Building a Carbon-free Future

Annual Fuel Cell Seminar and Exposition

Hydrogen@Scale: Chemical Energy Storage Panel

November 5, 2019

Frank Novachek
Manager, Planning & Technology Assessment

Leading the Clean Energy Transition

A bold vision for a carbon-free future

2018

2030

2050

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 STAVER – BLOOMBERG

Xcel Energy is pledging to be carbon-free by 2050. Above, its Green Wind Power 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

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*

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!

Business Wire
A Berkshire Hathaway Company

Xcel Energy Aims for Zero-Carbon Electricity by 2050

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

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.

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

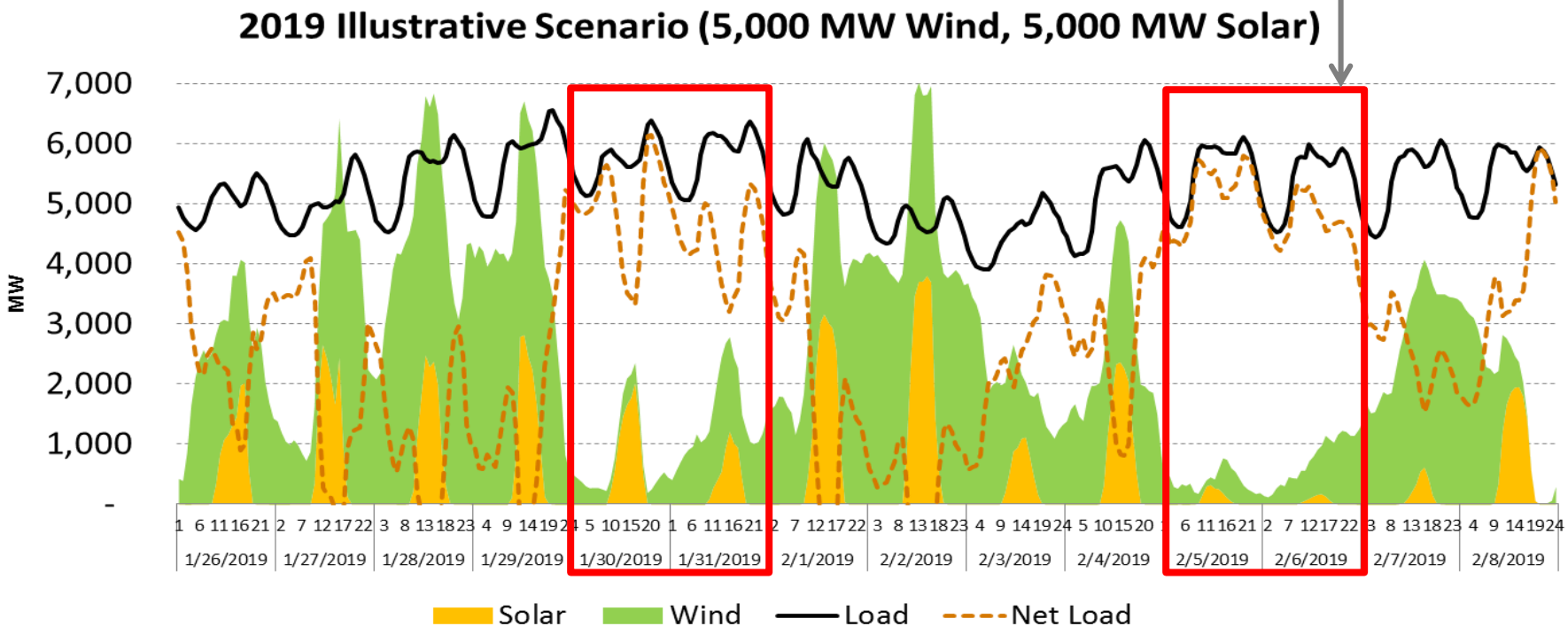
Path to an 80% Reduction by 2030

Affordably and reliably, with current technology

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

A Winter Challenge to Incremental Renewables

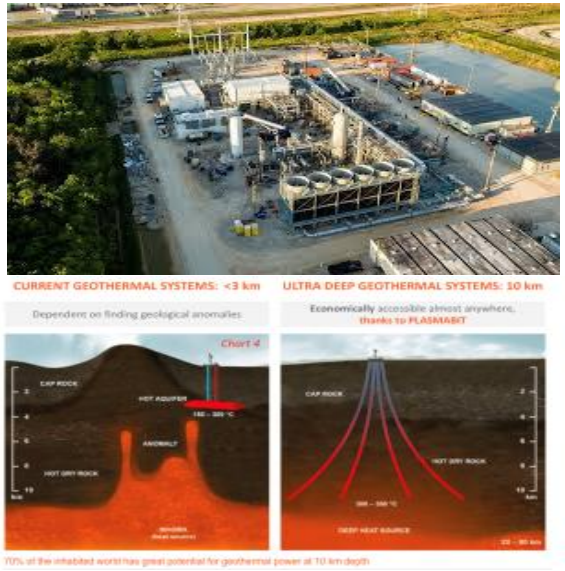
More renewables & use-limited resources alone cannot reliably fill the gap

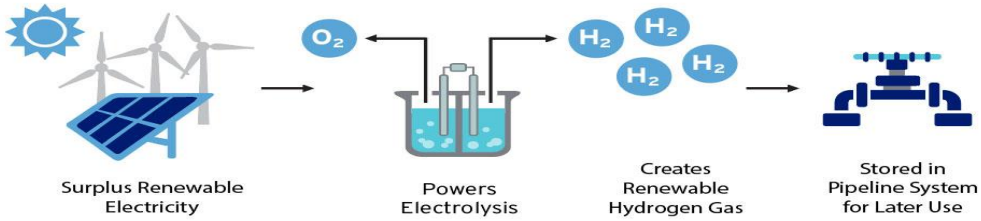


2050 Aspiration Depends on 24/7 Carbon-Free Technology

Examples beyond wind/solar/CSS/batteries include:

- Geothermal
- Natural gas with carbon capture and storage
- Advanced nuclear
- Seasonal storage (Hydrogen, Carriers)
- Power-to-gas* (Low/No-Carbon Hydrogen)
- Fusion
- Others

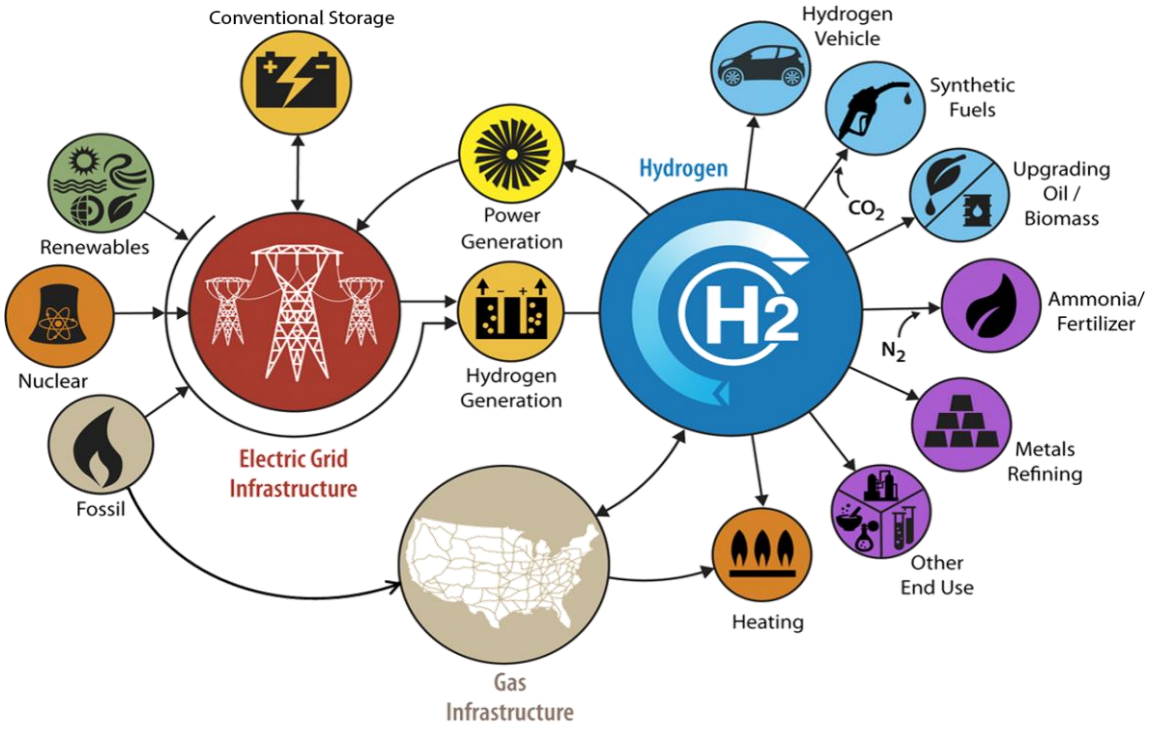




**Power to Gas Diagram Courtesy of SoCal Gas*

US Decarbonization Strategy Aligned with Xcel Energy Goals:

Hydrogen@Scale

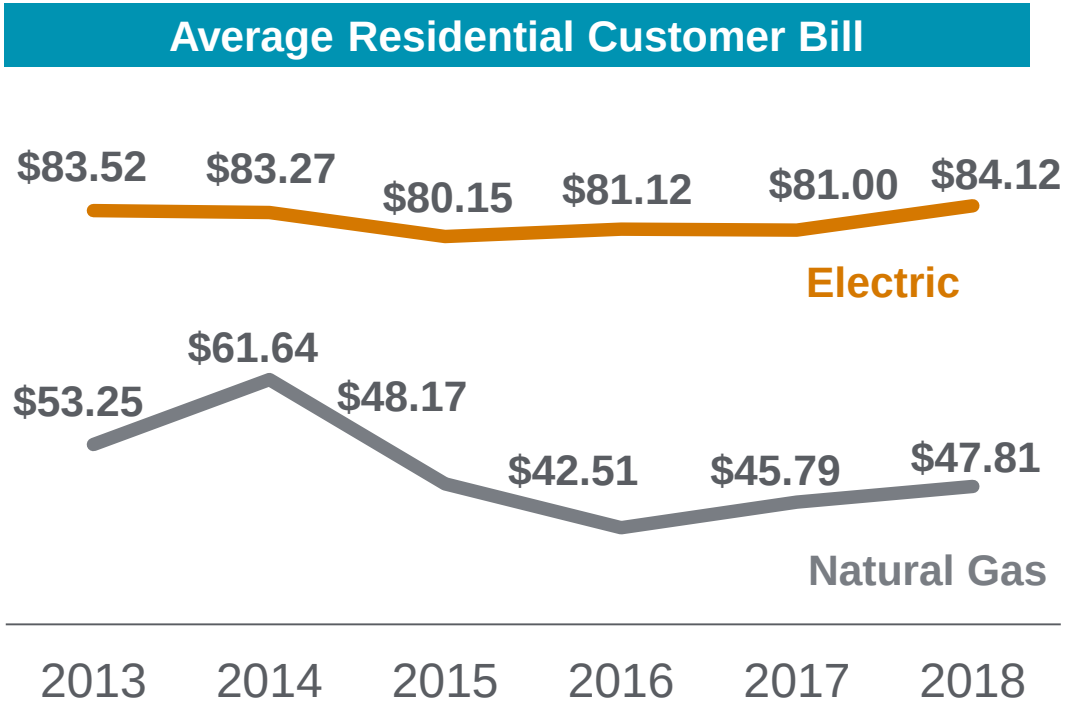


Producing Hydrogen with "Clean" Energy:

- Increases "Clean" Asset Utilization and Grid Flexibility
- Enables "Seasonal" Storage and Generation with "Clean" Energy
- Adds value for Customers by Enabling them to Reduce their Carbon Footprints

Source: DOE Fuel Cell Technologies Office

Parallel Goal: Keep Customer Bills Low



Xcel Energy's average residential gas and electric bills are below the national average

Eyes on the Prize

- Focus public policy on cost-effective carbon reductions
- Partner with customers to enable them to achieve their clean energy goals
- Support increased cost-effective renewables and invest in zero-carbon 24/7 technologies today


Xcel Energy®

Supportive Public Policy

State and Federal policy can drive innovation toward carbon-free technologies

Standards	Market certainty for long-term carbon emissions reductions
Incentives	Carbon-free, technology-neutral incentives that phase out as the resource matures
RD&D	Focus on commercialization of 24/7 carbon free breakthrough technologies
Ecosystem	Streamlined permitting, interconnection processes, and workforce development