How Industry is Working on Grid Security and Modernization Webinar

MGA

America's Smartland

Midwestern Governors Association

March 19, 2019

Today's Speakers

- S. Cat Wong, Manager, Customer Product Engineering, Energy Technology and Analytics Transformation, Entergy Services, LLC

- Nicholas Martin, Manager, Environmental Policy, Xcel Energy

MGA
America's Smartland
Midwestern Governors Association

S. Cat Wong
Entergy Services

MGA
America's Smartland
Midwestern Governors Association

Nicholas Martin
Xcel Energy

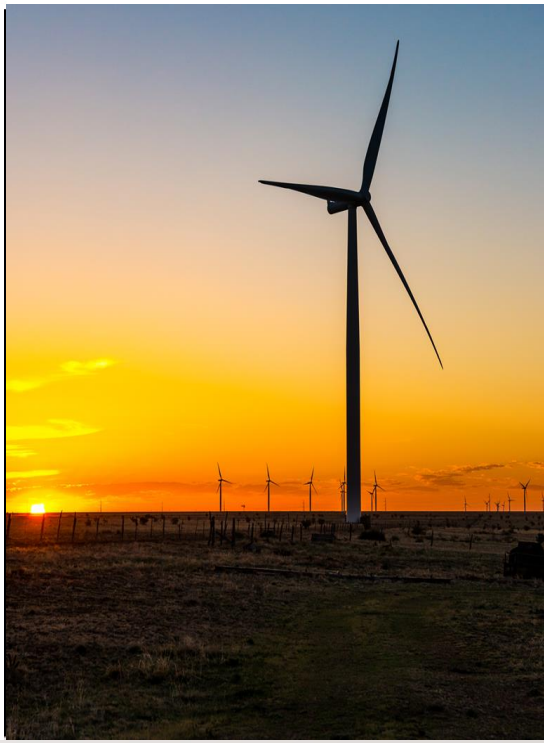
MGA
America's Smartland
Midwestern Governors Association

Building a Carbon-free Future:

Meeting Customer Expectations in a Time of Rapid Industry Change

Midwestern Governors Association webinar

March 19, 2019



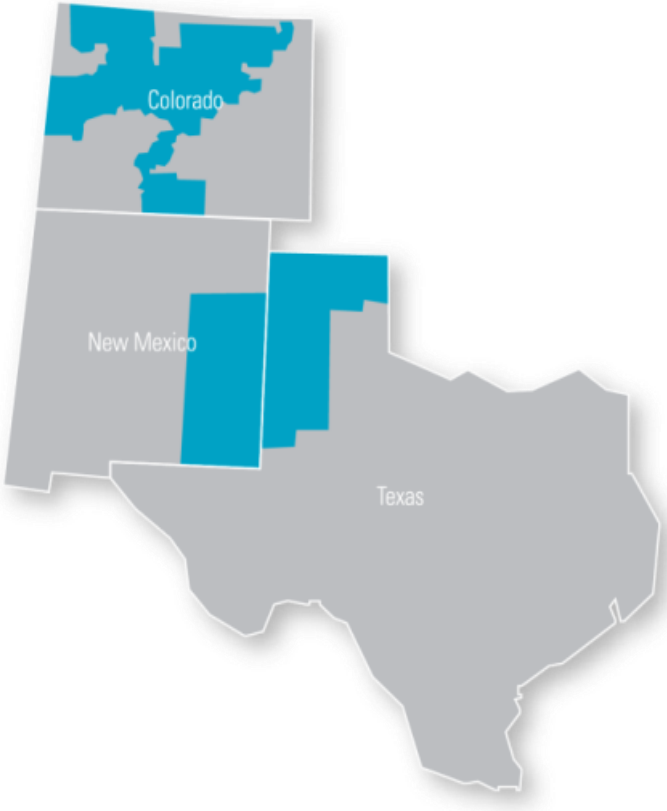
Xcel Energy

Serving eight states

- 3.6 million electricity customers
- 2 million natural gas customers

Nationally recognized leader:

- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Innovative technology



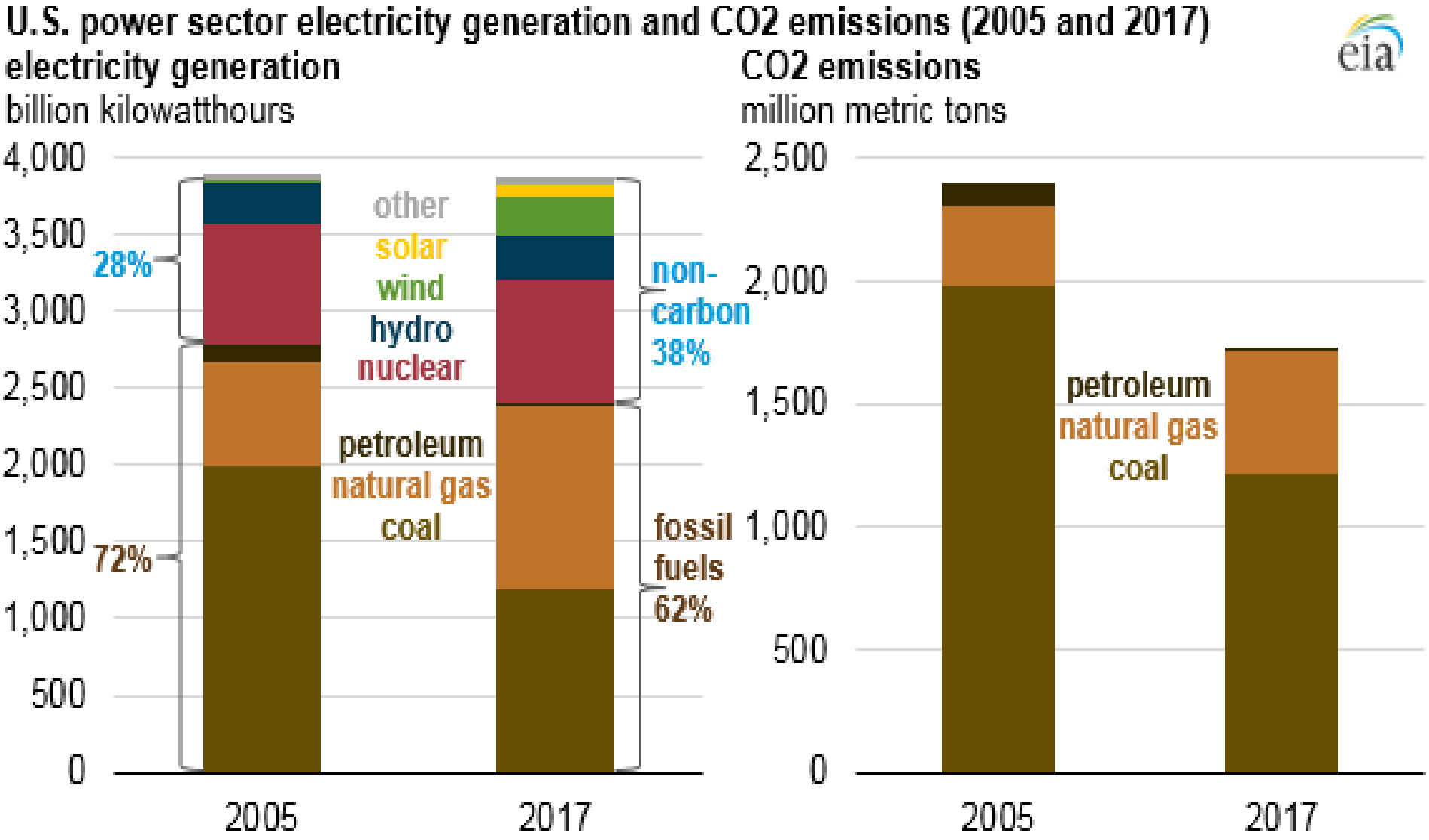
Xcel Energy Priorities

Lead the Clean Energy Transition

Enhance the Customer Experience

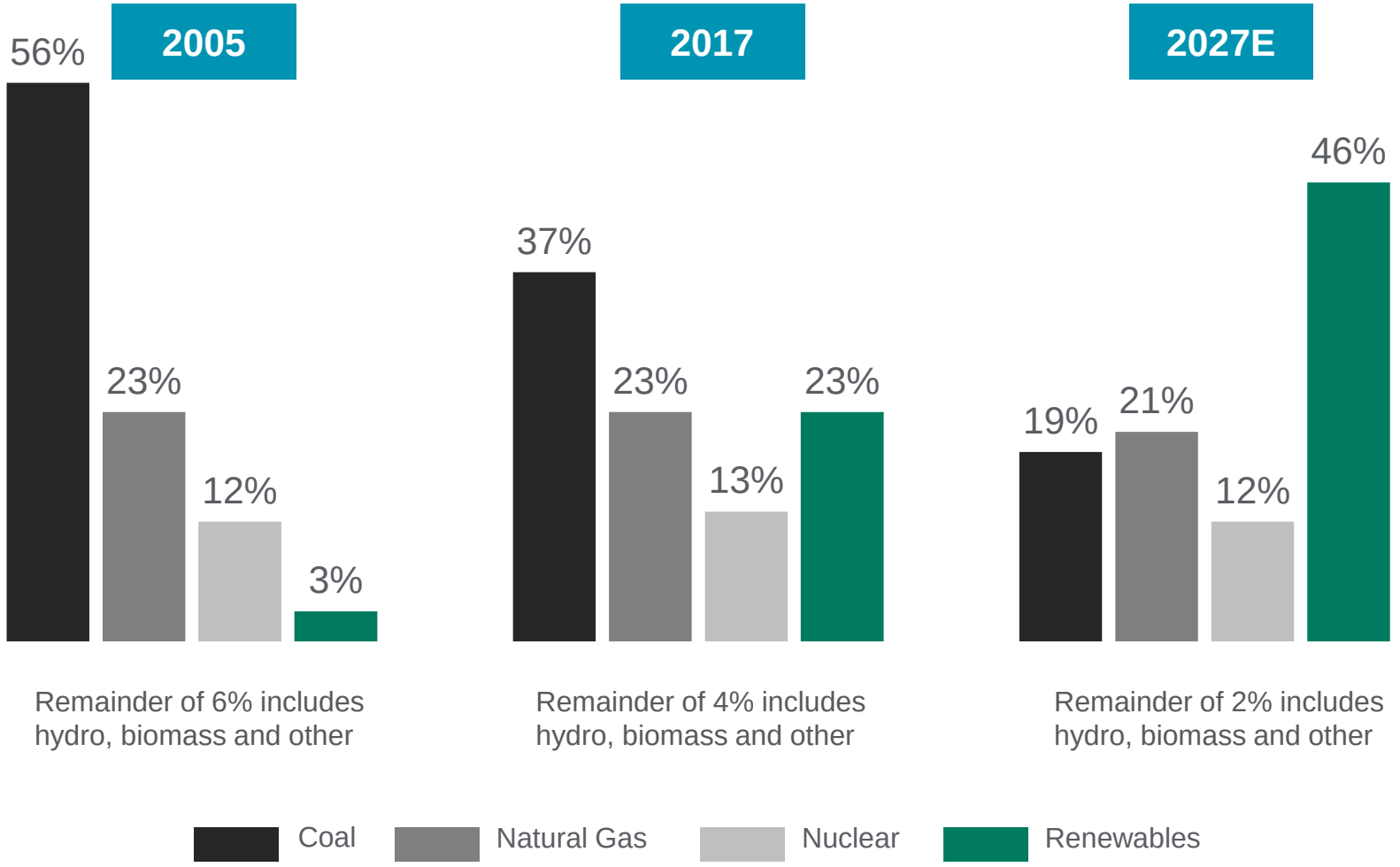
Keep Bills Low

U.S. Power Sector in Transition



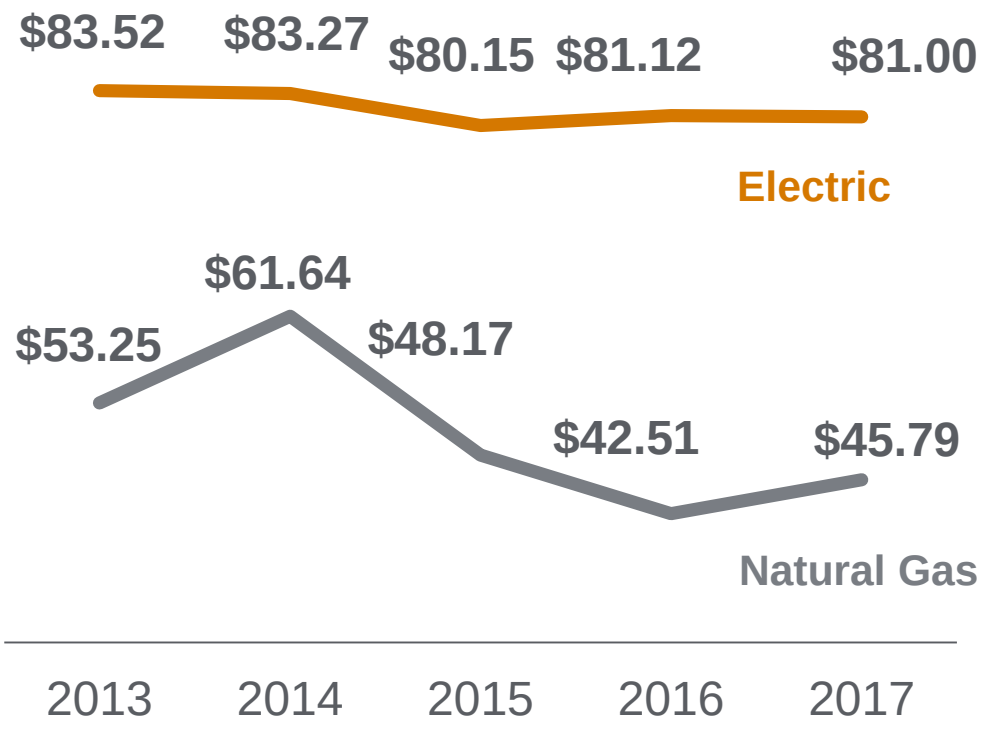
Xcel Energy's System

↓Coal, ↑Renewables, ↔Gas and Nuclear



Affordable Clean Energy

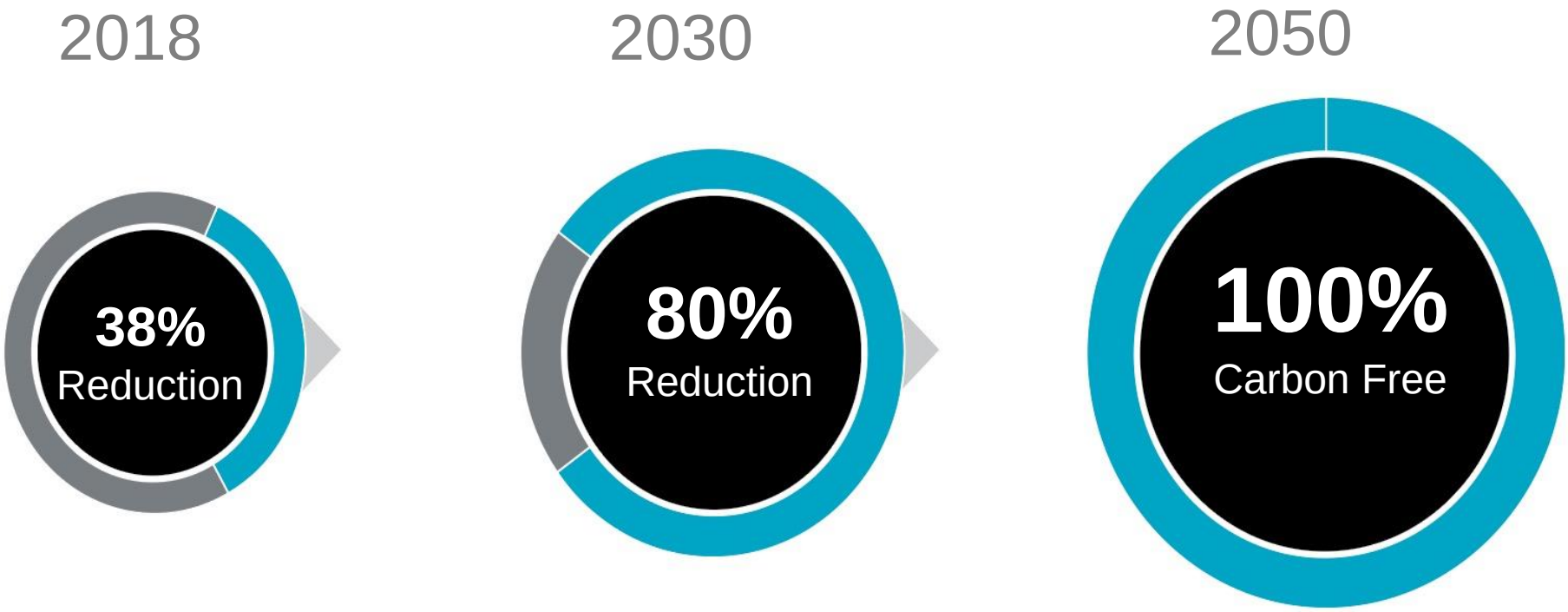
Average Residential Customer Bill



- At or below rate of inflation
- Below national average

Leading the Clean Energy Transition

A bold vision for a carbon-free future



A Commitment that Resonates

Xcel Energy®

StarTribune

BUSINESS

Xcel's pledge to be carbon-free by 2050 makes good business sense

What we have here might simply be a case of a big company going carbon-free to meet the rising expectations of its customers.

DECEMBER 9, 2018 — 6:58PM

MATTHEW STA

Xcel Energy is pledging to be carbon-free by 2050. Above, its Green
Project serves customers in Colorado.

WHY XCEL ENERGY'S PLAN TO GO 100% CLEAN ENERGY—IS A BIG DEAL

Xcel Energy, one of the biggest utilities in the US, has committed to going completely carbon-free by 2050 (and 80 percent carbon-free by 2030).

Bloomberg

Photograp

Climate Changed

Xcel Is First Big U.S. Utility to Swear Off Greenhouse Gas

By Brian Eckhouse

December 04, 2018 5:15 PM *Updated on December 05, 2018 8:15 AM*

Paul Douglas ✓
@pdouglasweather

Xcel is on the leading edge. Other utilities will quickly discover that lowering carbon can reduce climate risk AND lower costs for consumers over the long haul. There is a real and sustainable ROI for all stakeholders involved

Al Gore ✓
@algore

Follow

To bring global emissions down, we must demand that business & political leaders urgently #ActOnClimate. It can work: A major utility committed to a zero-carbon future, responding to investment opportunity & customer demand. Let's keep the pressure on!

BusinessWire
A Berkshire Hathaway Company

Xcel Energy Aims for Zero-Carbon Electricity by 2050

The New York Times

Utility Aims for Zero Carbon Emission From Electric Power

By The Associated Press

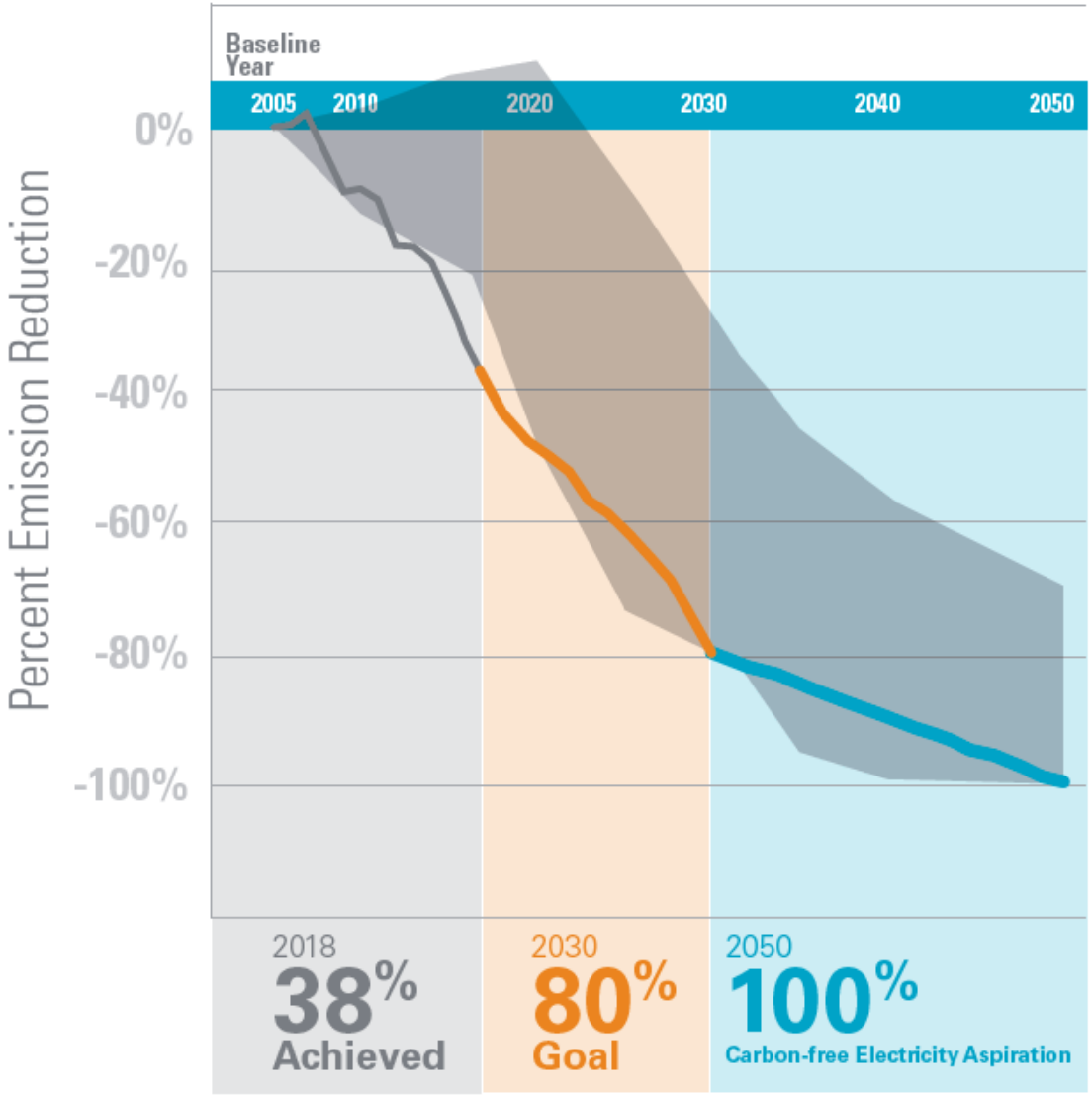
Dec. 4, 2018

DENVER — A utility serving 3.6 million electricity customers in eight states said Tuesday it will try to eliminate all its carbon emissions from electrical generation by 2050.

Grounded in Climate Science

Xcel Energy

Xcel Energy Carbon Goals Compared to 2 C Scenarios



Range of electric sector reductions in scenarios likely to limit warming to below 2 C

Goals align with Paris climate agreement target to limit warming to 2 C

Analysis by Brian O'Neill, University of Denver and IPCC lead author

Achieving the Vision

Reducing carbon emissions is job #1

- ☑ Protect energy reliability and affordability
- ☑ Support from our states and stakeholders
- ☑ Advocate for constructive public policy
- ☑ Develop carbon-free 24/7 technologies for 2050

Path to an 80% Reduction by 2030

Affordably and reliably, with current technology

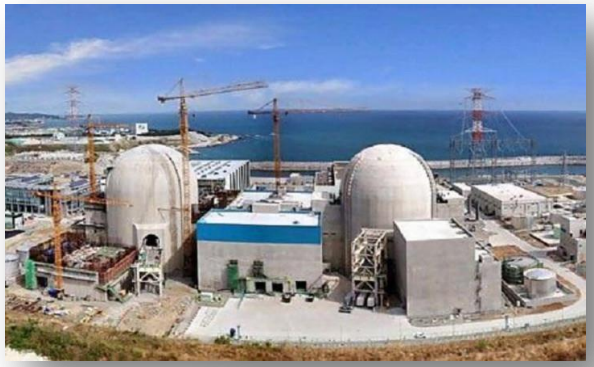
- Increase renewables
- Natural gas and energy storage
- Preserve nuclear
- Retire coal and/or further changes to coal unit operations
- Strategic electrification
- Invest in the grid

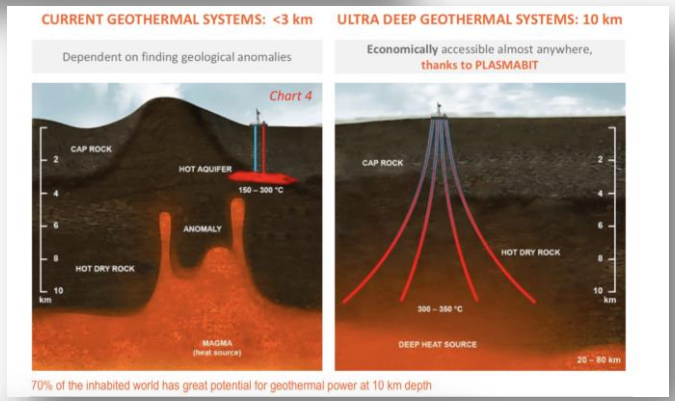
Path to 100% Carbon-Free by 2050

Relies on new 24/7 carbon-free technology

May include:

- Gas with carbon capture and storage
- Advanced nuclear
- Power to gas
- Deep rock geothermal
- Seasonal storage
- Others





Community Energy & Carbon Goals

Carbon Reduction Goals	
Minnesota	
Mahtomedi	100% by 2050
Edina	30% by 2025
Minneapolis	80% by 2050
Saint Paul	100% by 2050
Eden Prairie	80% by 2050
Saint Louis Park	100% by 2040
Red Wing	25% reduction
Winona	100% by 2050
Wisconsin	
Eau Claire	100% by 2050
Colorado	
Boulder	80% by 2050
Denver	80% by2050
Englewood	12% by 2030
Fort Collins	100% by 2050
Lafayette	80% by 2050
Lakewood	50% by 2050
Garfield County	100% by 2040

Renewable Energy Goals	
Minnesota	
Minneapolis	100% by 2022 for municipal facilities 100% by 2030 community-wide
St Louis Park	100% by 2030
St. Cloud	80% by 2018
Wisconsin	
Eau Claire	100% by 2050
La Crosse	25% by 2025
Colorado	
Boulder	100% by 2030
Breckenridge	100% by 2025 for municipal facilities 100% by 2035 community-wide
Denver	100% by 2030
Fort Collins	20% by 2020
Lafayette	100% by 2030
Lakewood	45% by 2025
Longmont	100% by 2030
Nederland	100% by 2020 for municipal facilities 100% by 2025 community-wide
Garfield County	35% by 2020
Pueblo County	100% county-wide by 2035
Summit County	100% community-wide by 2035

Challenges to a 100% Renewable Grid

1. Costs increase steeply over ~60% annual renewables

2. At 100%, “overbuilding” grid capacity as much as 8x peak is required

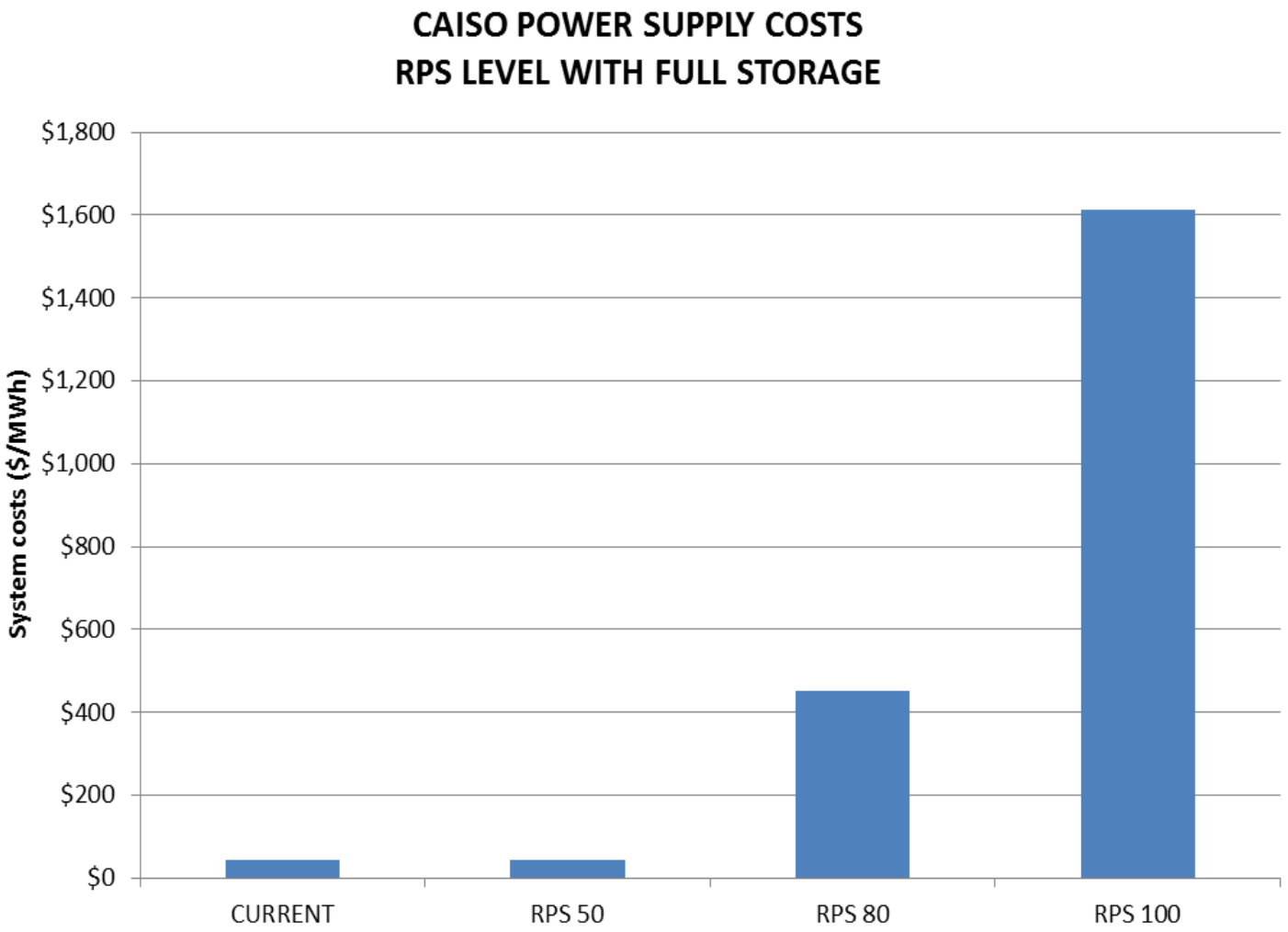
3. No great solution to use or store surplus renewable generation

California Example:

Steep cost increases above 50% renewable

System energy costs of ***$1,612/MWh***

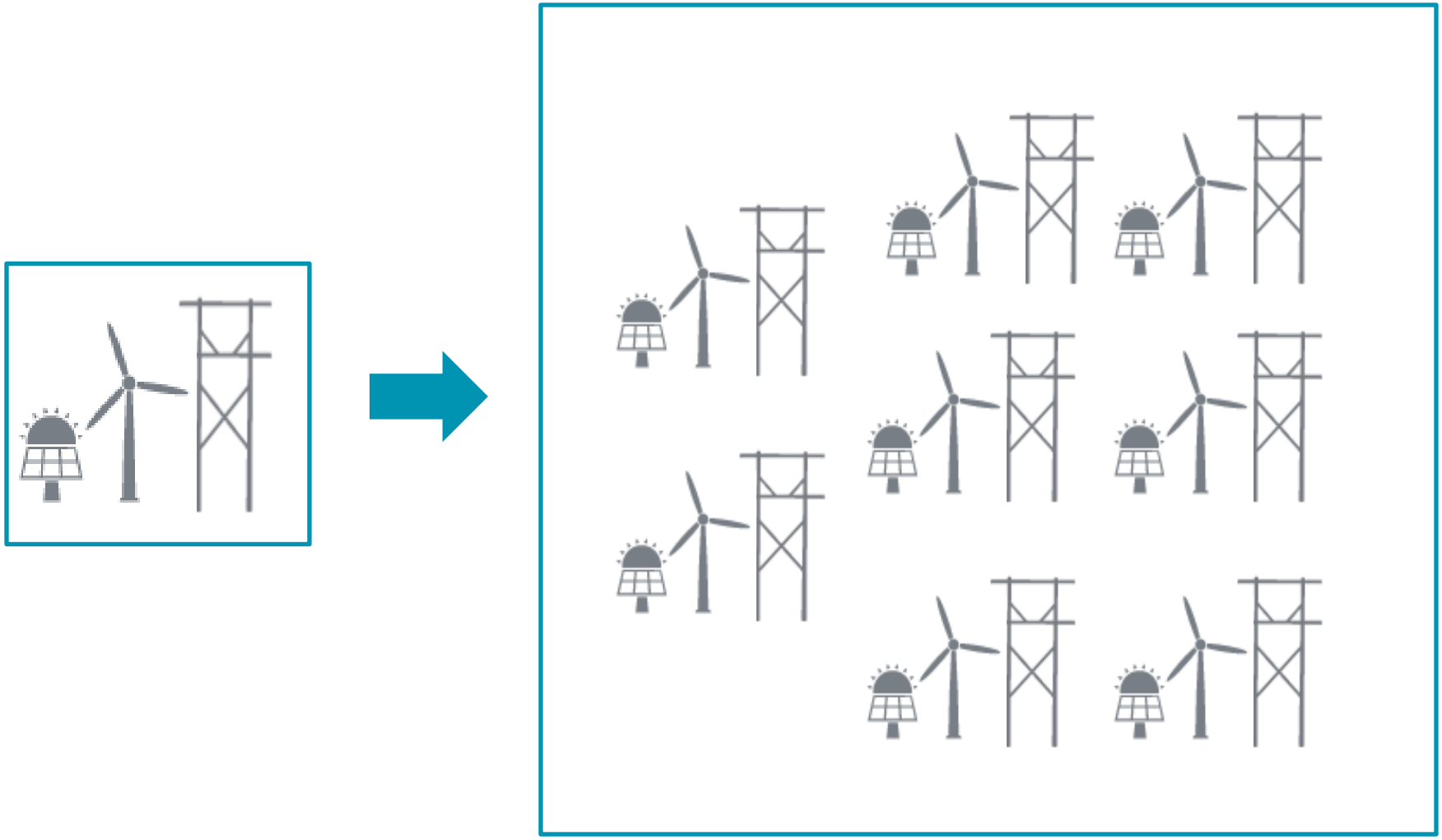
Current avg. price: **$50/MWh**



Source: Clean Air Task Force

Result is an “Overbuilt” Grid

Up to 8x the investment and resources



Source: Jesse D. Jenkins, Getting to Zero Carbon Emissions in the Electric Power Sector

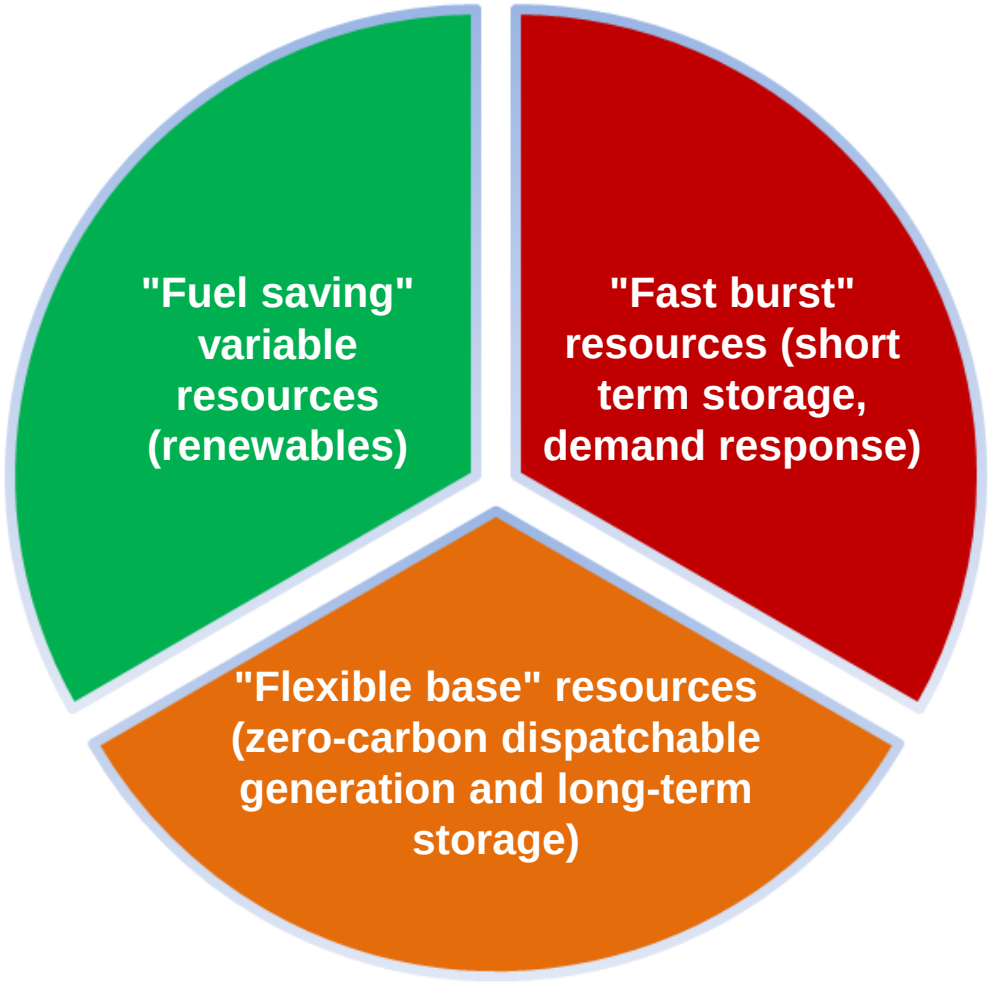
Battery Storage Alone Does Not Solve This Challenge

- 100% renewable scenarios create long-term imbalances of supply and demand
- Requires 8-16 weeks of storage
- Largest batteries today provide hours
- Storing all excess generation to avoid curtailment would cost trillions

Tesla's Hornsdale Power Reserve, South Australia: 100 MW/129 MWh

A Balanced Portfolio

Renewables, storage, flexible demand, and new technology



Source: Sepulveda et al., The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation

Eyes on the Prize

- Public policy should aim for the most cost-effective carbon reductions versus very high renewable mandates

- Keep all options open – add more renewables as long as they are the least-cost option, and invest in zero-carbon 24/7 technologies today

Questions & Answers

MGA
America's Smartland
Midwestern Governors Association

Upcoming Webinars

April 9 - Changing State Priorities, Part 1
April 30 - Changing State Priorities, Part 2

For more information, and to register, please visit
www.midwesterngovernors.org/GSM3

MGA
America's Smartland
Midwestern Governors Association