Compliance | 2,504 | 27,765 | 2,642 | (32,911) | - |
| 29 | Impact of Replacements (Ending REC Balance) | - | - | - | 1,847,146 | 1,847,146 |

# Forecasted RPS Need & Position - 2019

| Line No. | Description | Solar | Other | DG | Wind /Remaining | Total |
|---|---|---|---|---|---|---|
| 1 | 2019 NM Retail Sales | | | | | 5,483,283 |
| 2 | Less Qualifying Large Customer Sales (Total) | | | | | 2,231,085 |
| 3 | Adjusted NM Retail Sales (L1 - L2) | | | | | 3,252,198 |
| 4 | Overall RPS Requirement (%) | | | | | 15% |
| 5 | Unadjusted RPS Obligation (L3 * L4) | | | | | 487,830 |
| 6 | Qualifying Large Customer MWh for the RPS (Page 3) | | | | | 90,118 |
| 7 | Final RPS Obligation (L5 + L6) | | | | | 577,948 |
| 8 | Diversity Requirement (% of RPS) | 20% | 5% | 3% | 72% | 100% |
| 9 | RPS Obligation (L7 * L8) | 115,590 | 28,897 | 17,338 | 416,123 | 577,948 |
| 10 | | | | | | |
| 11 | Beginning REC Balance | - | - | - | 1,847,146 | 1,847,146 |
| 12 | | | | | | |
| 13 | Caprock Generation | - | - | - | 311,059 | 311,059 |
| 14 | San Juan Generation | - | - | - | 400,392 | 400,392 |
| 15 | Mesalands Generation | - | - | - | - | - |
| 16 | SunEdison Solar Generation | 105,723 | - | - | - | 105,723 |
| 17 | Company Owned Solar Generation | - | - | 151 | - | 151 |
| 18 | SolarRewards (Distributed Generation) | - | - | 13,795 | - | 13,795 |
| 19 | Total Annual Generation (Sum L13:L18) | 105,723 | - | 13,946 | 711,451 | 831,120 |
| 20 | Less Transfers to Wholesale Customers | - | - | - | 137,126 | 137,126 |
| 21 | Less REC Sales (all vintages) | - | - | - | - | - |
| 22 | Less Expiring RECs | - | - | - | - | - |
| 23 | Less Annual RPS Obligation (L9) | 115,590 | 28,897 | 17,338 | 416,123 | 577,948 |
| 24 | REC Adjustments from Prior Years | - | - | - | - | - |
| 25 | Annual Excess/(Deficiency) (L19 - L20 - L21 - L22 - L23 - L24)1 | (9,866) | (28,897) | (3,393) | 158,203 | 116,046 |
| 26 | | | | | | |
| 27 | Cumulative Excess/(Deficiency) (L11 + L25) | (9,866) | (28,897) | (3,393) | 2,005,349 | 1,963,192 |
| 28 | Replace Solar, Other, & DG with Wind for Overall RPS Compliance | 9,866 | 28,897 | 3,393 | (42,157) | - |
| 29 | Impact of Replacements (Ending REC Balance) | - | - | - | 1,963,192 | 1,963,192 |

# Questions and Discussion

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# Topics For Future Meetings

- Environmental Update
- Aging Generation Fleet
- Gas & Power Markets
- Coal Supply
- Demand-side Management and Energy Efficiency
- Storage

# Information

For more information on the overall transmission plan and individual projects:

Power for the Plains

**www.powerfortheplains.com**

# IRP Information

- **Web Page**
  - **www.xcelenergy.com/About_Us/Rates_&_Regulations/Resource_Plans**

- **Bennie Weeks – Xcel Energy/SPS Contact**
  - **Address – 790 Buchanan, Suite 700, Amarillo TX 79101**
  - **Phone - (806) 378-2508**
  - **Email – bennie.weeks@xcelenergy.com**

# Next Meeting

- **Date:**
  - **Thursday, November 9, 2017**
- **Time:**
  - **10:00am to 12:00pm (Mountain Time)**
- **Location:**
  - **Webinar meeting**

# Tolk Water Situation

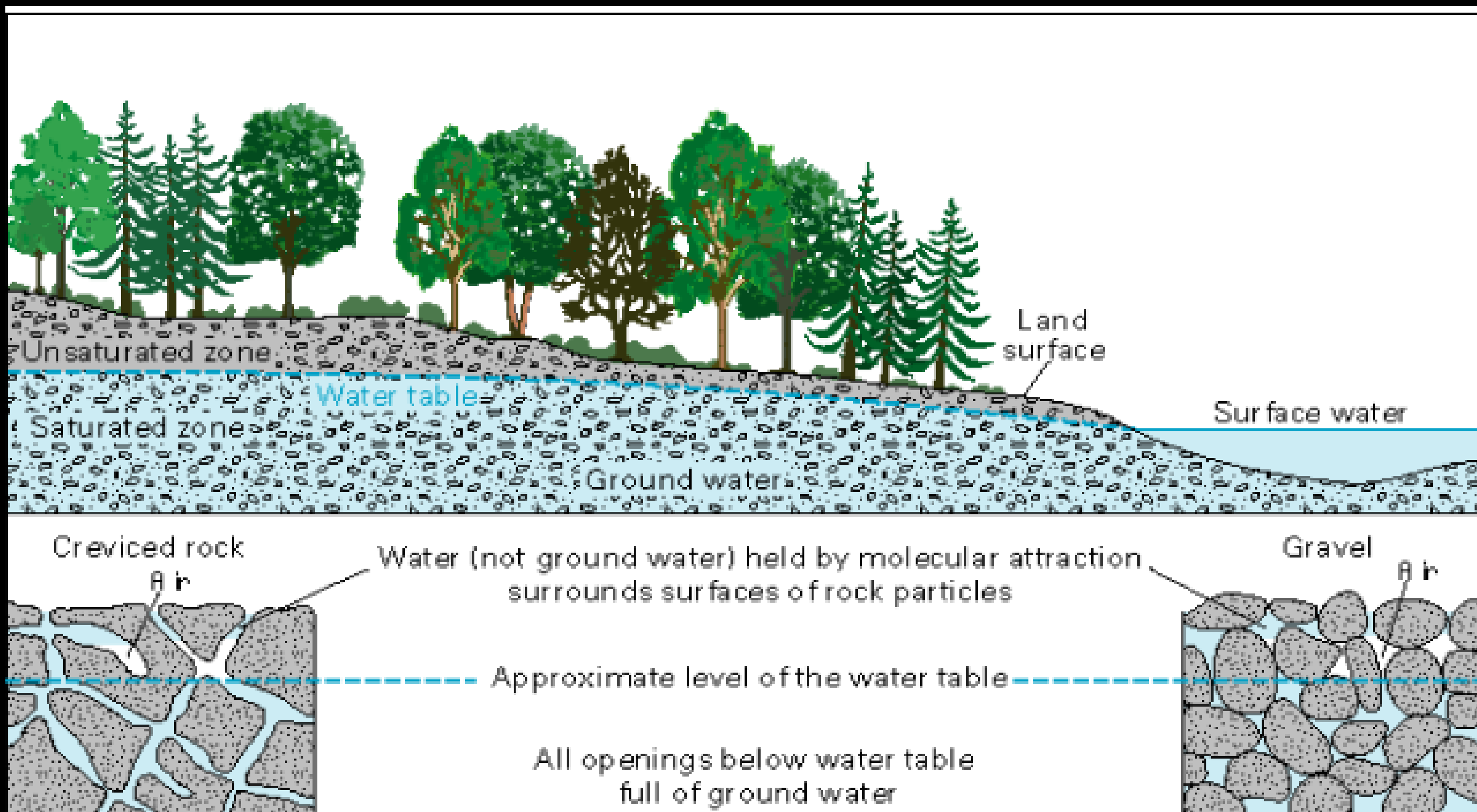
Alan J. Davidson
Director, Capital Projects

November 9, 2017

# What is an aquifer?

- Below a certain depth, the ground, if it is permeable enough to hold water, is saturated with water
- The upper surface of this zone of saturation is called the water table
- The saturated zone beneath the water table containing sediment and rock is called an aquifer, and aquifers are huge storehouses for water
- Wells can be drilled into the aquifers and water can be pumped out
- Precipitation eventually can add water (recharge) into the porous rock of the aquifer if the surface area is adaptive.

# Diagram of an Aquifer



# What is Saturated Thickness?

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- Saturated thickness is the volume of the aquifer in which the pore spaces are completely filled (saturated) with water.
- For an unconfined aquifer like the Ogallala, the saturated thickness is the distance from the water table surface to the base of the aquifer
- It is the thickness that supplies water to wells. As water levels decline, so does the saturated thickness

# Regional Overview

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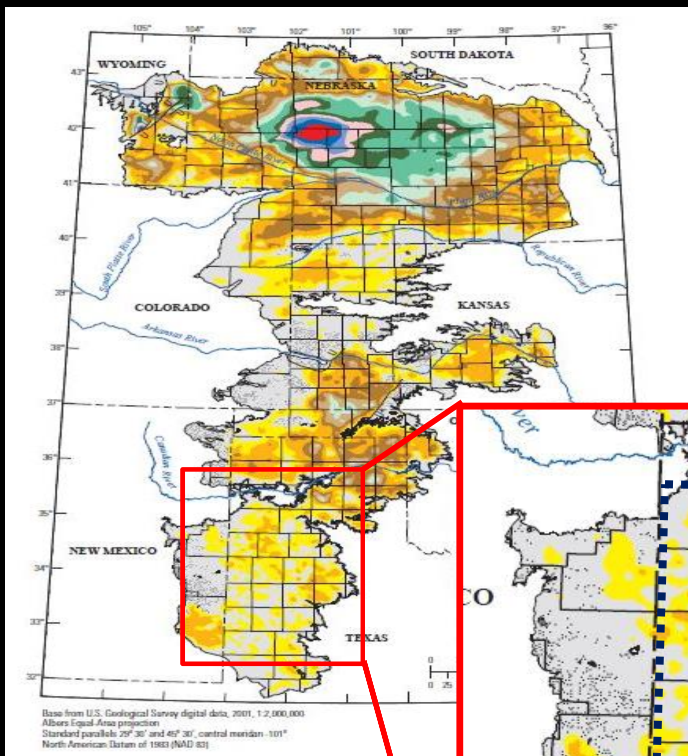
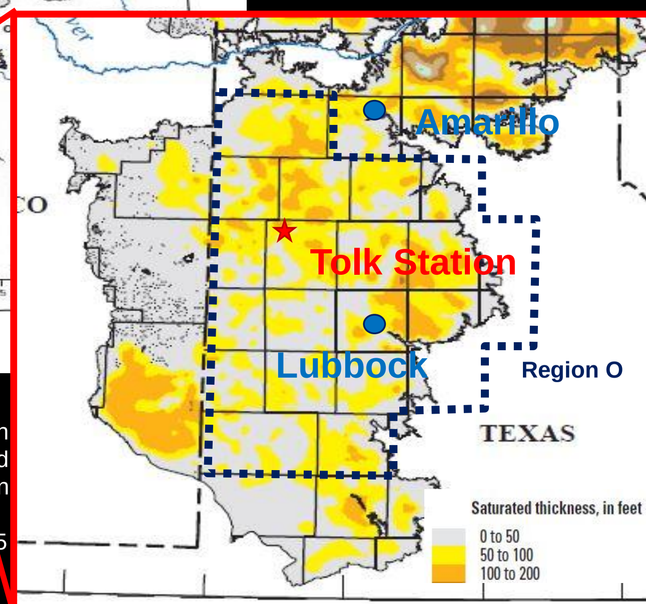
- In Lamb Co. (HPWD, 2016)
  - ~50-foot avg saturated thickness
  - ~16-foot avg saturated thickness decline since 2006
- At ~40-foot saturated thickness, high-capacity well production collapses

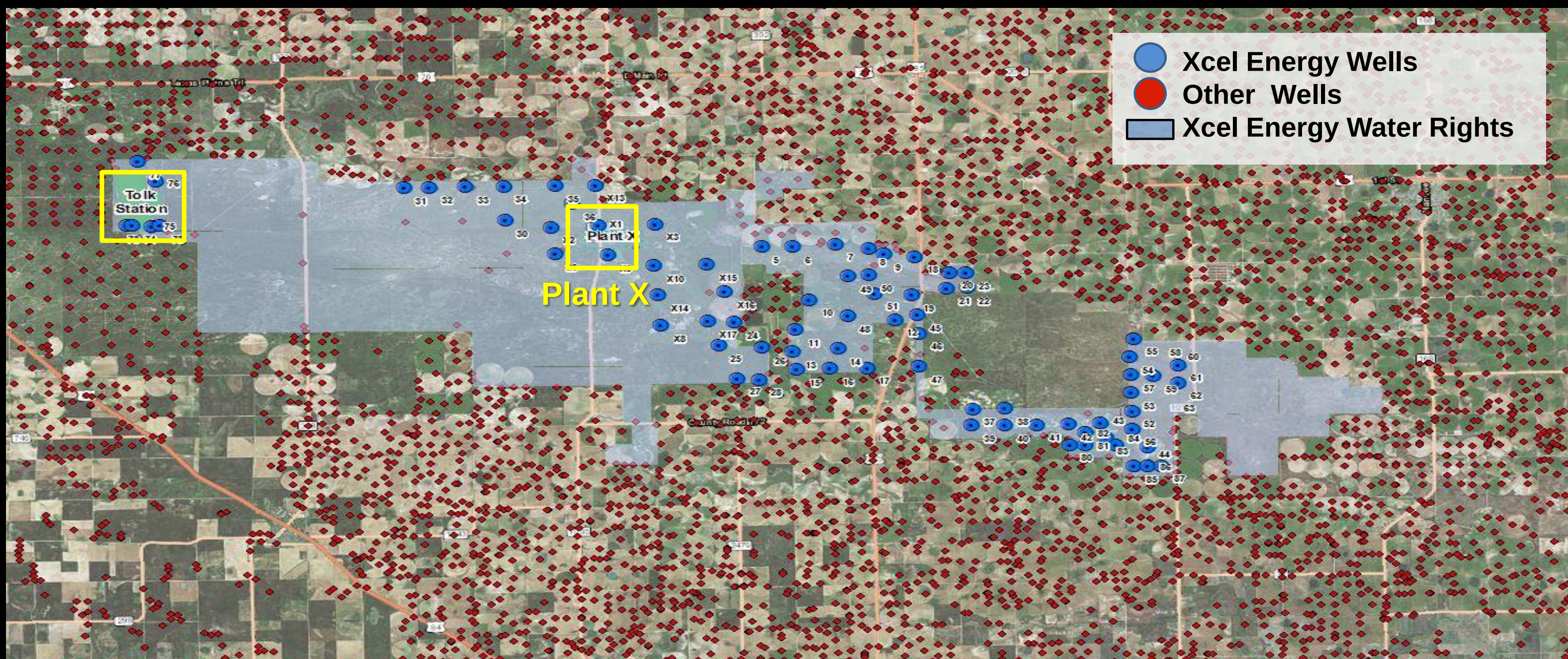



McGuire, V.L., Lund, K.D., and Densmore, B.K., 2012, Saturated thickness and water in storage in the High Plains aquifer, 2009, and water-level changes and changes in water in storage in the High Plains aquifer, 1980 to 1995, 1995 to 2000, 2000 to 2005, and 2005 to 2009: U.S. Geological Survey Scientific Investigations Report 2012–5177, 28 p.

- TWDB Region O Plan
  - Annual 2.9M acre-foot supply deficit by 2020
- High Plains Water District
  - No strict water production limit and no required usage metering for agricultural water users

# Competition for Water




- 90+% of regional water usage for agriculture
- 50K acre wellfield with ~80 wells (Approximately 32 miles to furthest well)
- Both declining wellfield volume & wellfield peak productivity concerns
- Lack of agricultural water use measurement = forecast uncertainty

# Operational Issues

## Tolk aquifer depletion - 2 issues

**Issue 1 - Aquifer longevity**

**When will the plant run out of water?**

- Tolk & X generation
- Aquifer storage
- Aquifer geology
- Water use by others

**Issue 2 - Peak production**

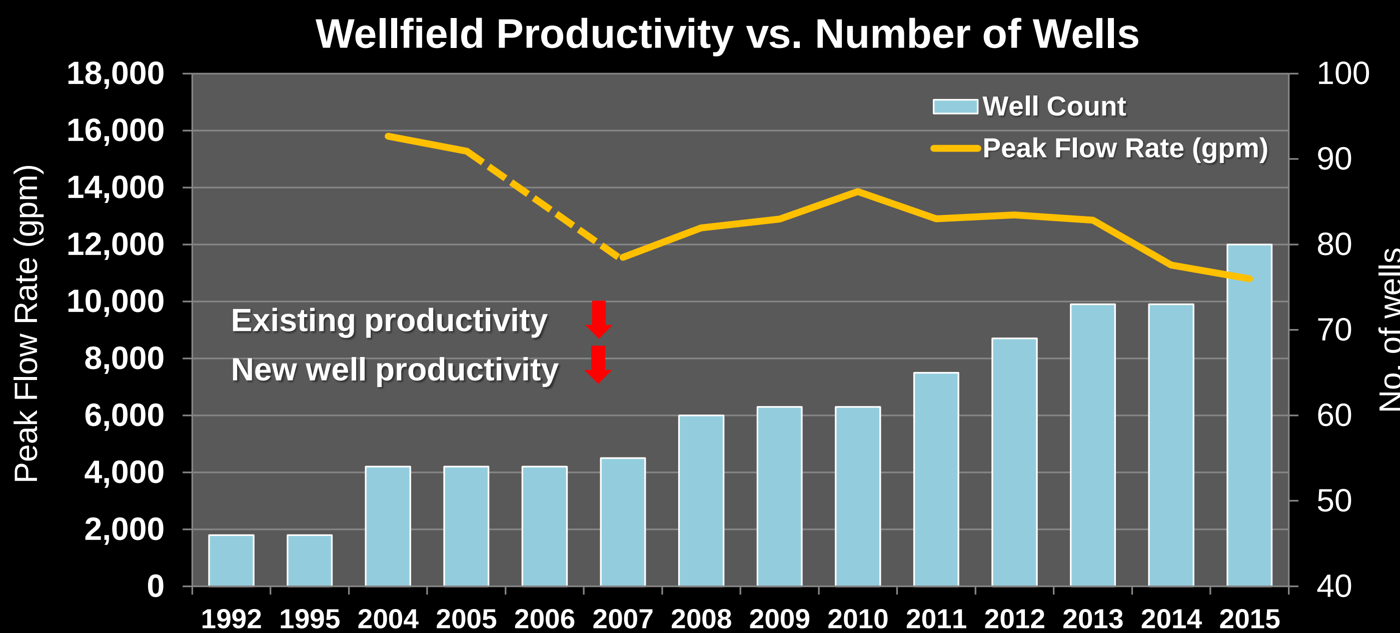
**Can we get the water we need to run the plant?**

- Tolk & X generation
- Wellfield capacity
- Other plant operations
- Water conveyance
- Production decline

## Water balance spreadsheet

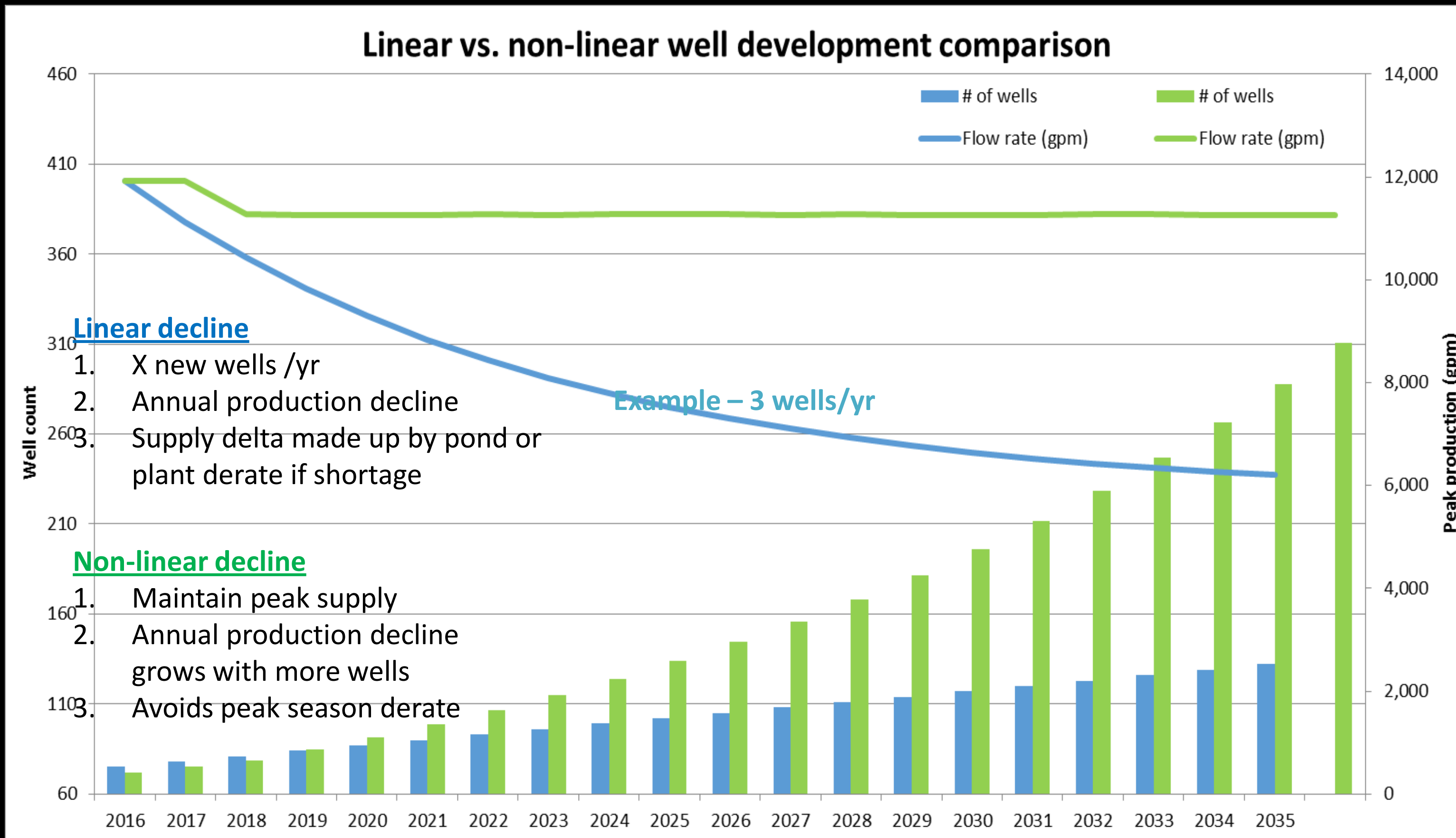
- Quickly evaluate changes/interactions between both issues
- Changes in capacity factor/retirement date for subsequent charts

# Plant Wellfield Decline




- **August 2016 – Tolk/Plant X water supply issues (recovery during short outage)**
- **Annual groundwater modeling – LBG-Guyton Associates**
- **Bi-annual total system supply testing**

# Well Development Approaches




**Linear decline**

1. X new wells /yr
2. Annual production decline
3. Supply delta made up by pond or plant derate if shortage

**Non-linear decline**

1. Maintain peak supply
2. Annual production decline grows with more wells
3. Avoids peak season derate

# Future Projections

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- Adequate water supply
- Concerns, may have peak production challenges
- Water supply nearly exhausted, peak and annual production challenges

**Tolk/X Wellfield - Long-term water supply alternatives**

| Alternative ID | WR Cost Est. ($M) | Dev Cost Est. ($M) | Total Cost ($M) | Cumulative Cost ($M) | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Current* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 4 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 89.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 5 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 119.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 6 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 149.72 | | | | | | | | | | | | | | | | | | | | | |
| *Lubbock pipeline (2019 in-service)* | - | 192.00 | 192.00 | 192.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 ac) | 8.34 | 6.50 | 14.84 | 206.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 ac) | 8.58 | 5.60 | 14.18 | 221.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (2,690 ac) | 9.10 | 12.50 | 21.60 | 242.62 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 1 (U1 2020; U2 2022)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 3 (U1 2024; U2 2028)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 9.10 | 12.50 | 21.60 | 50.62 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 4 (U1 & U2 2028)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 5 (2018 derate; U1 2023; U2 2025)* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 6a (2018 derate to 47%)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 6b (2020 derate to 47%)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |

- Dynamic operational model created to monitor / predict life remaining of well field
- TWDB and consults confirm that aquifer is dropping with serious future consequence

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# Mitigation Alternatives Considered

| Alternatives | Cost |
|---|---|
| Hybrid cooling tower retrofit | $200M+ & technology risk |
| | |
| Wastewater effluent pipeline | ~$200M |
| Ongoing water right acquisition & wellfield expansion (acquisition challenges due to reluctance to sell farm businesses) | Price is uncertain |
| Horizontal well development | ~$3M |
| Reduced Tolk/Plant X generation | Currently being studied |

# Ongoing Activities

- Wellfield Saturation Thickness and Production Monitoring
- Plant Process Review for Water Conservation/ Production Optimization
- Groundwater Model Update (Internal and External)

# Questions and Discussion

# IRP Information

- Web Page:

https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/sps_2019-2038_integrated_resource_plan

*Note: After navigating to the webpage, in the upper left-hand corner of the page, make sure that "New Mexico" is selected. Click on Public Advisory Meeting then click on the link for the second meeting.*

- Ashley Gibbons and Ben Elsey – Xcel Energy/SPS Contact
  - Address: 1800 Larimer Street, Ste, 1600 Denver CO 80202
  - Phone: Ashley (303) 571-2813 and Ben (303) 571-6705
  - Email: ashley.gibbons@xcelenergy.com
    ben.r.elsey@xcelenergy.com

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# Topics For Future Meetings

- Environmental Update
- Aging Generation Fleet
- Gas & Power Markets
- Coal Supply
- Demand-side Management and Energy Efficiency
- Storage

# Next Meeting

- Date:
  - Tuesday, January 30, 2018
- Time:
  - 10:00am to 12:00pm (Mountain Time)
- Location:
  - Webinar meeting

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# Gas and Power Market Price Forecasting

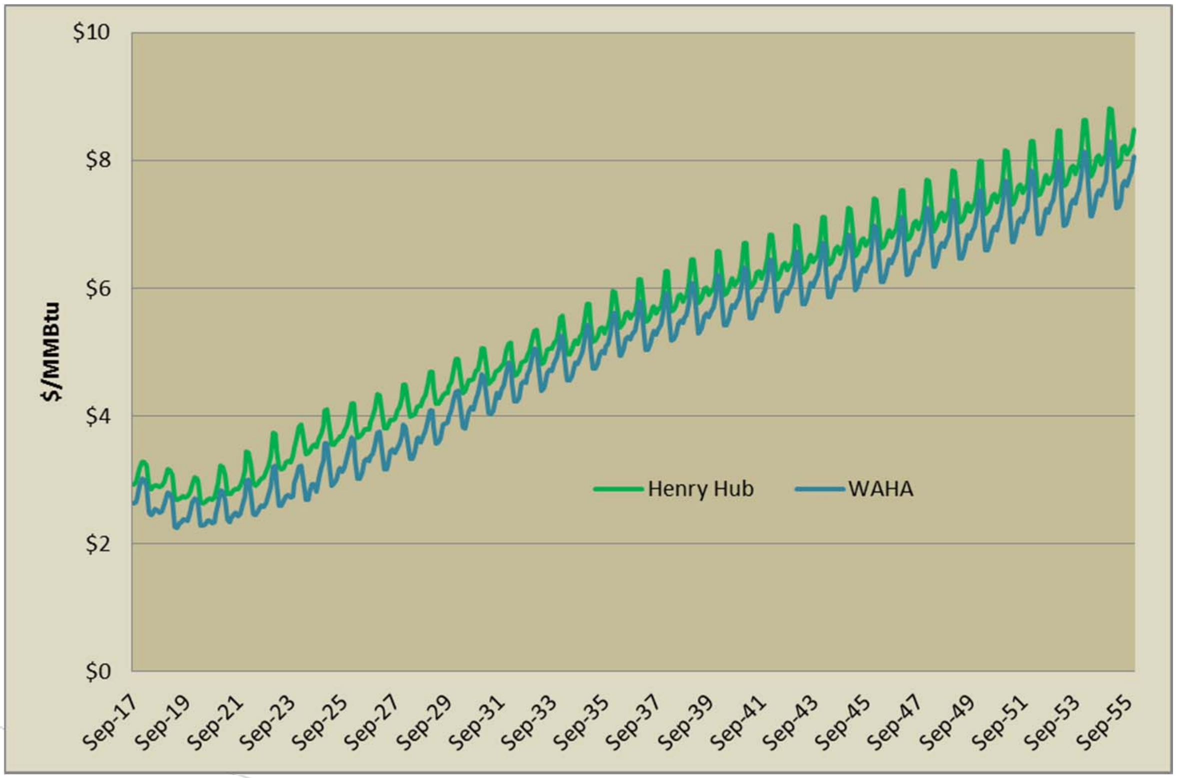
**Robin Preston**

**January 30, 2018**

# Natural Gas Price Forecasting Methodology

- **Xcel creates forecasts semi-annually in Feb/Aug**
- **Henry Hub forecast “4-Source Blend” is an average of three consultants’ long term forecasts and the current NYMEX strip**
- **Currently consultants forecasts are…**
  - IHS-CERA
  - PIRA
  - Wood Mackenzie

# Recent Henry Hub 4-Source Blend Forecast
## (August 15th, 2017)



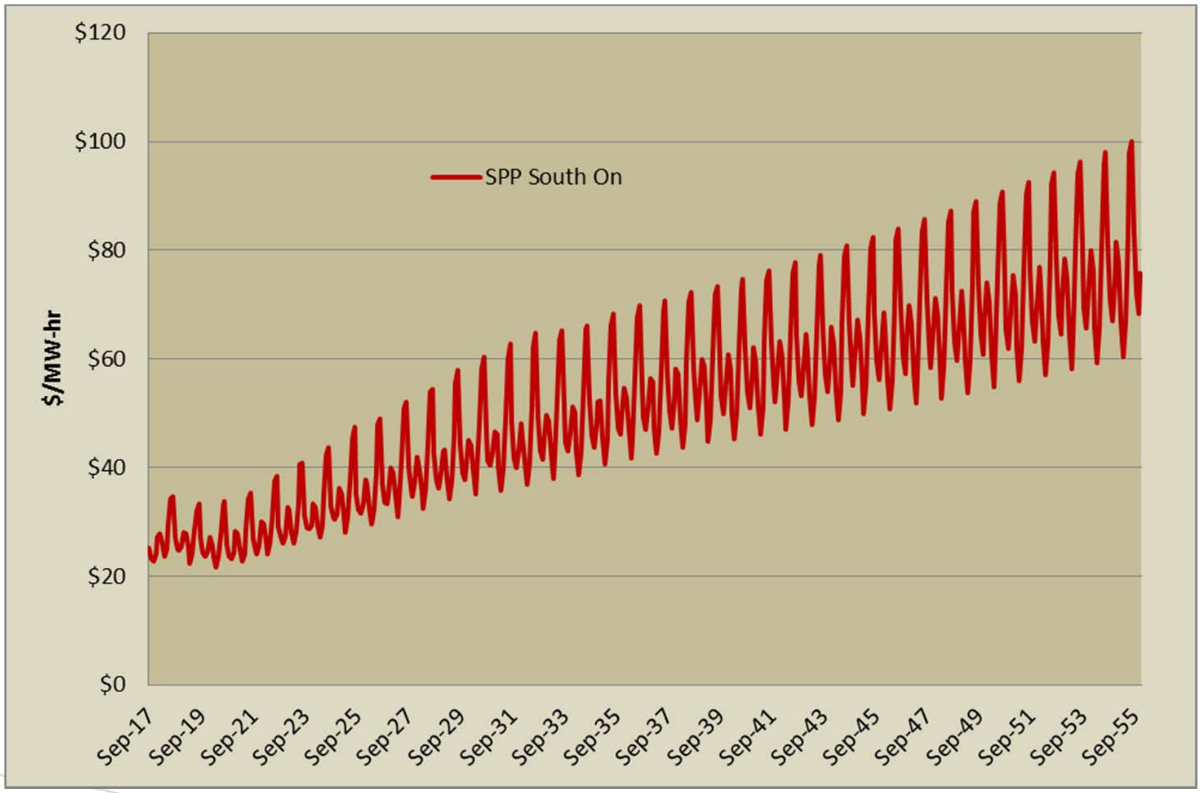
# Natural Gas Delivered Price

- **Basis differential is difference in the gas price at a given Hub compared to a benchmark location (i.e. Henry Hub)**
  - Current data sources for basis: IHS-CERA, PIRA & Wood Mackenzie
- **Methodology:**
  - Determine appropriate hub
    - Existing units: Use the hub from where gas is traditionally procured
    - New units: Determine most likely general location of unit and associated hub
  - Add appropriate transportation, storage and fuel surcharges to achieve a delivered price.

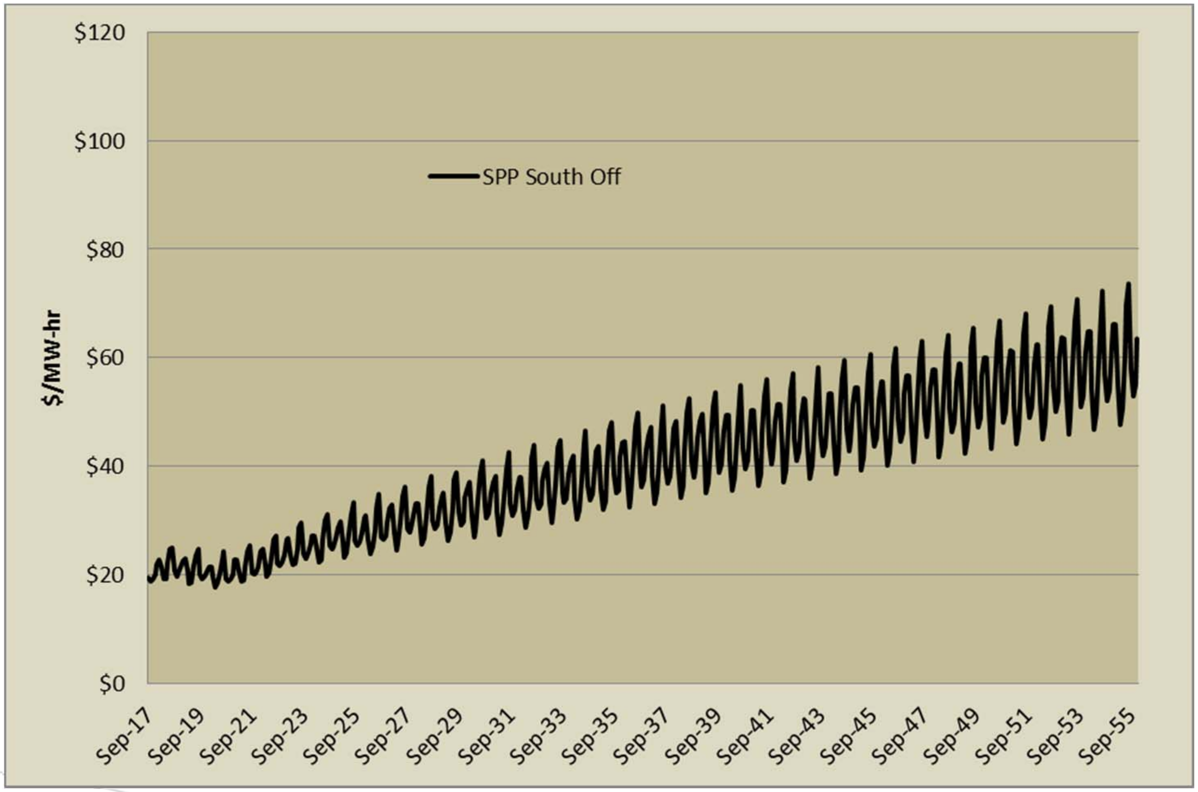
# Electricity Market Prices

- Calculate the average of IHS-CERA, PIRA, and Wood Mackenzie implied heat rate forecasts to derive the “heat rate” ( per MWh) for a given location.
- Multiply the “heat rate” by the “4-Source Blend” natural gas price to get the $/MWh price for a given location.

# Recent SPP Electricity Forecast – On Peak
## (Aug. 15th, 2017)



# Recent SPP Electricity Forecast – Off Peak
## (Aug. 15th, 2017)



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# Emerging Environment Impacts for SPS NMIRP

**Dean Metcalf**
Manager, Environmental Services and Media Compliance
January 30, 2018

# Major Regulations Affecting SPS

## Cross-State Air Pollution Rule (CSAPR)

- EPA adopted in 2011 (Xcel made comments and sued EPA)
- Two Main Issues – Texas' Inclusion and EPA Disapproval of Texas State Plan
- DC Circuit Court Stayed CSAPR - December 30, 2011
- Litigation went from DC Circuit Court to Supreme Court and back
- CSAPR largely upheld, but Texas emission budgets were found to over-control and were remanded to EPA
- CSAPR program took effect January 1, 2015
- EPA made summer NOx budget tighter, and removed Texas from CSAPR limits for annual NOx and SO2 in 2016-17
- Changes in SPS since 2011 (Added Wind and Transmission)
- Compliance Strategy – Dispatch and Allowance Purchase

# Major Regulations Affecting SPS (Cont.)

**EGU MACT – MATS Rule Regulates**

- Mercury (Hg)
- Particulate Matter (PM) – surrogate for toxic non-mercury metals
- HCl – surrogate for all toxic acid gases
- Compliance Strategy - ACI and PM Averaging Plan for H1, H2, H3.
- 2015 Compliance (Tolk and Harrington)

# Major Regulations Affecting SPS (Cont.)

**Regional Haze**

- BART – Harrington 1 and 2 Eligible
- Reasonable Progress – Can apply to all units
- 2009 Texas submitted RH SIP
- 2014 EPA proposed RH FIP:
  - CSAPR meets BART for Texas
  - Reasonable Progress: proposed scrubbers for Tolk Units
- 2016 EPA adopted final rule:
  - Did not finalize BART due to CSAPR remand
  - Required scrubbers for Tolk Units

# Major Regulations Affecting SPS (Cont.)

- SPS appealed rule impacting Tolk to 5th Circuit Court
- In 2016, 5th Circuit Court stayed rule
- In 2017, EPA requested a remand
- Remand granted by 5th Circuit Court, which left stay in effect and is holding litigation until EPA completes reconsideration
- EPA plans to address this now that it has completed its BART rule as described below

# Major Regulations Affecting SPS (Cont.)

- January 2017 - EPA proposed Texas BART rule that included dry scrubbing for Harrington 1 and 2
- Xcel submits comments in May 2017
- September 2017 EPA adopted a rule for a Texas only trading program based on CSAPR $SO_2$ budgets. Limits apply to all SPS coal units as a BART Alternative
- EPA also adopts rule removing Texas from CSAPR
- Environmental advocates have appealed both rules

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# Major Regulations Affecting SPS (Cont.)

- Litigation continues
- SPS has intervened in support of EPA’s rules
- Next regional haze plan for all states is due in 2021

# Major Regulations Affecting SPS (Cont.)

**National Ambient Air Quality Standards**

- **NAAQS for $SO_2$, Ozone, PM, $NO_2$**
- **Areas near SPS plants have been designated attainment for ozone, PM and $NO_2$**
- **$SO_2$ designations complete:**
  - **Area near Tolk Station meets standard**
  - **Area near Harrington Station being monitored and area will be designated in 2020**
- **If designated nonattainment, Texas plan would be due in 2022**
- **Potential for increased controls at Harrington**
- **Attainment would be required by 2025**

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# Major Regulations Affecting SPS (Cont.)

**Coal Combustion Residuals (CCR) Rules**

- **Regulation of coal ash as nonhazardous**
- **Increased landfill construction & monitoring requirements once our ash becomes non-saleable**
- **Potential to affect ash sales – 100% beneficial use**

# Major Regulations Affecting SPS (Cont.)

**Clean Power Plan – GHG 111(d)**

- 2015 final rules for GHG regulation from existing sources
- Stayed by Supreme Court in 2016
- EPA has proposed to repeal the CPP
- Comments due in April 2018
- Unknown whether EPA would adopt a replacement rule, or what form that might take

# Major Regulations Affecting SPS (Cont.)

## Threatened and Endangered Species

– Sand Dune Lizard

– Lesser Prairie Chicken

## Avian Protection

– APP

# Major Rules Not Affecting SPS (at this time)

- **CCR – Coal Combustion Residual rule or Ash Rule**
- **316(b) – Water Intake Structure Rule**
- **WOTUS – Waters of the United States**

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# Recent Issues Affecting SPS

- Gaines Co Plant Permitting
- Wind, Wind, Wind
- City of Amarillo and N/H Wastewater Permit

# Questions and Discussion

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# IRP Information

- Web Page:

https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/sps_2019-2038_integrated_resource_plan

*Note: After navigating to the webpage, in the upper left-hand corner of the page, make sure that "New Mexico" is selected. Click on Public Advisory Meeting then click on the link for the second meeting.*

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# Topics For Future Meetings

- Aging Generation Fleet
- Coal Supply
- Demand-side Management and Energy Efficiency
- Storage

# Next Meeting

- Date:
  - Tuesday, March 27, 2018
- Time:
  - 10:00am to 12:00pm (Mountain Time)
- Location:
  - Webinar meeting

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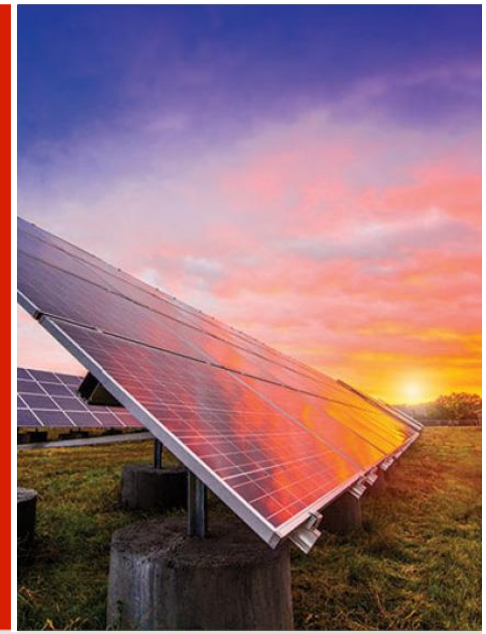
# Southwestern Public Service Company

## Sales and Load Forecasting

New Mexico Resource Plan Public Advisory Meeting

March 27, 2018



**Used for Planning Purposes Only**

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# Agenda

- Energy and peak demand forecasting process
- Economic and demographic assumptions
- Weather assumptions
- Forecast adjustments
- Energy and peak demand forecast results
- SE New Mexico oil development
- Forecast scenarios

# Forecasting Process

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- 30-year forecasts of monthly customers, sales and peak demand are developed using primarily regression analysis.
- Retail sales are forecast by major class and by state.
- Retail peak demand is forecast at the aggregated company level.
- Wholesale sales and peak demand are forecast by individual customer.

# Regression Analysis

- Use statistical relationships between monthly sales or demand and explanatory variables such as economics, weather, customers, and price of electricity. Once a statistical relationship is established from historical data, the relationship is applied to the forecast of the explanatory variables to derive a sales or demand forecast. This process is referred to as regression analysis.
  - For example: Residential sales = *f* ( number of customers, weather, household income)
- Strengths: industry standard, robust, test results, defines relationships, adaptable/flexible
- Weaknesses: historical relationships can change, limited by available data, extremes can create challenges

# Other Methodologies

- Load factor analysis
- Historical trends
- Contractual requirements
- Exogenous adjustments for new load on the system

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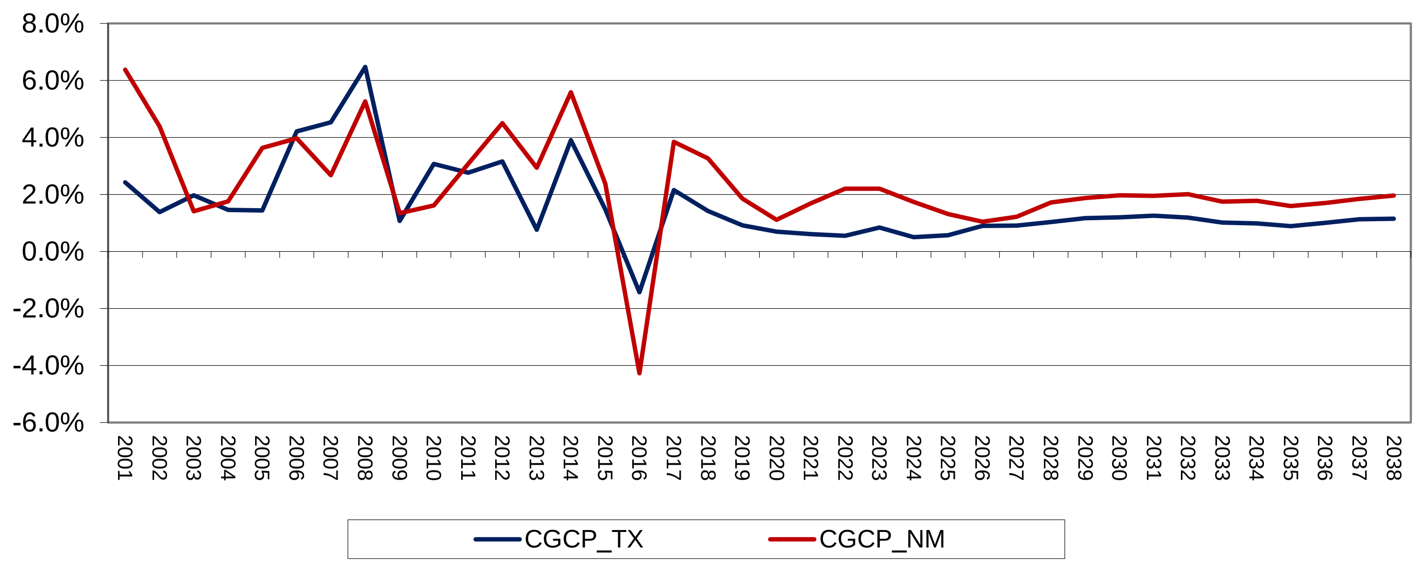
# Economic and Demographic Assumptions

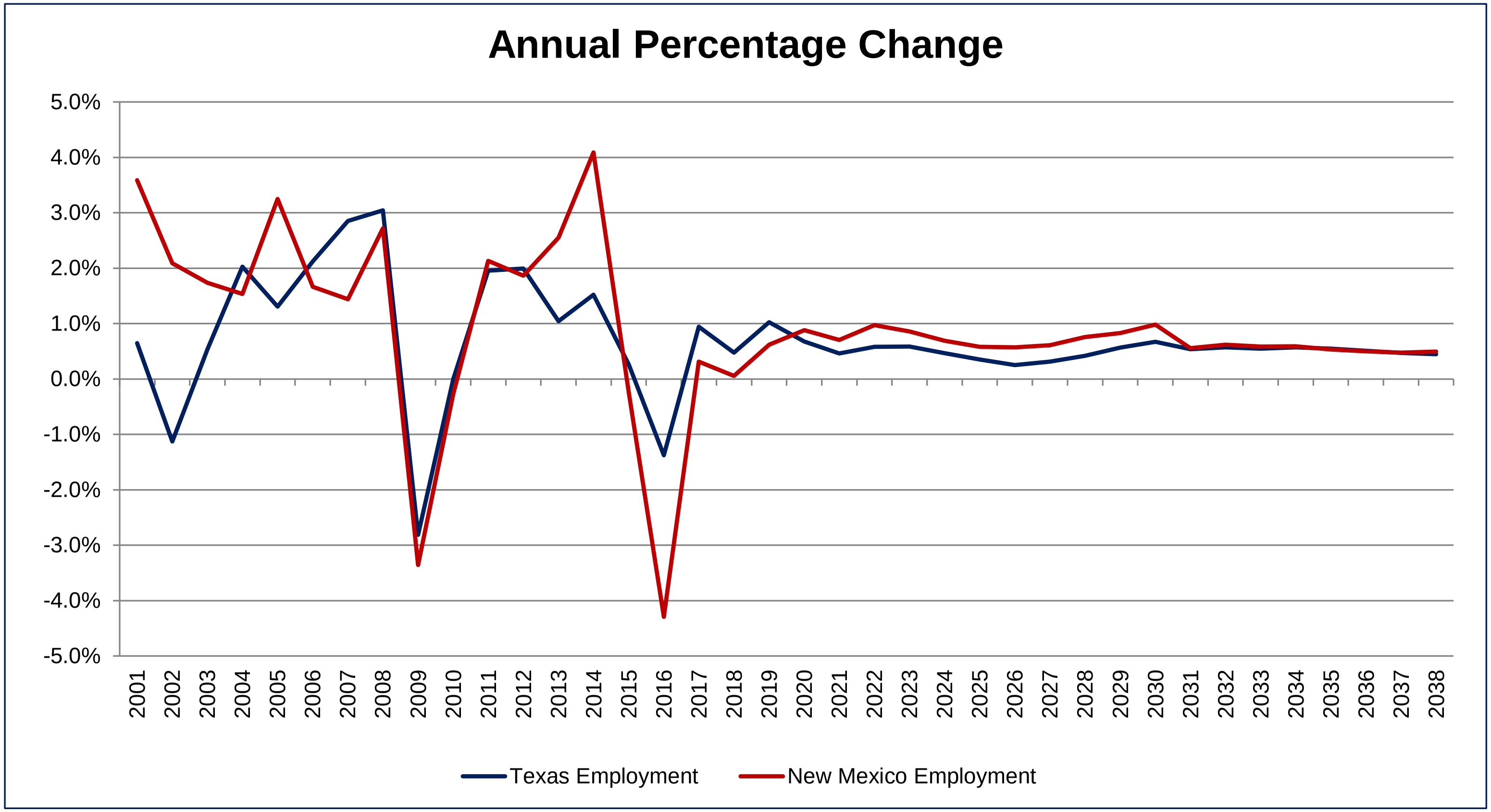
- Economic and demographic data obtained from IHS Global Insight, Inc. (both historical and forecast) for U.S., state and counties.  County level data is aggregated to service territory.
- Economic and demographic variables used in modeling include service area employment, households, personal income, population, Gross County Product; Gross State Product (GSP); and U.S. Gross Domestic Product, oil and gas extraction index and  oil prices.

# Texas and New Mexico Service Area Gross County Product Growth



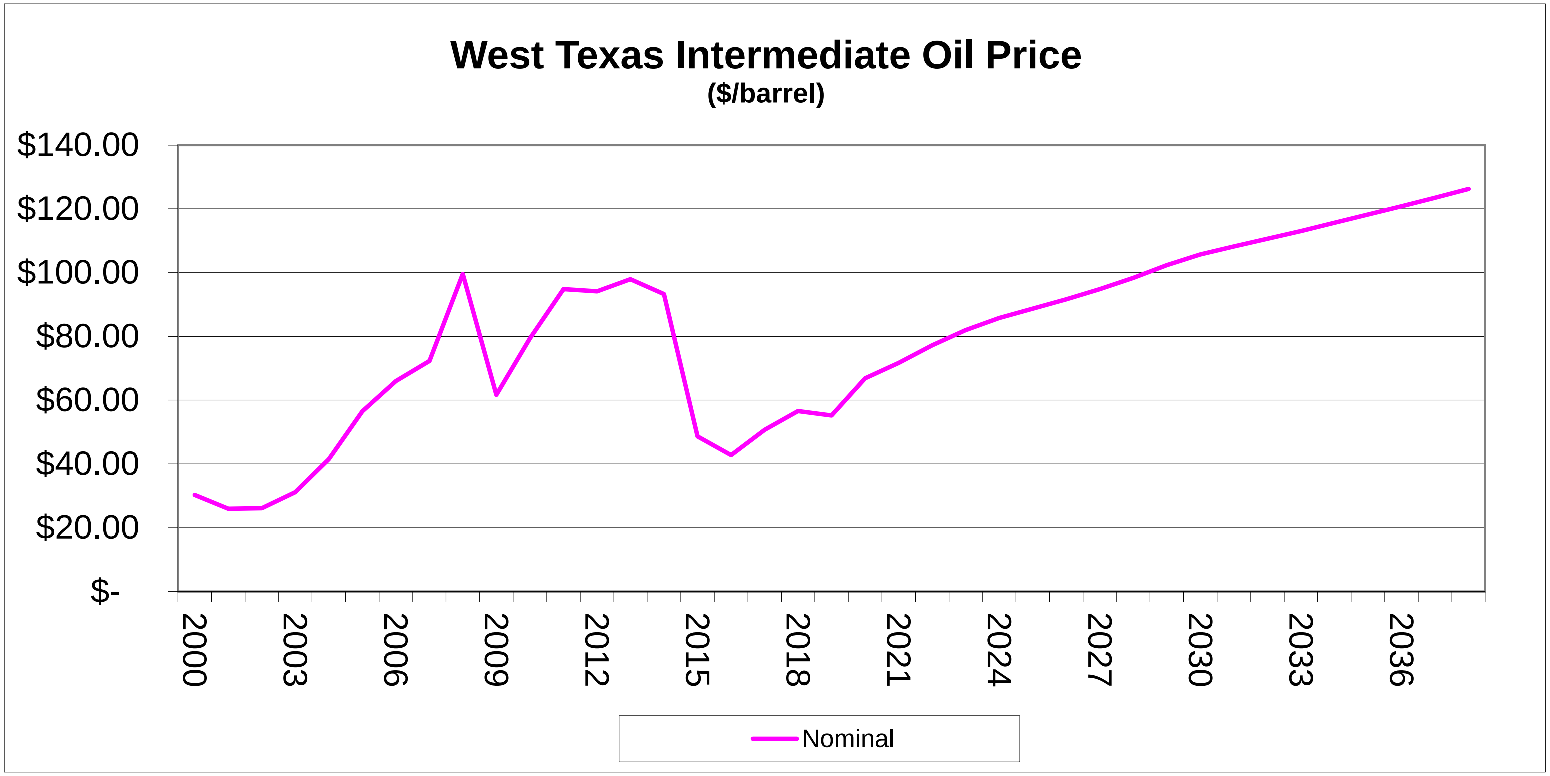

Source: IHS
Historical Data Ends: 2016

# Texas and New Mexico Job Growth



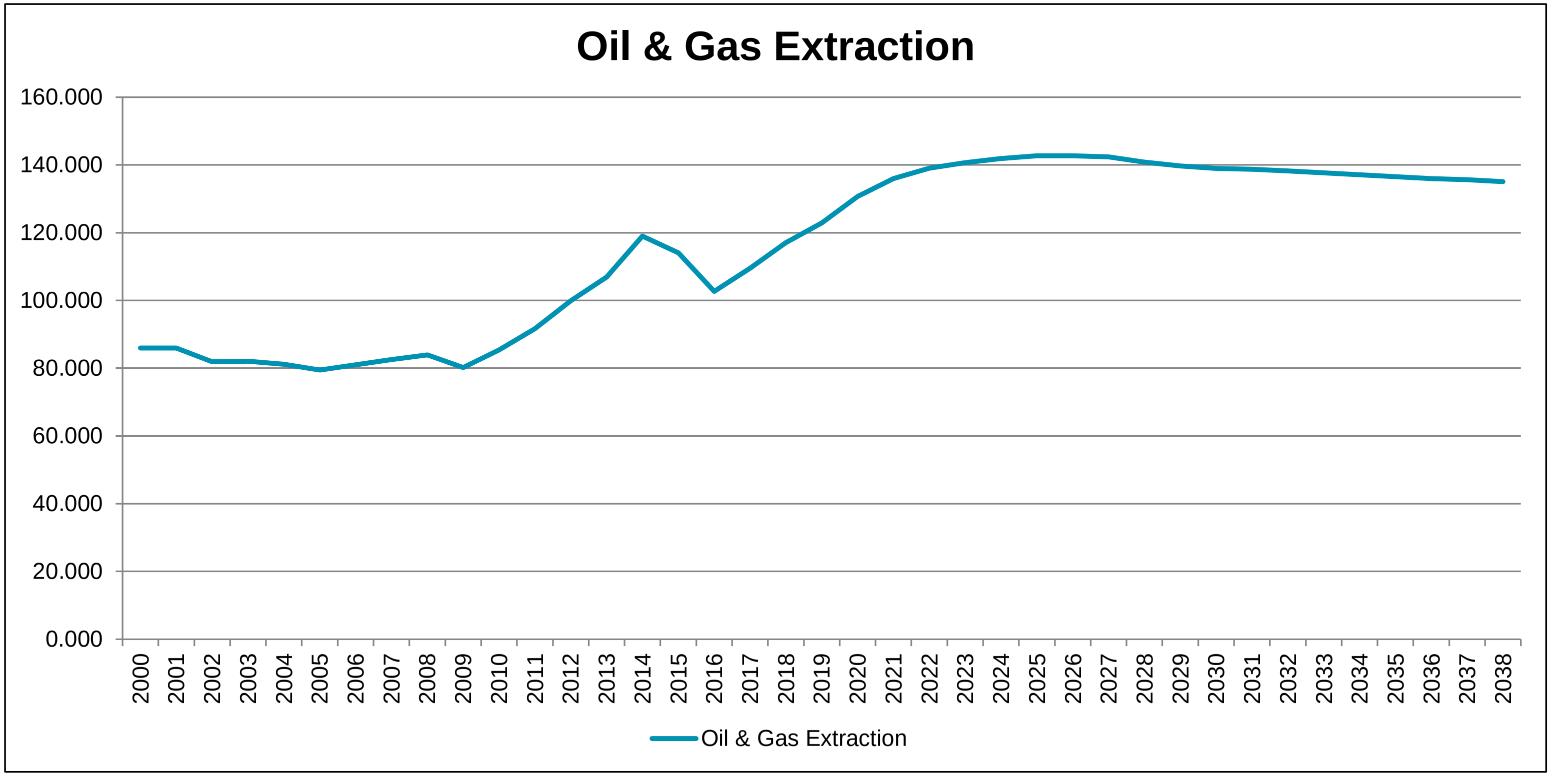

Source: IHS, Bureau of Labor Statistics
Historical Data Ends: 2016

# Oil Price




Source: IHS
Historical Data Ends: December 2017

# Oil and Gas Extraction Index

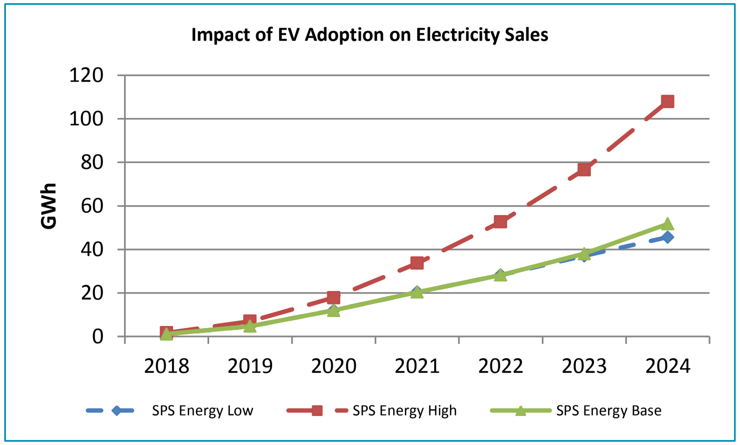



Source: IHS
Historical Data Ends: December 2017

# Weather Assumptions

- Weather data collected from NOAA for Amarillo, Lubbock, and Roswell
- Forecast assumes normal weather defined as 30-year rolling average
- Includes temperature, Heating Degree Day (HDD), Cooling Degree Day (CDD), and precipitation
- Historical sales and peak demand are weather normalized for variance analysis

# Residential Forecast
# Exogenous Adjustment for Electric Vehicles*




**Electric Vehicle Adoption Comparison**

| U.S. Adoption Rates | 2016 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| *Xcel Energy* | 0.2% | 0.7% | 2.8% | 9.6% |
| **Bloomberg** | 0.2% | 1.0% | 3.0% | 9.0% |
| **GreenTech Media** | | | 3.8% | |
| **Energy Information Agency** | | | 2.6% | |
| **Navigant** | 0.2% | 1.0% | 2.8% | |
| ***Bank of America/Merrill Lynch (global adoption)*** | *0.2%* | *1.0%* | *10.0%* | *33.0%* |

| SPS Base Scenario | | | |
|---|---|---|---|
| Year | # Cars | % of cars | EV Forecast (GWh) |
| 2018 | 1,793 | 0.30% | 1 |
| 2019 | 2,898 | 0.40% | 5 |
| 2020 | 5,016 | 0.70% | 12 |
| 2021 | 6,641 | 1.00% | 20 |
| 2022 | 8,485 | 1.20% | 28 |
| 2023 | 11,004 | 1.60% | 38 |
| 2024 | 14,586 | 2.10% | 52 |
| 2025 | 14,586 | 2.10% | 52 |
| 2026 | 14,586 | 2.10% | 52 |
| 2027 | 14,586 | 2.10% | 52 |
| 2028 | 14,586 | 2.10% | 52 |
| 2029 | 14,586 | 2.10% | 52 |
| 2030 | 14,586 | 2.10% | 52 |
| 2031 | 14,586 | 2.10% | 52 |
| 2032 | 14,586 | 2.10% | 52 |
| 2033 | 14,586 | 2.10% | 52 |
| 2034 | 14,586 | 2.10% | 52 |
| 2035 | 14,586 | 2.10% | 52 |

*Electric Vehicle assumptions provided by EV Strategy team (Risk Analytics, Strategy & Planning, and Customer Solutions)

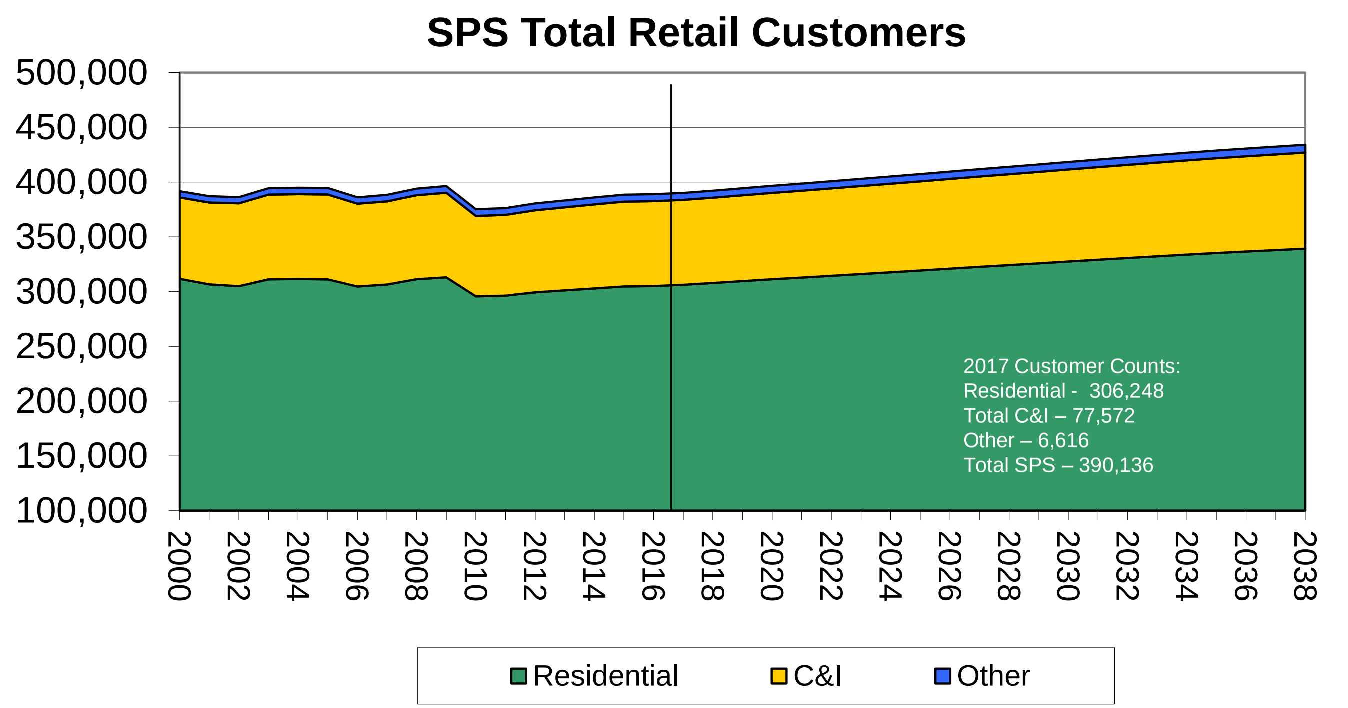
# Distributed Generation

- The historical energy sales data used in SPS's forecast modeling process is net of behind-the-meter generation and demand response energy sales.
- The historical peak demand data used in the forecasting process has been adjusted to add back behind-the-meter generation and demand response to represent the total demand on the system.

# Demand-Side Management

- Sales and peak demand forecasts are adjusted to account for expected incremental DSM savings
- DSM savings are based on legislated mandates
- Residential programs: CFLs, air source heat pumps, and cooling
- C&I programs: business lighting, cooling, motor replacement, and custom projects

# Customer Forecast

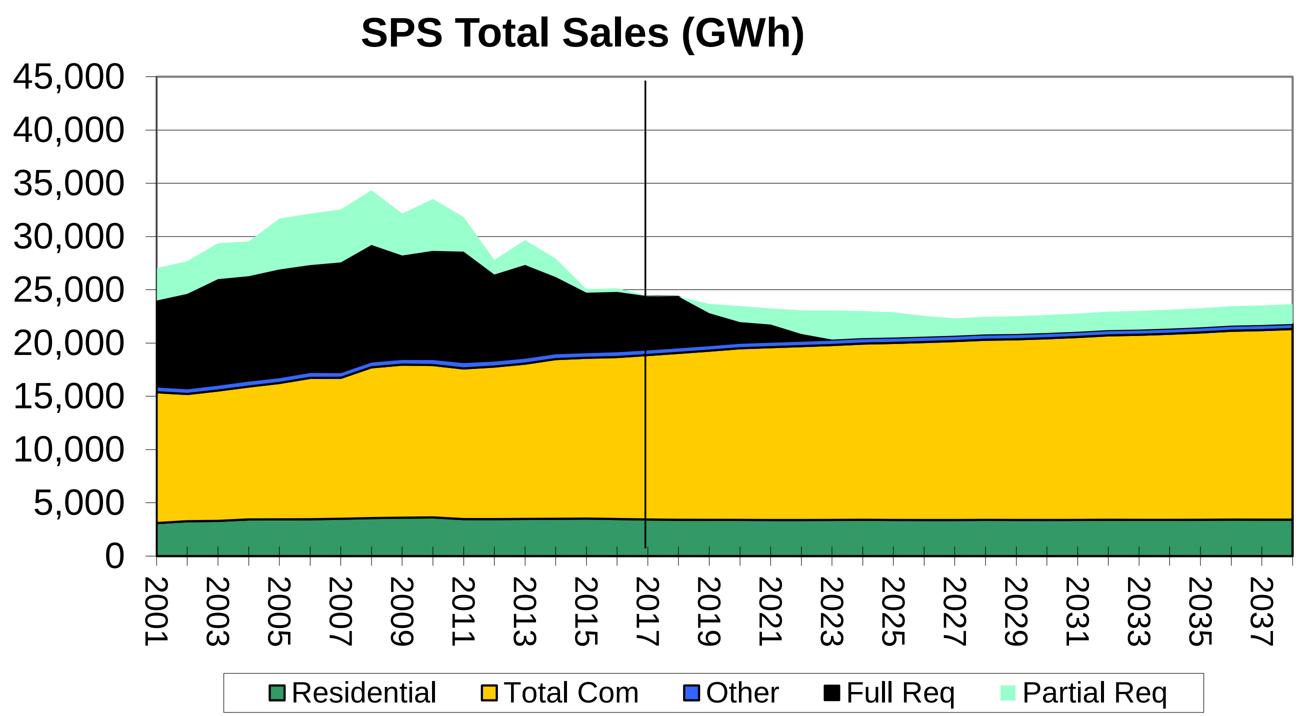



Retail Avg. Annual % Ch. 2011-2017 = 0.6% 2018–2038 = 0.5%

# SPS Forecast Key Drivers

- Residential
  - Declining use per customer due to lighting standards
  - Forecast adjusted for impacts of EV's
- Small C/I
  - Declining use per customer in Texas
  - Increasing use per customer in New Mexico
- Large C/I
  - Sales growth flattens after 2020 based on Oil & Gas Extraction Index

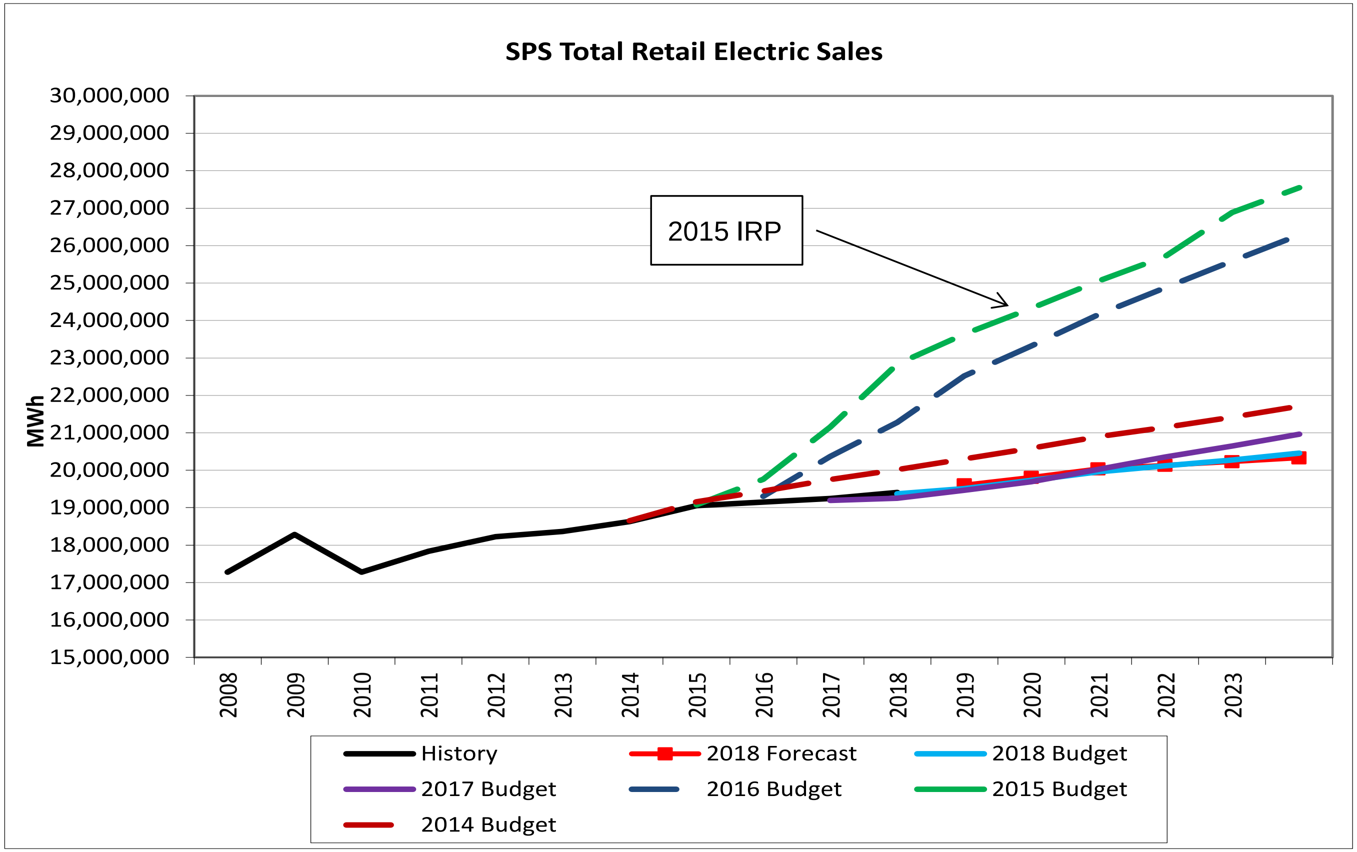
# Sales Forecast



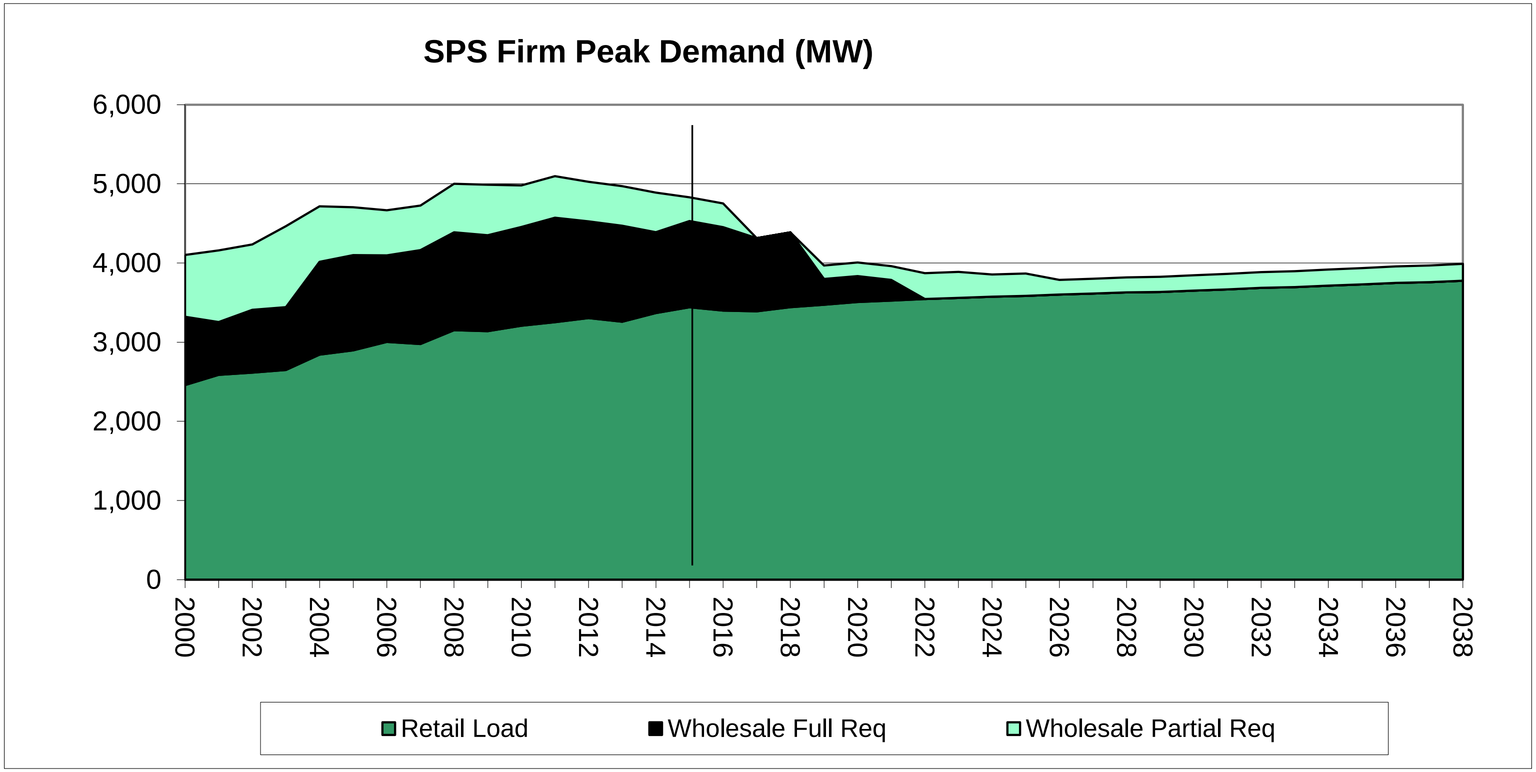

Retail Avg. Annual % Ch. 2011-2017 = 1.1% 2018–2038 = 0.5%

SPS Avg. Annual % Ch. 2011-2017 = -4.3% 2018–2038 = -0.1%

# Sales Forecast Comparison



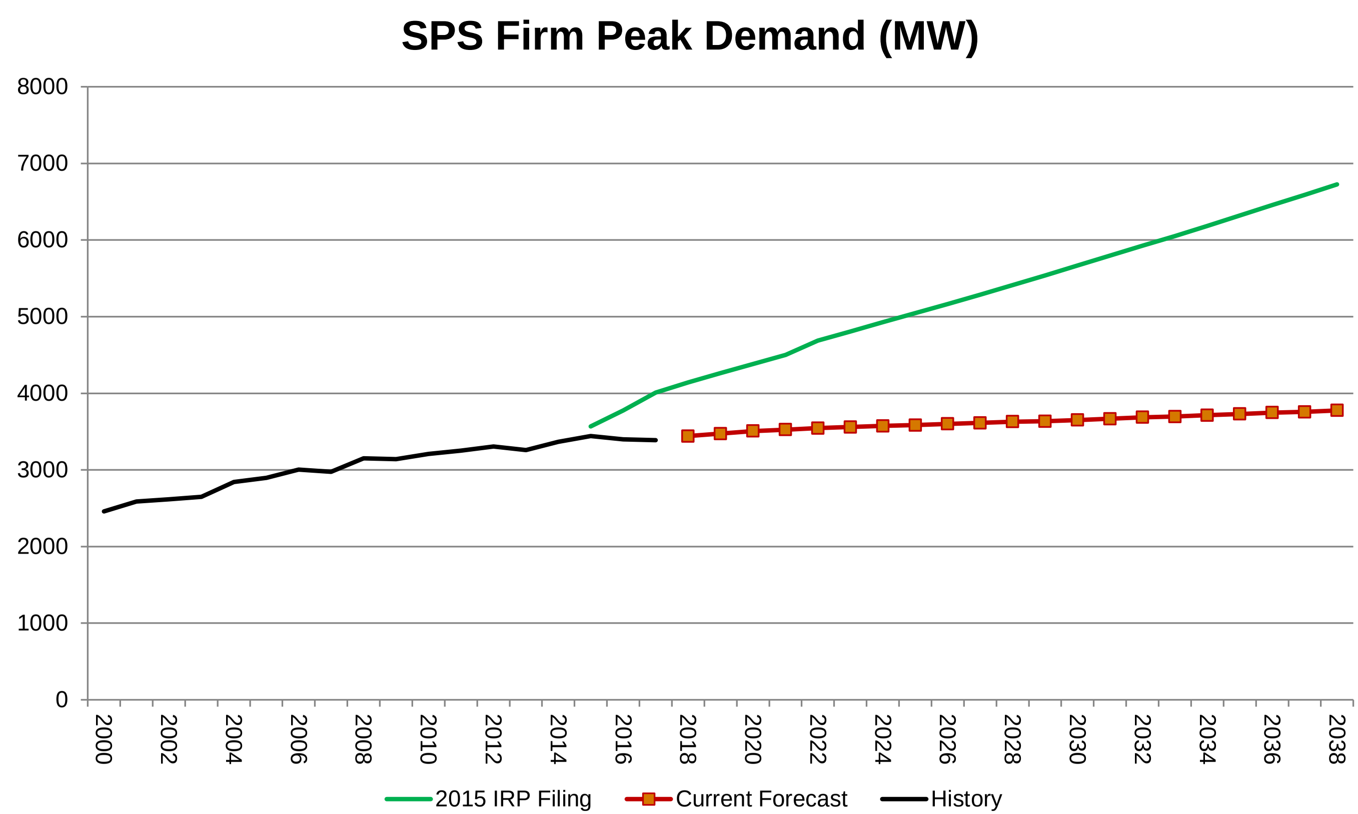
# Peak Demand Forecast




Retail Avg. Annual % Ch. 2011-2017 = 0.7% 2018–2038 = 0.5%

SPS Avg. Annual % Ch. 2011-2017 = -2.7% 2015–2038 = -0.5%

# Peak Forecast Comparison



# Potential Load For SPS (in MW)

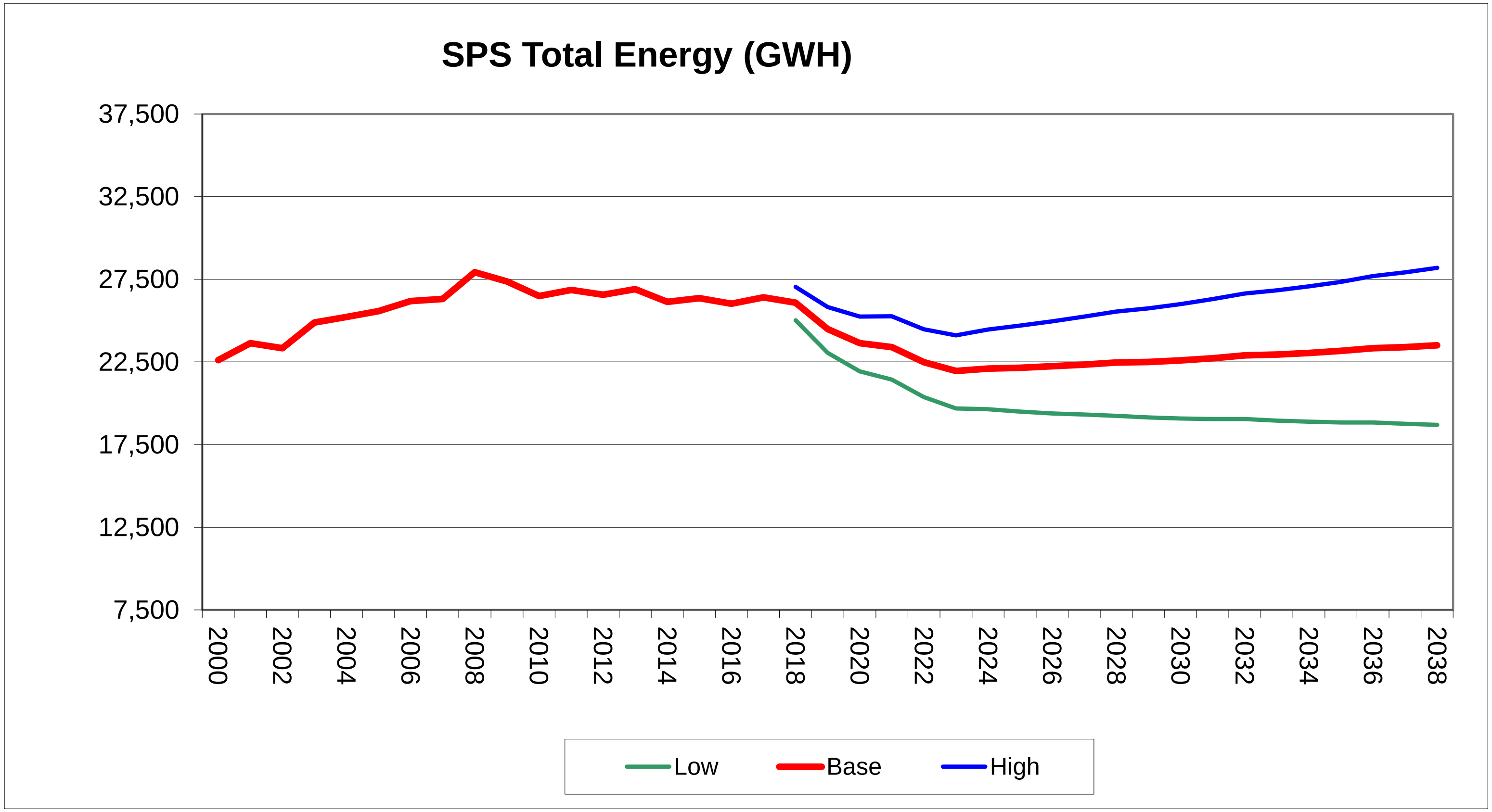
| Year | Cust 1 | Cust 2 | Cust 3 | Cust 5 | Cust 4 | Cust 6 | Cust 7 | Cust 8 | Cust 9 | Cust 11 | Cust 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | 5 | 9 | 6 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| 2019 | 5 | 55 | 6 | 30 | 9 | 53 | 25 | 14 | 28 | 0 | 0 | 224 |
| 2020 | 5 | 55 | 12 | 52 | 9 | 140 | 46 | 20 | 28 | 25 | 0 | 391 |
| 2021 | 5 | 55 | 12 | 52 | 9 | 230 | 46 | 26 | 28 | 25 | 0 | 487 |
| 2022 | 5 | 55 | 12 | 52 | 9 | 273 | 46 | 32 | 28 | 25 | 0 | 536 |
| 2023 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2024 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2025 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2026 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2027 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2028 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2029 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2030 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2031 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2032 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2033 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2034 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2035 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2036 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2037 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |
| 2038 | 5 | 55 | 12 | 52 | 9 | 311 | 46 | 38 | 28 | 25 | 17 | 597 |

- SPS Key Account Managers provide potential new load that has been identified through conversations with the customer.
- Timing and actual load risks.

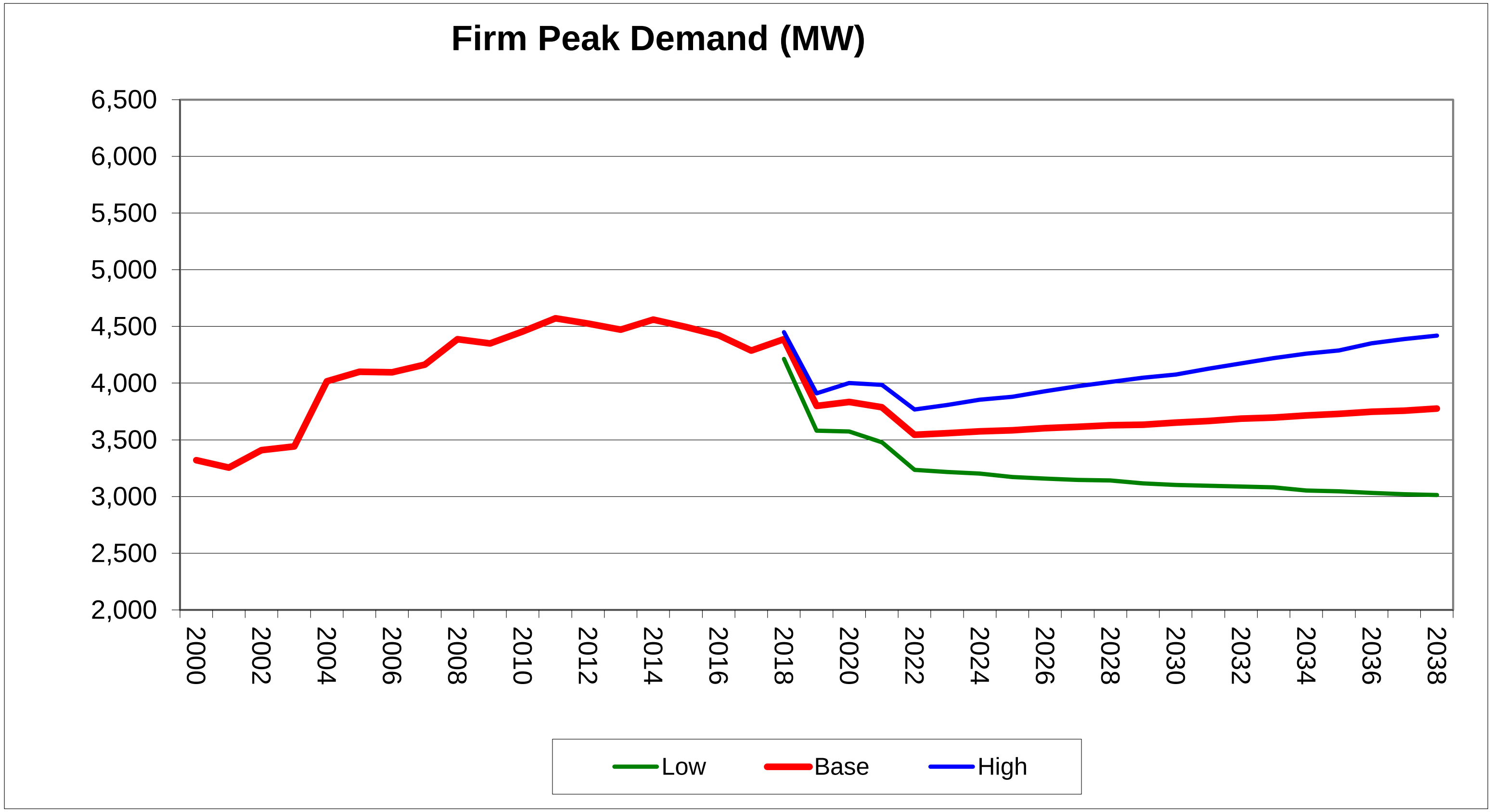
# Forecast Scenarios

- Probability distributions are developed by conducting Monte Carlo simulations on the main drivers (e.g., weather and economics) of energy and peak demand forecasts
- Low-growth scenario is equivalent to the $15^{th}$ percentile probability distribution
- High-growth scenario is equivalent to the $85^{th}$ percentile probability distribution

# Energy Forecast Scenarios



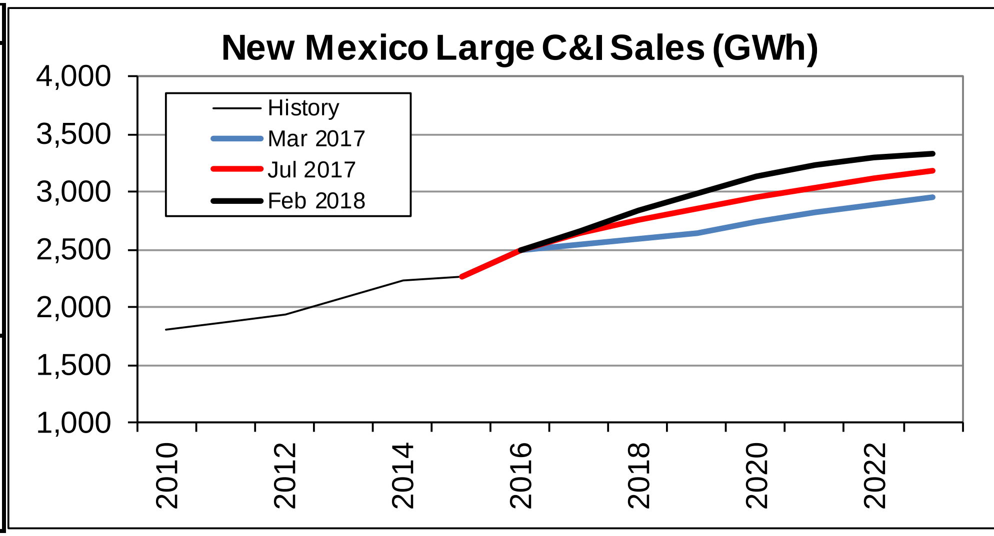
# Peak Demand Forecast Scenarios



# Appendix

**2018-2023 Forecast (Feb 2018)**

| | MWh | Change | %Change |
|---|---|---|---|
| **2010** | 1,803,197 | 134,059 | 8.0% |
| **2011** | 1,864,306 | 61,109 | 3.4% |
| **2012** | 1,940,917 | 76,612 | 4.1% |
| **2013** | 2,090,460 | 149,543 | 7.7% |
| **2014** | 2,232,083 | 141,622 | 6.8% |
| **2015** | 2,273,323 | 41,240 | 1.8% |
| **2016** | 2,488,619 | 215,296 | 9.5% |
| **2017** | 2,656,487 | 167,869 | 6.7% |
| **2018** | 2,834,224 | 177,737 | 6.7% |
| **2019** | 2,991,610 | 157,386 | 5.6% |
| **2020** | 3,138,174 | 146,564 | 4.9% |
| **2021** | 3,236,092 | 97,918 | 3.1% |
| **2022** | 3,293,567 | 57,475 | 1.8% |
| **2023** | 3,340,905 | 47,337 | 1.4% |

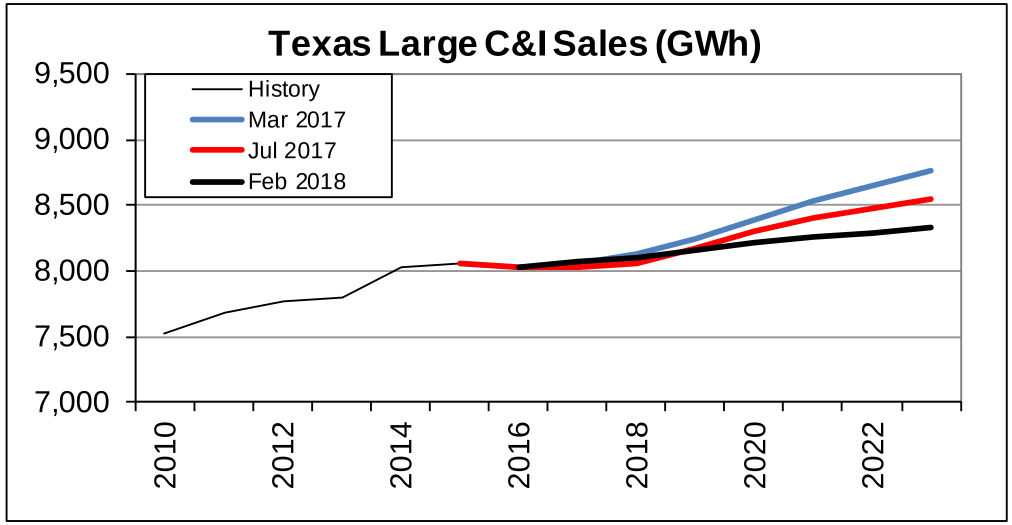



**Feb 2018 Forecast adjusted for customer which came online in January 2018**

**New Mexico Large C/I Sales Growth**

| Year | Historical Growth | Historical Growth w/o New Loads |
|---|---|---|
| 2013 | 7.7% | 2.6% |
| 2014 | 6.8% | 2.7% |
| 2015 | 1.8% | 2.0% |
| 2016 | 9.5% | 3.4% |
| 2017 | 6.7% | 2.1% |

| | 2018-2023 Forecast (Feb 2018) | | |
|---|---|---|---|
| | MWh | Change | %Change |
| 2010 | 7,521,317 | 210,548 | 2.9% |
| 2011 | 7,681,654 | 160,337 | 2.1% |
| 2012 | 7,761,988 | 80,334 | 1.0% |
| 2013 | 7,799,867 | 37,878 | 0.5% |
| 2014 | 8,029,491 | 229,624 | 2.9% |
| 2015 | 8,060,610 | 31,119 | 0.4% |
| 2016 | 8,028,725 | -31,885 | -0.4% |
| 2017 | 8,067,144 | 38,419 | 0.5% |
| 2018 | 8,105,092 | 37,948 | 0.5% |
| 2019 | 8,155,717 | 50,625 | 0.6% |
| 2020 | 8,218,413 | 62,696 | 0.8% |
| 2021 | 8,253,211 | 34,798 | 0.4% |
| 2022 | 8,292,393 | 39,182 | 0.5% |
| 2023 | 8,332,214 | 39,820 | 0.5% |



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# Questions and Discussion

# IRP Information

- Web Page:

https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/sps_2019-2038_integrated_resource_plan

*Note: After navigating to the webpage, in the upper left-hand corner of the page, make sure that "New Mexico" is selected. Click on Public Advisory Meeting then click on the link for the third meeting.*

- Ashley Gibbons and Ben Elsey – Xcel Energy/SPS Contact
  - Address: 1800 Larimer Street, Ste, 1600 Denver CO 80202
  - Phone: Ashley (303) 571-2813 and Ben (303) 571-6705
  - Email: ashley.gibbons@xcelenergy.com<br>ben.r.elsey@xcelenergy.com

# Topics For Future Meetings

- Coal Supply
- Storage

# Next Meeting

- Date:
  - Thursday, May 31, 2018
- Time:
  - 10:00am to 12:00pm (Mountain Time)
- Location:
  - Webinar meeting

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# 2018 SPS Integrated Resource Plan (“IRP”)

# Public Advisory Meeting #5

## SPS Resource Planning

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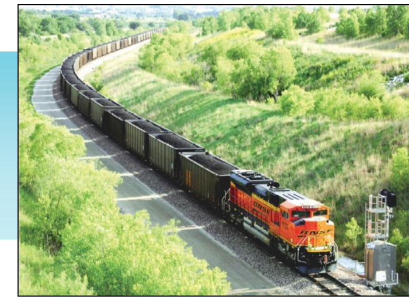



# Coal Supply Presentation

**Dana Echter**
**Manager, Fuel Supply Operations**
**May 31, 2018**

# Harrington Station

- Location:  near Amarillo, Texas
  - Three coal-fired units:  1,066 net MW
  - Coal sources
    - Low-sulfur Southern Powder River Basin ("PRB") coal mines - North Antelope Rochelle, Antelope and Black Thunder
  - Rail Transportation:  Burlington Northern Santa Fe (BNSF)
  - Trestle unloading system
  - 2017 consumption: ~2.8 million tons

# Tolk Station

- Location: near Muleshoe, Texas
  - Two coal-fired units:  1,130 net MW
  - Coal sources
    - Low-sulfur Southern Powder River Basin (“PRB”) coal mines - North Antelope Rochelle, Antelope and Black Thunder
  - Rail Transportation:  Burlington Northern Santa Fe (BNSF)
  - Rotary unloading system
  - 2017 consumption: ~3.0 million tons

# SPS Contract Information

- TUCO, Inc.
  - TUCO is a third-party supplier responsible for managing contracts with coal suppliers, rail transportation and coal handling.
  - SPS purchases coal from TUCO at the plant bunkers
  - Xcel Energy's Fuel Supply Operations manages the TUCO contract
  - The TUCO contracts expire on Dec 31, 2022

# TUCO Coal Contract Information

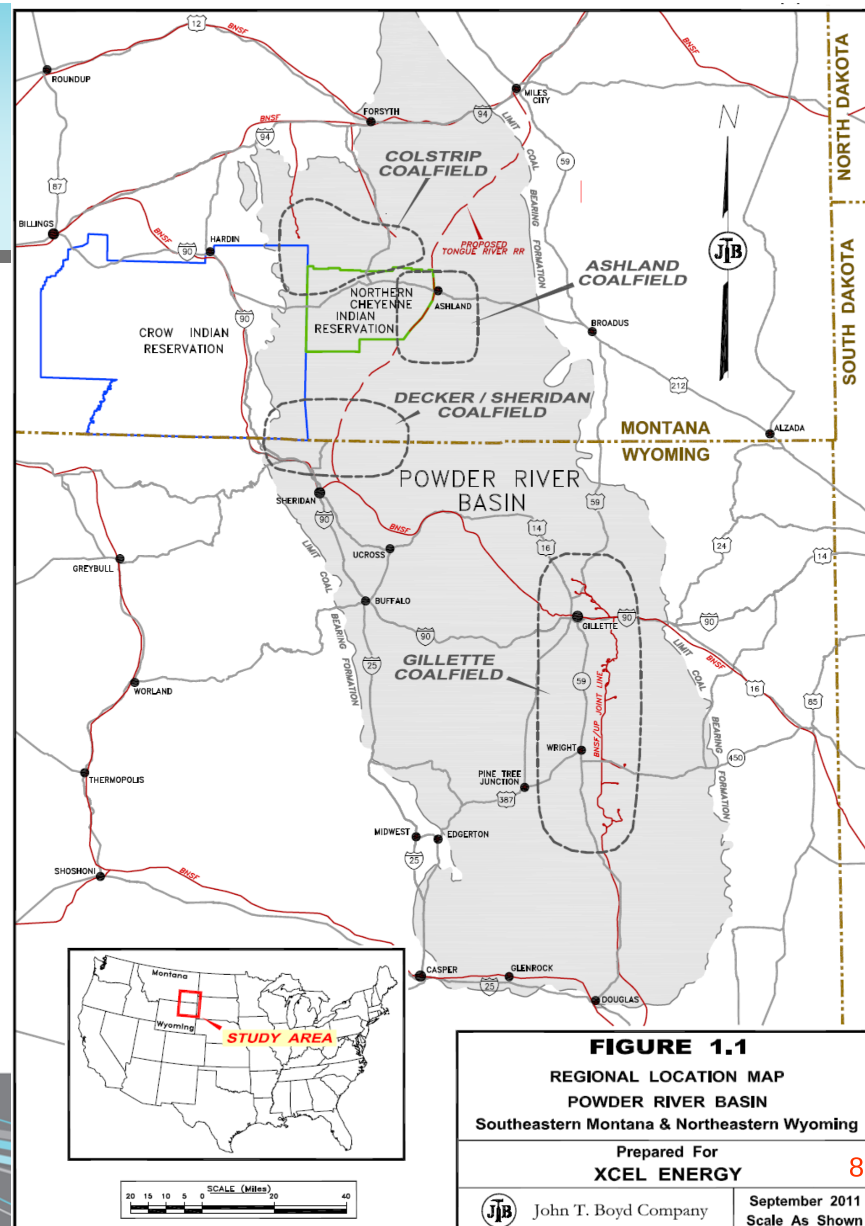
- Coal suppliers are Peabody Energy (North Antelope Rochelle), Cloud Peak Energy (Antelope) and Arch Coal (Black Thunder)
- Coal contracts are fixed price, term and quantity
- Coal supply agreements are short term and expire before the TUCO agreements

# TUCO Transportation Contract Information

- **Transportation**
  - **Tolk and Harrington served by BNSF Railway**
  - **The Harrington rail agreement expires in Dec 2022**
  - **The Tolk rail agreement expires in Dec 2022**
  - **Include Mileage Based Fuel Surcharges**
- **Railcars**
  - **Railcars are provided by long-term lease held by TUCO and expire concurrently with the TUCO Coal Supply Agreements**

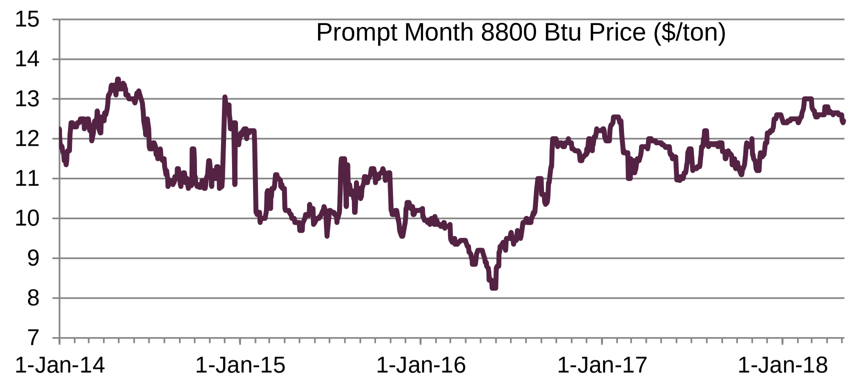
# Powder River Basin

- Roughly 300mi x 100 mi
- USGS
  - 140b tons of resources in areas of most interest
  - 77b tons in Gillette Coalfield alone



# Purchase Strategy

- Current market is approximately $12.40/ton for 8,800 Btu/lb PRB coal (fob mine)




- Keep relatively large open position to be able to react to changes in system operations
- Target is by December, purchase ~75% of upcoming year requirements, ~40% for 2nd year and ~20% for 3rd year.

# Questions and/or Discussion?

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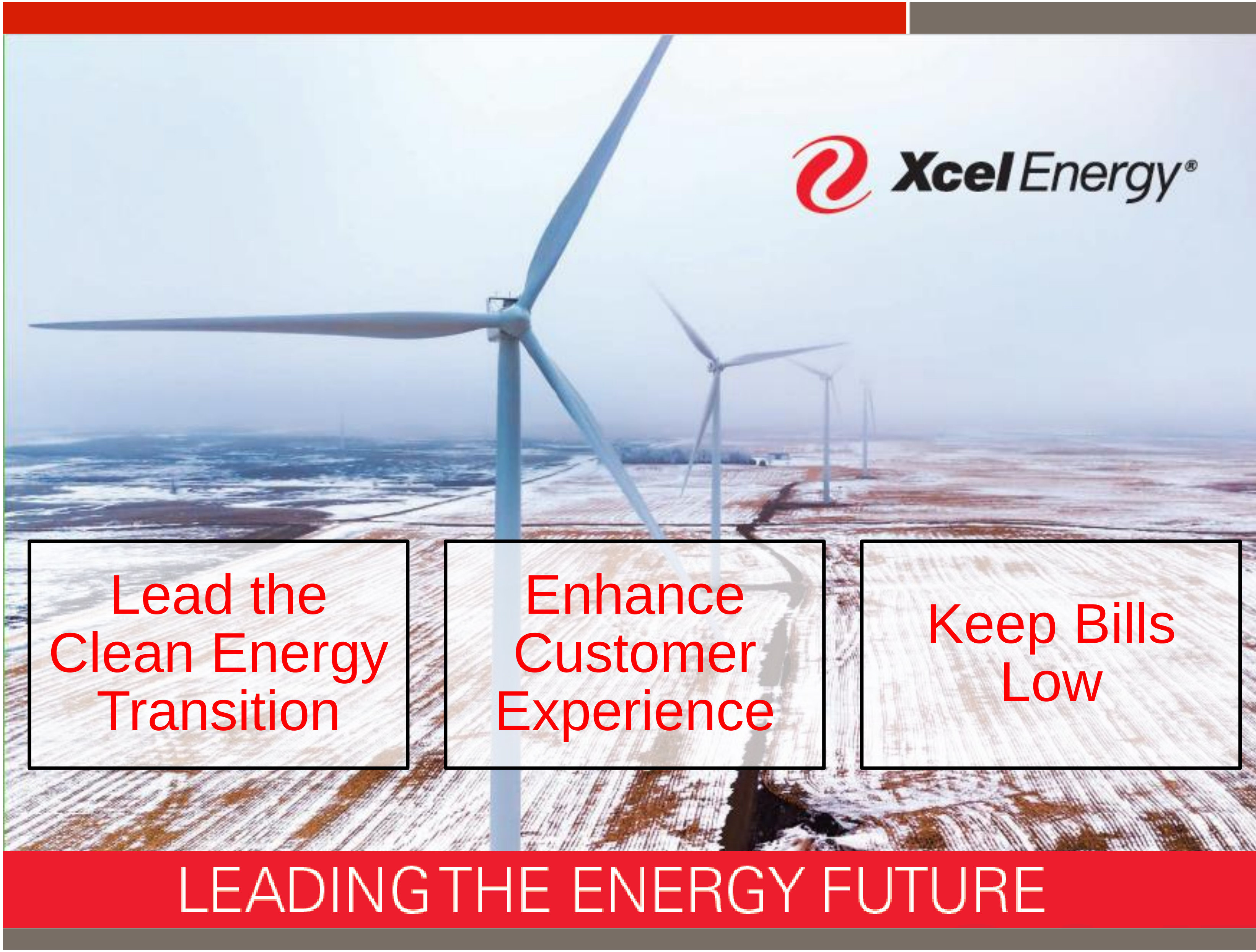
# Energy Storage Overview

SPS New Mexico IRP Public Advisory Meeting

May 31, 2018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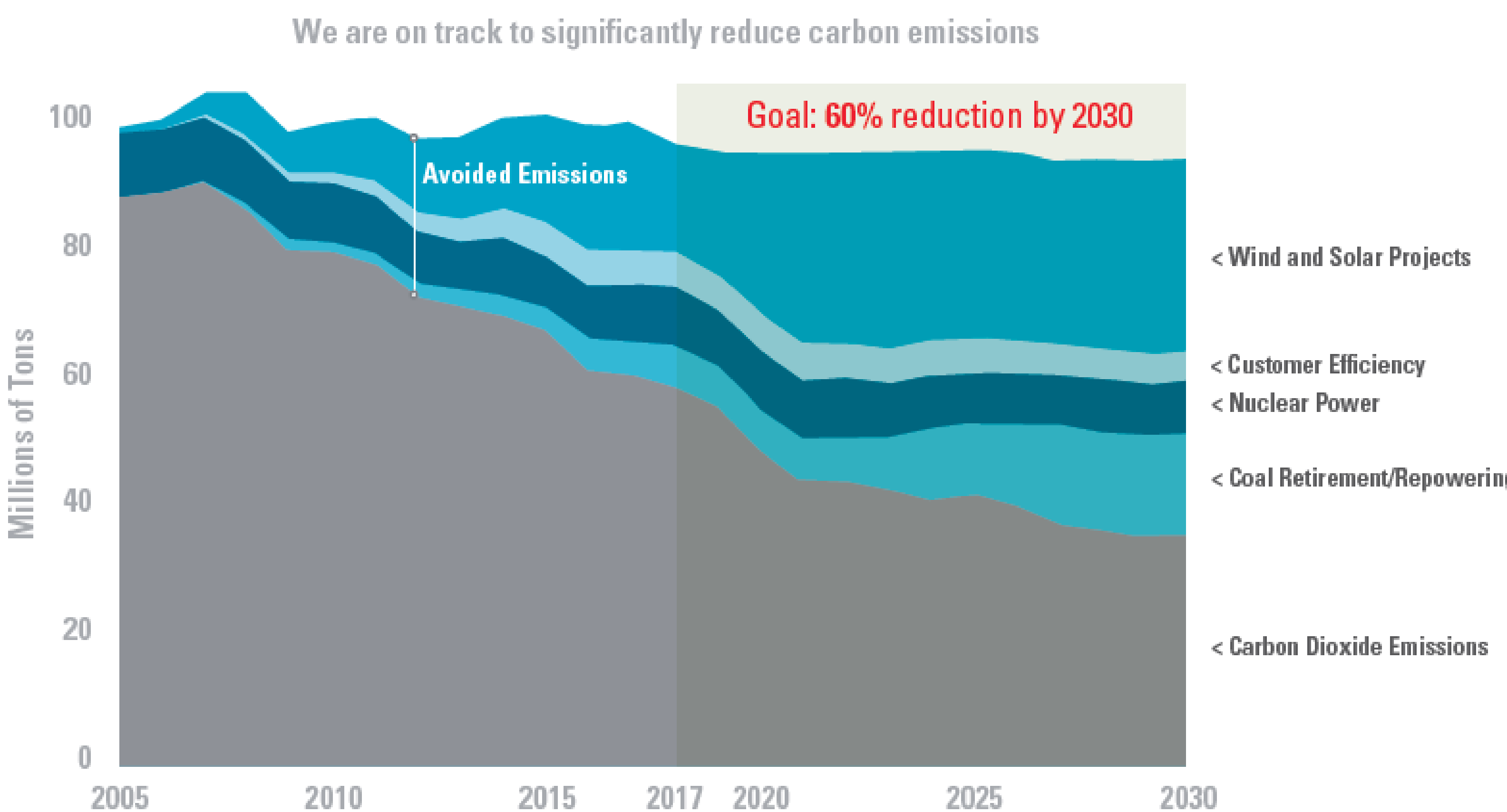
Enhance Customer Experience
Keep Bills Low
LEADING THE ENERGY FUTURE

# Carbon Emissions Reductions




https://www.xcelenergy.com/company/corporate_responsibility_report/2017_highlights

# Energy Storage

# What is Energy Storage?

### Definition

- Technology capable of storing previously generated electric energy and releasing it at a later time.
- Can occur as potential, kinetic, chemical, or thermal energy.
- Release of energy can be in forms that include electricity, gas, thermal energy and other energy carriers.
- Can be deployed in all parts of the grid – helps to enable a smarter, stronger, cleaner, and more reliable energy grid for all customers.

### Asset Categories

- Electric generation asset
- Transmission asset
- Distribution asset
- DSM asset

### Uses

- Capacity
- Flexibility
- Reliability/resiliency
- Microgrids and community projects

### Technologies

**Solid state batteries:** Electrochemical storage, including advanced chemistry batteries and capacitators – sodium sulfur, lead acid, lithium ion

**Flow batteries:** Energy is stored in electrolyte solution for longer life cycle and quick response

**Flywheels:** Mechanical devices that harness rotational energy to deliver instantaneous electricity

**Compressed air energy storage:** Compressed air is used to create a potent energy reserve

**Thermal:** Heat and cold are captured to create energy on demand

**Pumped hydro power:** Large scale reservoirs of energy are created with water

# Storage Technologies

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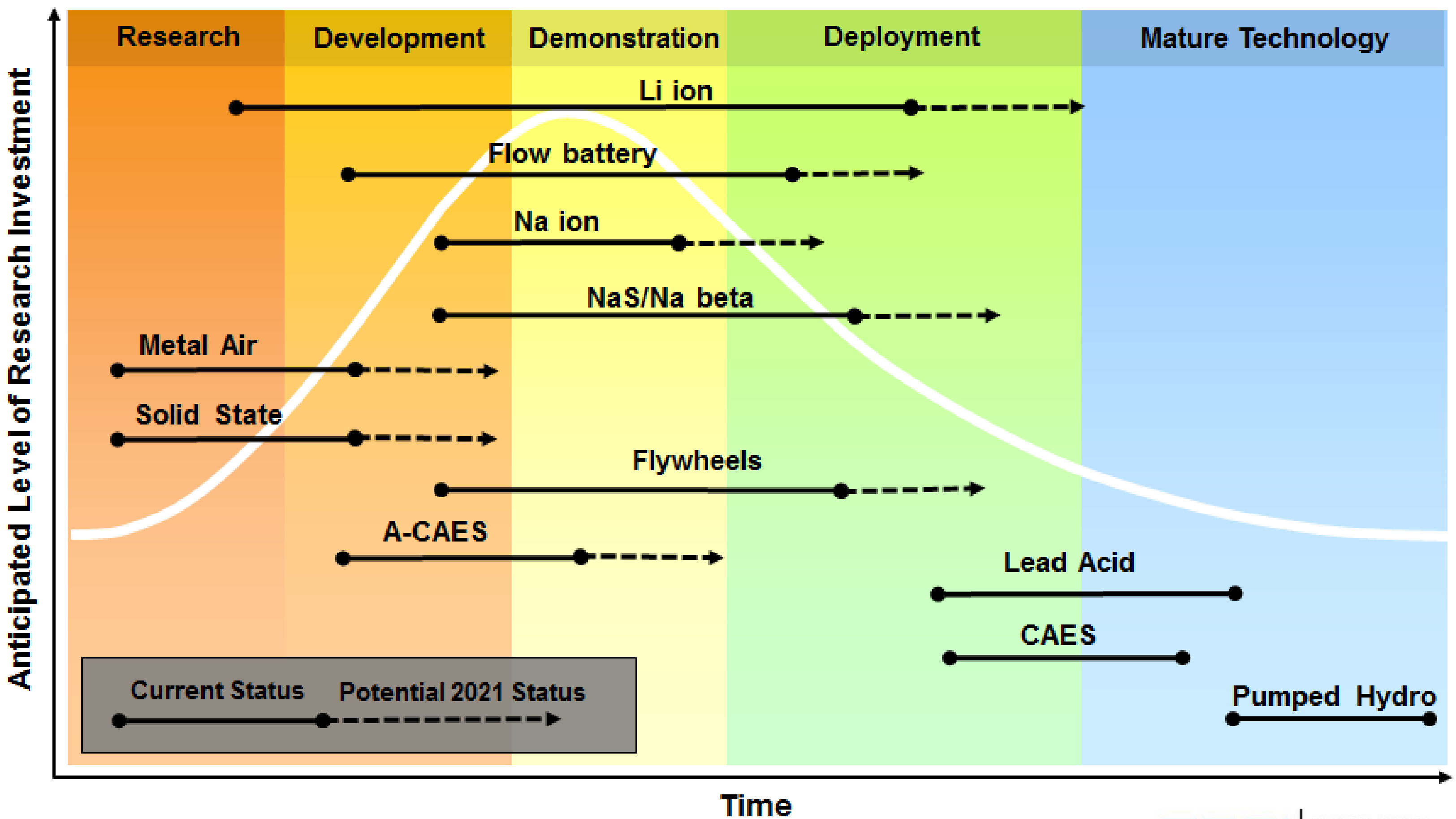
| Technology | Benefits | Challenges | Applications |
|---|---|---|---|
| **Lithium-Ion Battery** | • Energy density<br>• Power density | • Cycle life constraints<br>• Safety concerns | Peak shaving, T&D investment deferral, renewable integration, ancillary services |
| **Lead Acid Battery** | • Familiar<br>• Inexpensive | • Relatively low energy & power density<br>• Poor cycle life<br>• Often requires maintenance<br>• Environmental impacts | Best suited for relatively limited-cycle applications requiring shallow depth of discharge such as backup power and limited peak shaving. |
| **Sodium Sulfur Battery** | • High energy density | • High temps required<br>• Limited power capabilities | Peak shaving, T&D investment deferral, renewable integration |
| **Flow Batteries** | • Decouple power (reactor size) from energy (tank size)<br>• Improved cycle life | • Low energy density<br>• Added components with pumping | Peak shaving, T&D investment deferral, renewable integration, ancillary services |
| **Flywheels** | • Fast Response<br>• High Power | • Low Energy<br>• High self discharge rates | Power quality, frequency regulation, wind generation stabilization |
| **Compressed Air Energy Storage (CAES)** | • Reliable bulk storage | • Geologically limited | Capacity/energy services, ancillary services, renewable integration |
| **Pumped hydro** | • Reliable Bulk Storage | • Geographical limits<br>• Capital intensive | Capacity/energy services, ancillary services, renewable integration |

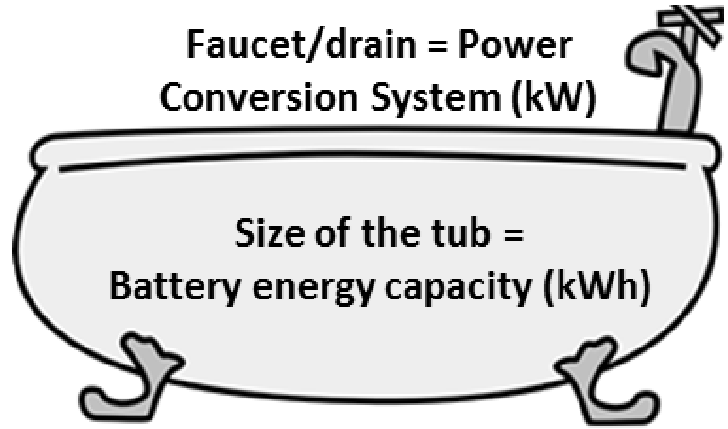
# Storage Technology Development Status




ELECTRIC POWER RESEARCH INSTITUTE

# Battery as a Bathtub

- The size of the tub (or reservoir in the case of a pumped hydro facility), and therefore how much water or energy it can store, determines the **kWh (battery energy capacity)**
- The Power Conversion System works like the faucet/drain in the tub. It determines how quickly the tub will drain and then refill, and therefore determines the **kW (power)** metric
- The cost of the tub as a resource can be described in terms of **$/kW-month (system capacity cost)**
- Duration is one of the most important drivers of the value of a particular storage system **(hours)**

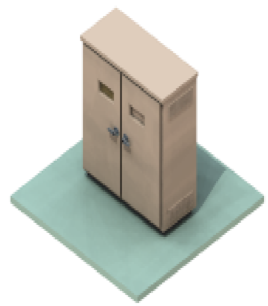


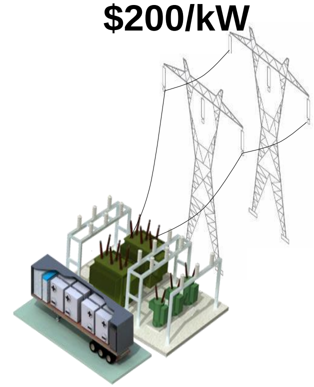

Fixed Cost of the Bathtub, levelized over the life = System Capacity Cost ($/kW-month)

**Stored Energy (kWh) = Power (kW) * Discharge time (hrs)**

# Storage Costs Example

| Battery | Power Conversion System (PCS) | Integration / Balance of Plant | |
|---|---|---|---|
| **$300/kWh*4hr = $1200/kW** | **$250/kW** | **$200/kW** | **$1650/kW <u>for 4 hr Duration</u>** |
| **$300/kWh*2hr = $600/kW** | **$250/kW** | **$200/kW** | **$1050/kW <u>for 2 hr Duration</u>** |

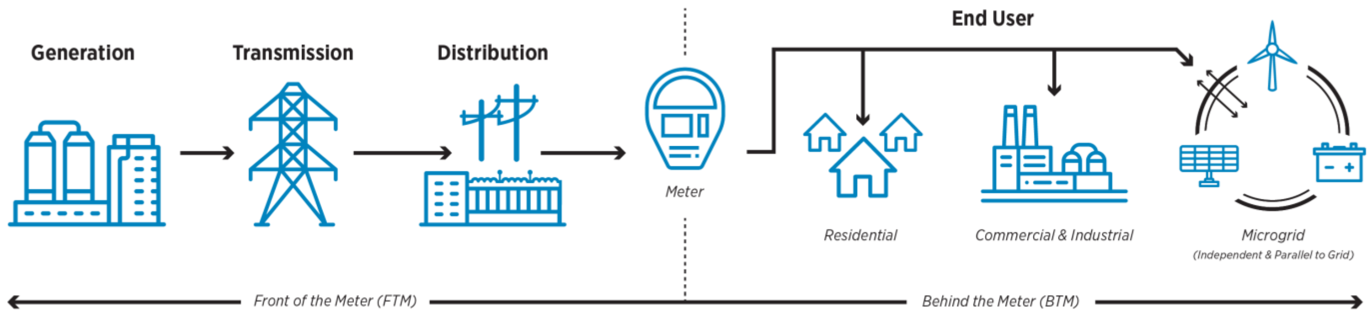




***For Illustration Only – not actual costs***

# Why Energy Storage?

Energy storage can be deployed in all parts of the grid, and has applications in all parts of the value chain.




| Enhance Utility Operations | Provide Grid Support | Optimize Power System | Enhance Customer Experience |
|---|---|---|---|
| • Alleviate high energy prices through time shifts<br>• Reduce the need for new generation | • Regulate frequency<br>• Reduce spinning, non-spinning and supplemental reserve requirements<br>• Voltage support<br>• Black start electricity restoration | • Defer transmission and distribution upgrades<br>• Relieve electricity congestion | • Higher power quality and reliability<br>• Retail electric energy time shift |
| FERC REGULATED | | STATE REGULATED T&D | END USE |

Source: Adapted from DOE/EPRI Handbook, EEI (graphic)

# Why Now?

## Grid needs

Deployment of distributed energy resources

Integration of variable renewable resources

Grid operations and grid modernization

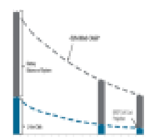
Resiliency improvements

➕

## Market and policy drivers

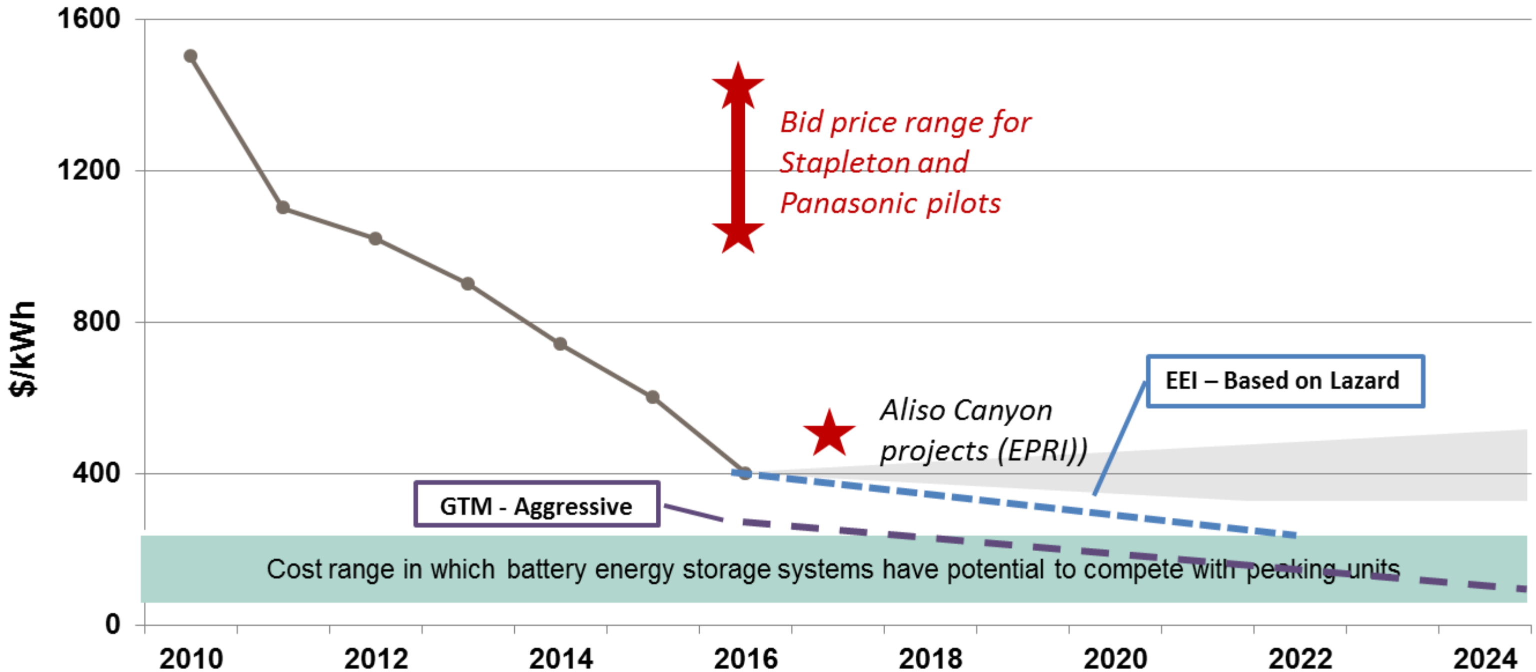
Policy changes

Technology advances



Cost declines

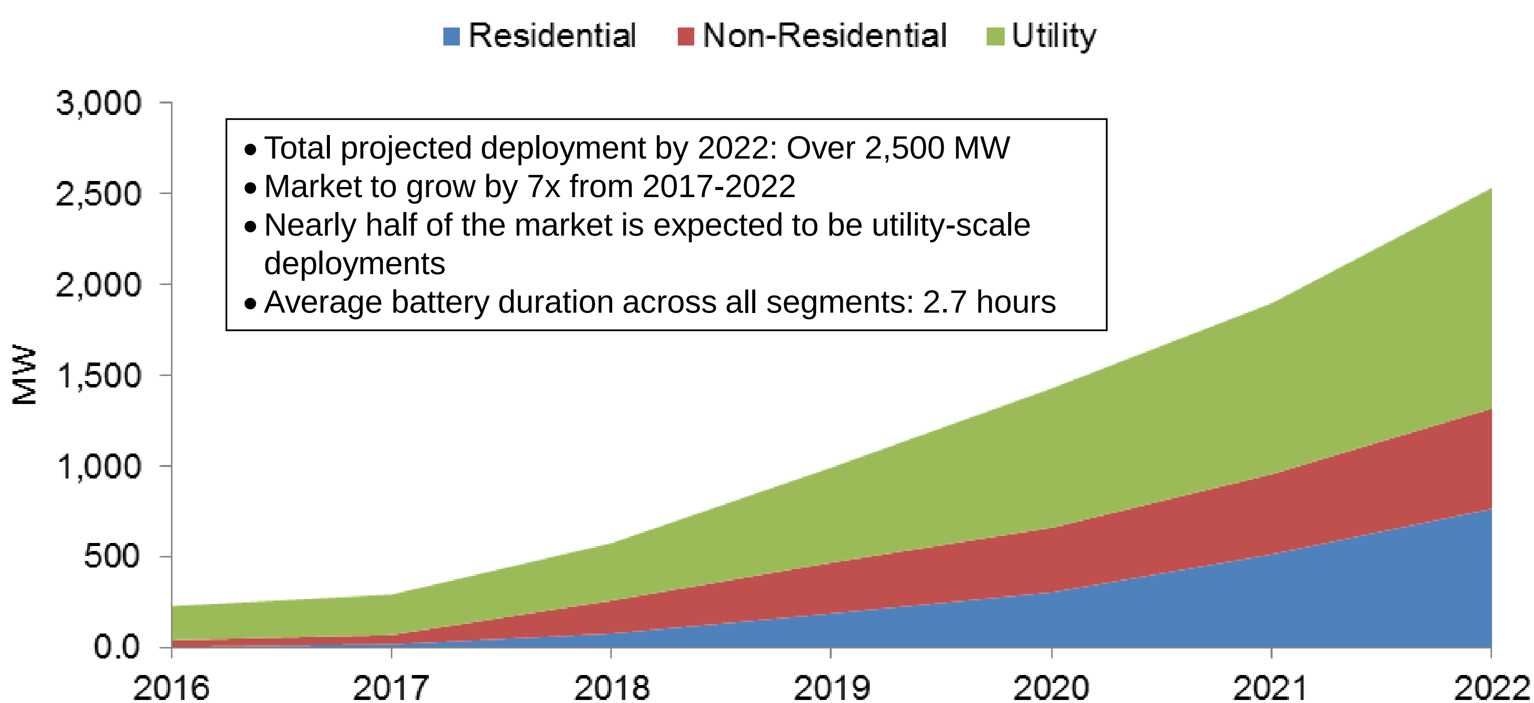
# Lithium-Ion Battery Costs






- Cost declines of 70% from 2010-2016
- 5-10% annual cost declines projected for the next 5-10 years

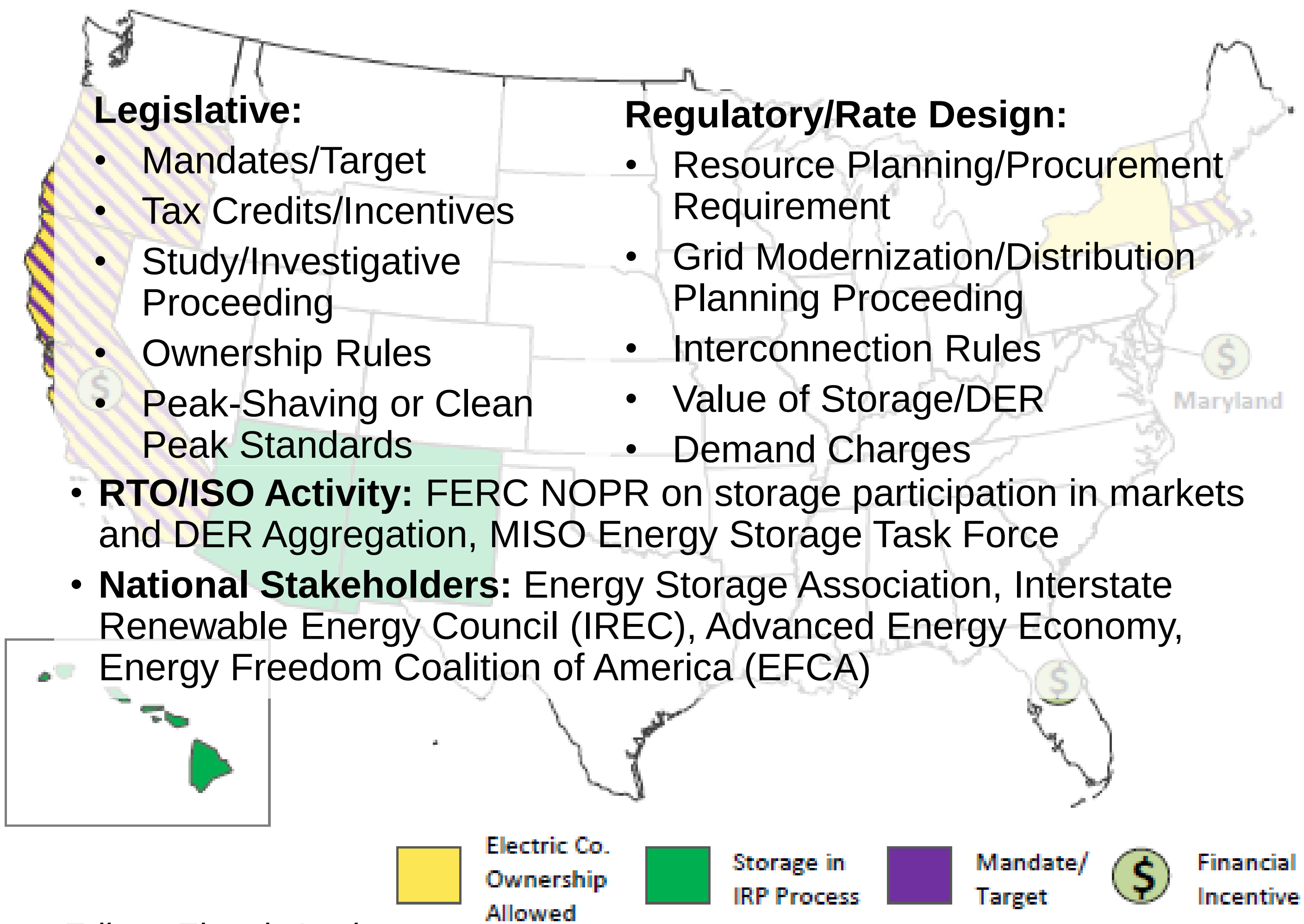
# Projected Market Growth




- Residential Storage: 2-5% of U.S. additions
- Non-Residential Storage: 1-2% of U.S. additions
- Utility Storage: 2-3% of U.S. additions

# National Storage Policy Trends

Xcel Energy




**Legislative:**

- Mandates/Target
- Tax Credits/Incentives
- Study/Investigative Proceeding
- Ownership Rules
- Peak-Shaving or Clean Peak Standards

**Regulatory/Rate Design:**

- Resource Planning/Procurement Requirement
- Grid Modernization/Distribution Planning Proceeding
- Interconnection Rules
- Value of Storage/DER
- Demand Charges

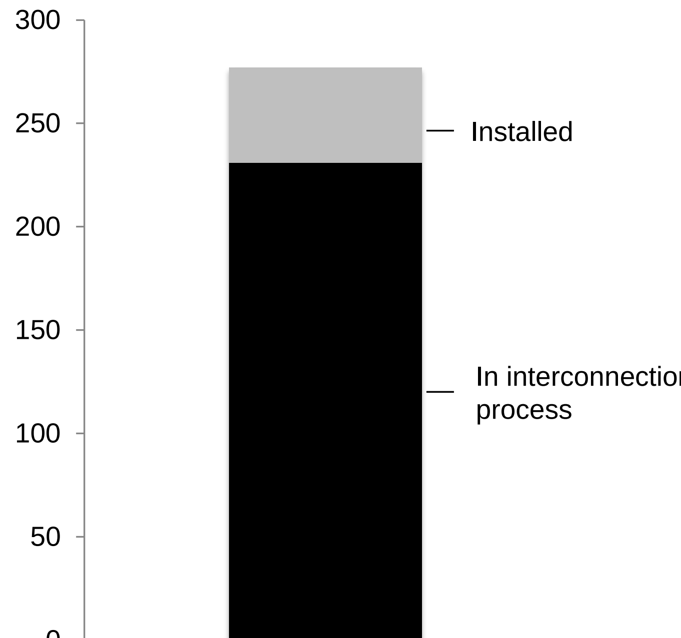
- **RTO/ISO Activity:** FERC NOPR on storage participation in markets and DER Aggregation, MISO Energy Storage Task Force
- **National Stakeholders:** Energy Storage Association, Interstate Renewable Energy Council (IREC), Advanced Energy Economy, Energy Freedom Coalition of America (EFCA)

*Source: Edison Electric Institute*

# Residential batteries in Xcel Energy service territory today

## Stapleton Pilot with Sunverge

## Residential Battery Interconnections in CO and MN, (2017-present)



# Where we are going

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## Pre-2017

**Backup only**

## TODAY

**Primary use for backup**

Other options:
- Rate management
- Commercial DR
- Voluntary solar time shifting

- Interconnection options

## FUTURE

**Primary use can be shared between grid and customer**

**Integrated, optimized with other technology**

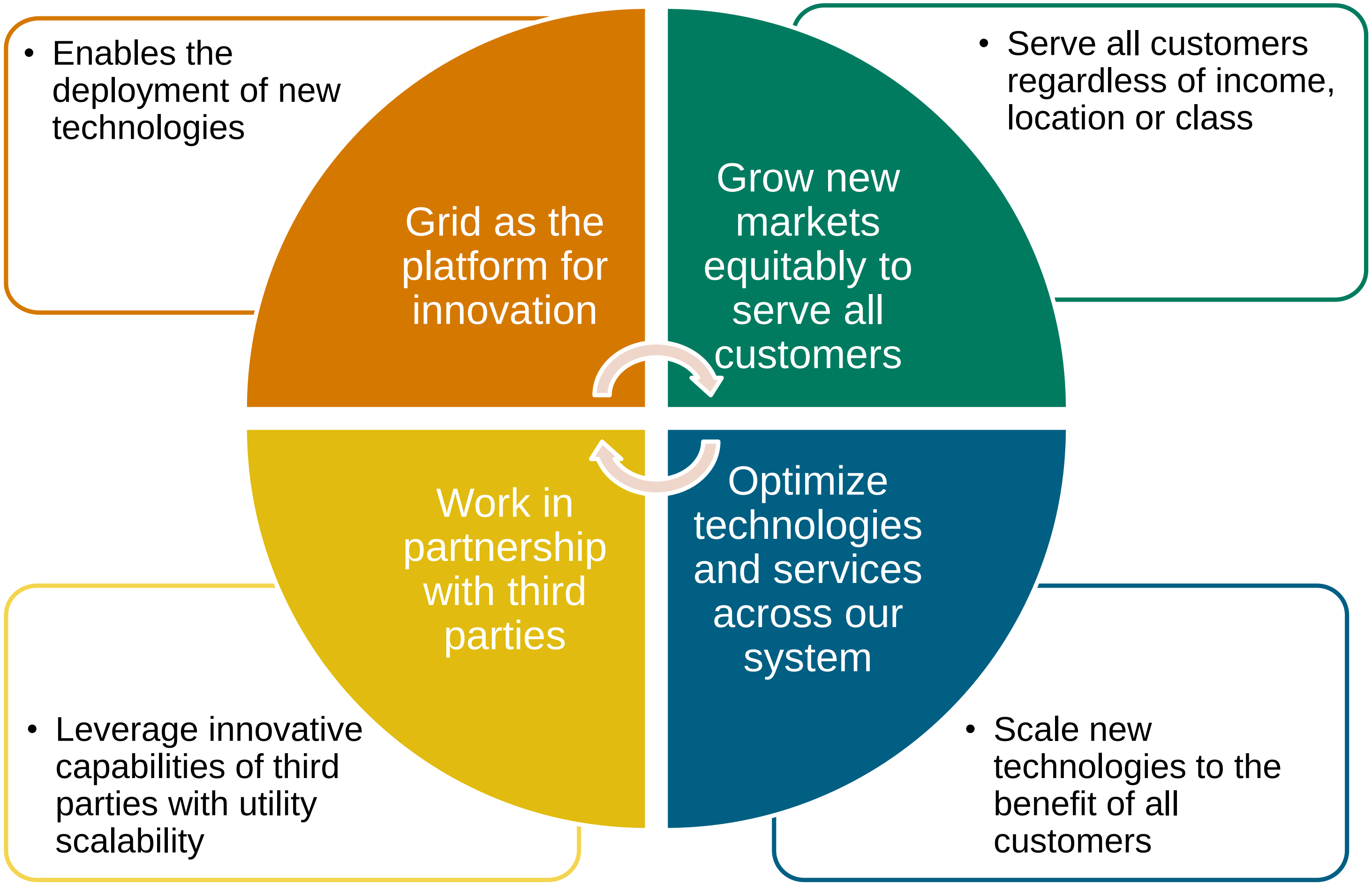
Grid Examples:
- Demand response
- Renewable integration
- Distribution deferral
- Ancillary services

Customer examples:
- Rate management
- Back-up

# Utility Innovation & Emerging Technologies

# Utilities can be Engines of Innovation

Xcel Energy

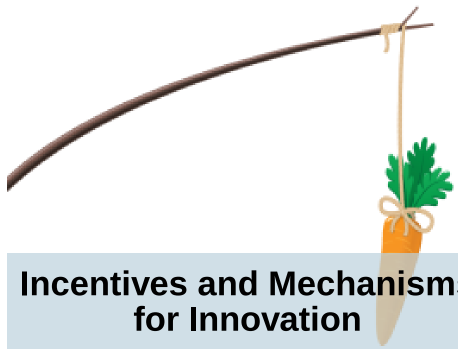


# Strategies for Utility Innovation

Xcel Energy

Lead the Clean Energy Transition | Keep Bills Low | Enhance the Customer Experience

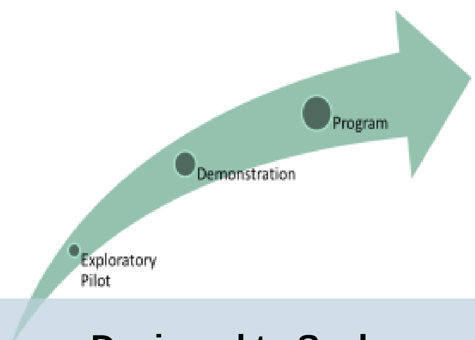
**Tied to Strategic Vision**



**Incentives and Mechanisms for Innovation**

**Internal Coordination**

**Stakeholder Engagement**



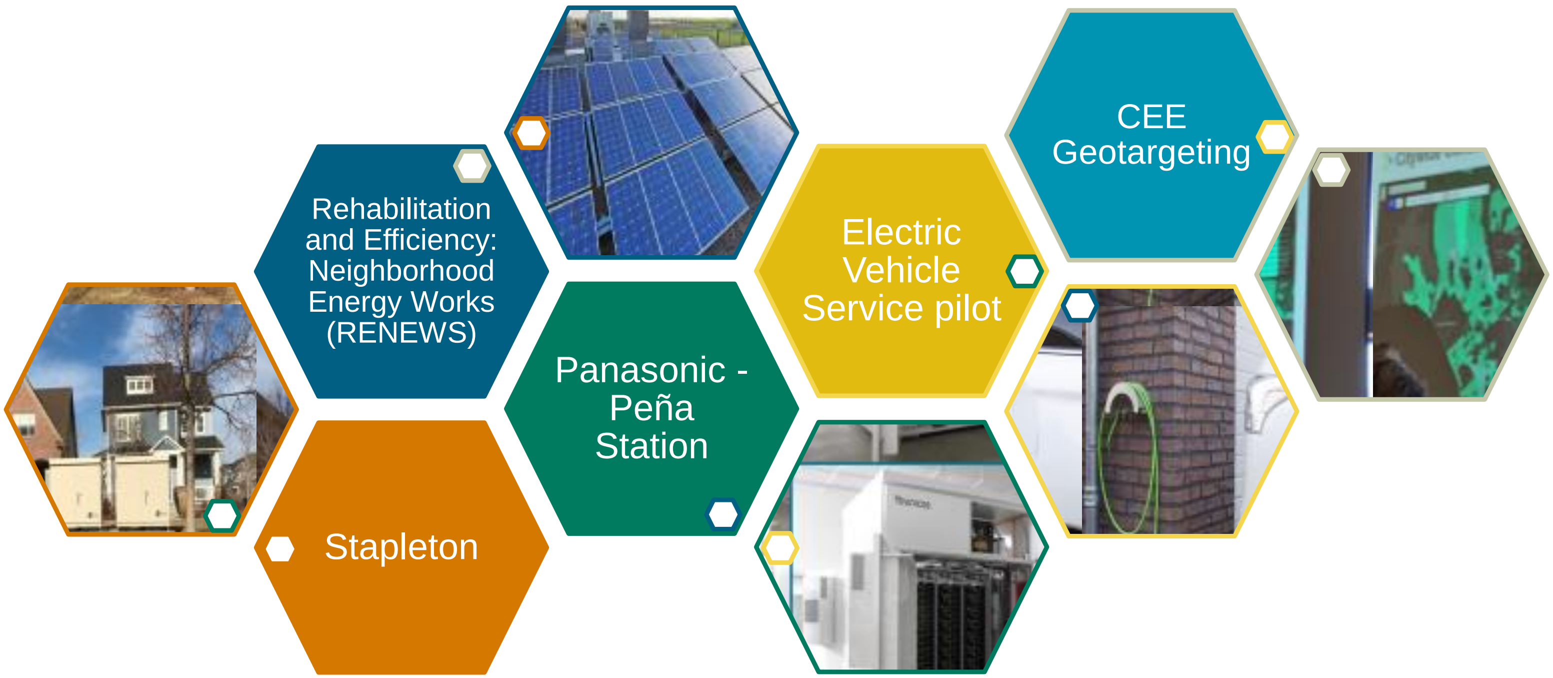

**Designed to Scale**

DENVER
CITY NOW
RTD
Xcel Energy

**Partnerships**

Source: Framework adapted from “Pathways for Innovation” (2017) from Rocky Mountain Institute

# Pilot & Demonstration Projects



# Panasonic – Peña Station Pilot

Xcel Energy

- Utility-sited 1 MW, 2 MWh Lithium-Ion Younicos Battery Storage System
- 1.6 MW carport solar PV system
- 260 kW customer-sited rooftop PV system
- Switching and control systems owned by Xcel Energy
- **Main operations:** Microgrid/Resiliency, Voltage Regulation, System Peak Demand Reduction, Solar Ramp Rate Control, Energy Arbitrage, Frequency Response
- **Microgrid capabilities:** During a grid outage, battery powers Panasonic facility
    - Panasonic's building management system prioritizes energy usage based on battery state of charge and expected length of outage
    - Panasonic's 240 kW rooftop PV also able to operate
    - 10% of battery capacity reserved for Panasonic

# Community Energy Storage - Stapleton

Xcel Energy

- Located in Stapleton neighborhood in Denver, CO
- 6 utility-sited batteries
- 6 customer batteries
- 2015: ~18.5% PV Penetration

- <u>Main Operations:</u>
  - Solar Time Shifting
  - Voltage Regulation
  - System Peak Demand Reduction
  - Energy Arbitrage

- Testing of BTM batteries to understand future impact of batteries

# Questions?

Thank you

Julia Eagles – Public Policy & Strategy Manager
julia.h.eagles@xcelenergy.com

# IRP Information

- **Web Page:**

**https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/sps_2019-2038_integrated_resource_plan**

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- **Ashley Gibbons and Ben Elsey – Xcel Energy/SPS Contact**
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  - *Phone: Ashley (303)571-2813, Ben (303)571-6705*
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    *ben.r.elsey@xcelenergy.com*