NAVIGATING THE NEW ERA OF ELECTRIC LOAD GROWTH AS AN INTEGRATED UTILITY

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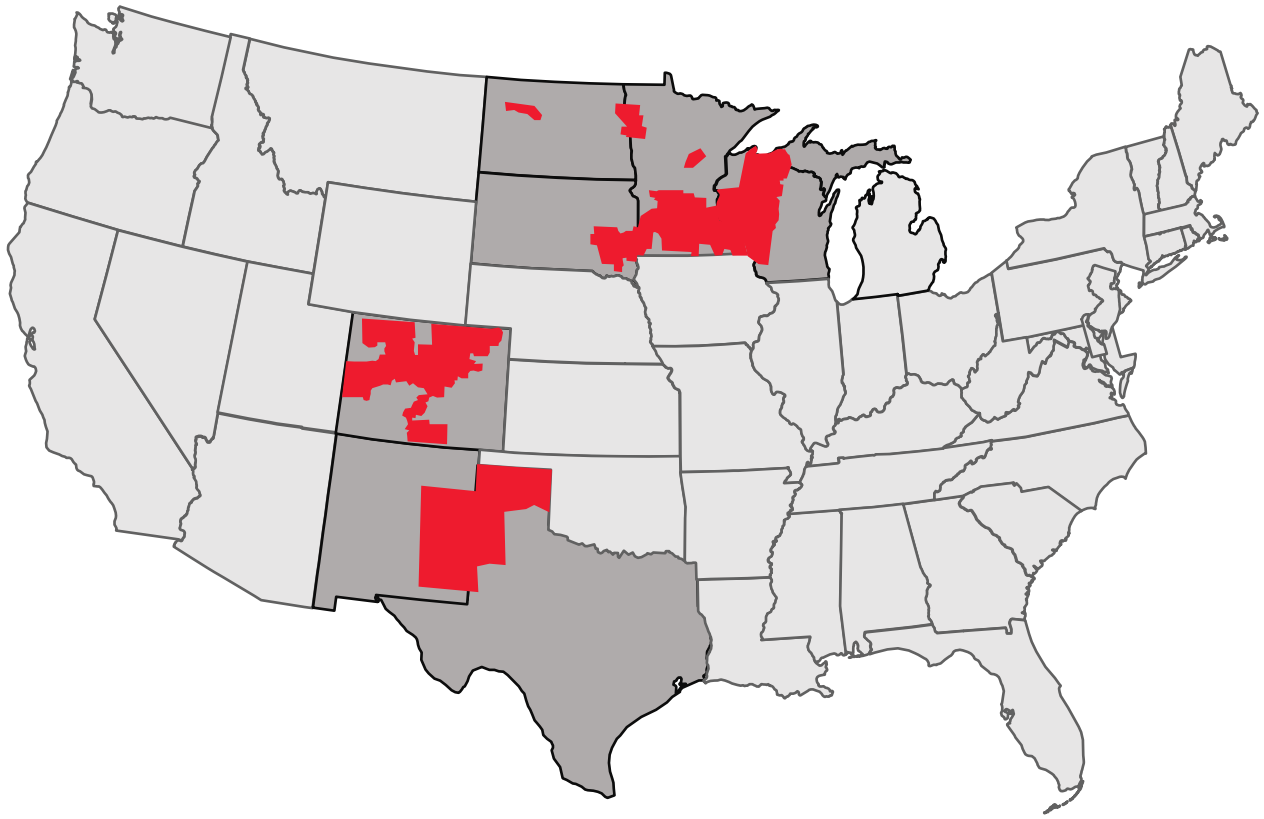
About Xcel Energy



Serving eight states

3.8 million electricity customers

2.2 million natural gas customers

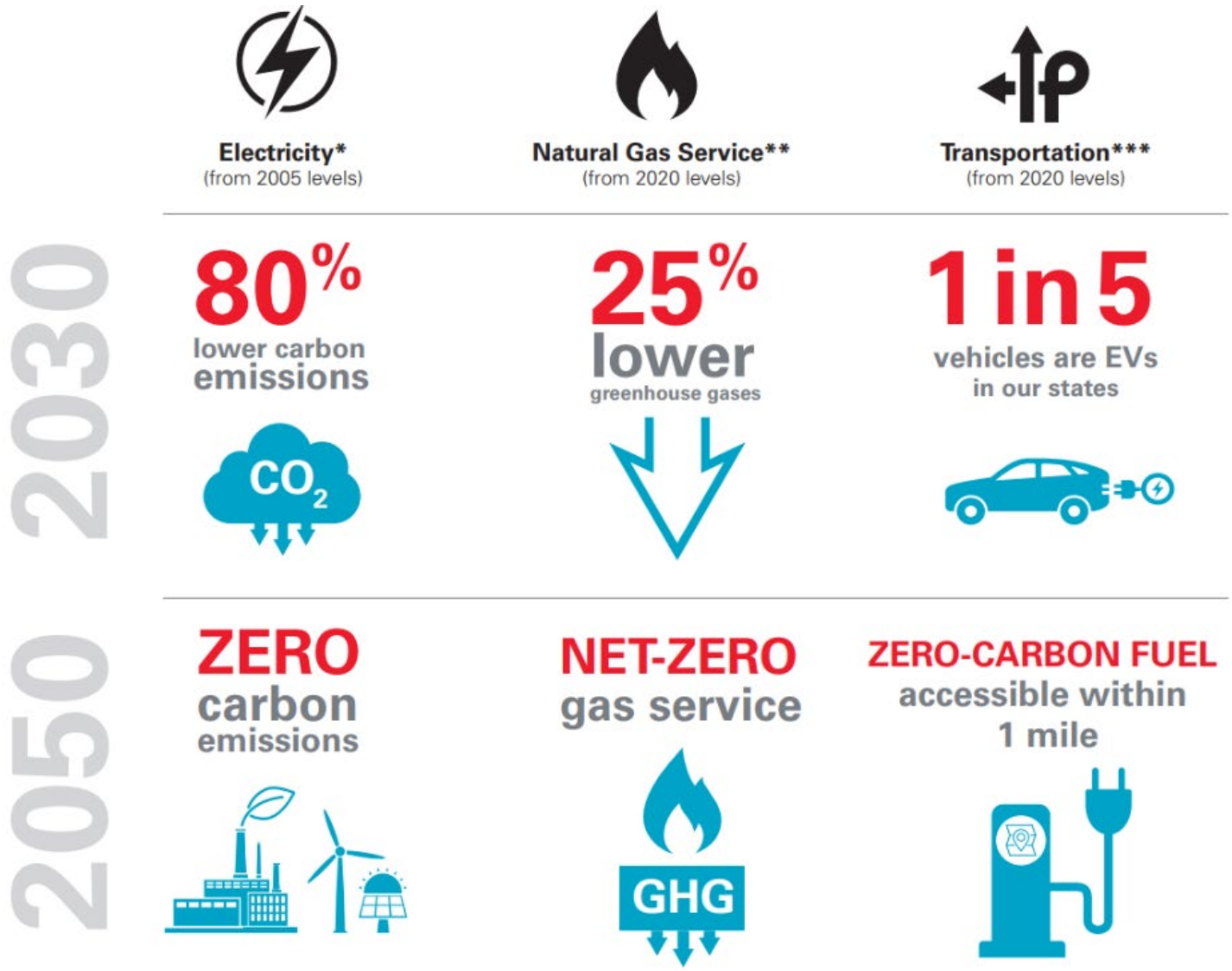
2 GW interconnected DER

125,000 DER installations

Nationally recognized leader:

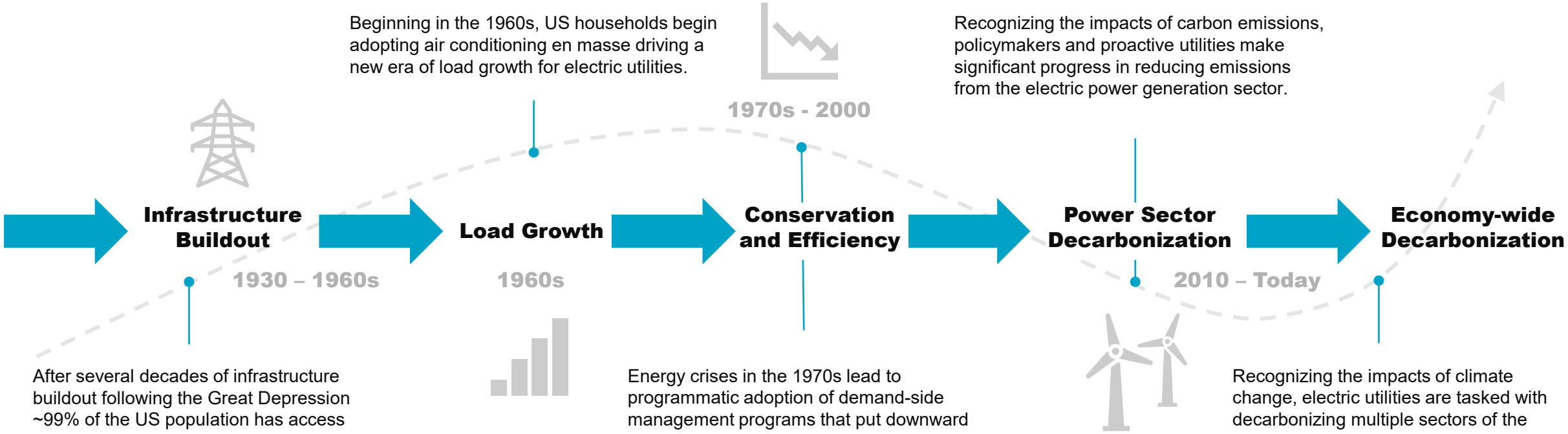
- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Innovative technology
- Storm restoration

Our Goal to be a Net Zero Energy Provider by 2030



A Brief History of the Distribution Grid in the United States

The electric grid has been built out over the last century in tranches in response to various drivers of load growth and public policy objectives – a strategy that has worked well historically, but is no longer able to match the rate of change.



This Approach to Grid Planning has Worked for Several Reasons

1. Just in time investment model allowed us to meet customer expectations while balancing holistic rate impacts.

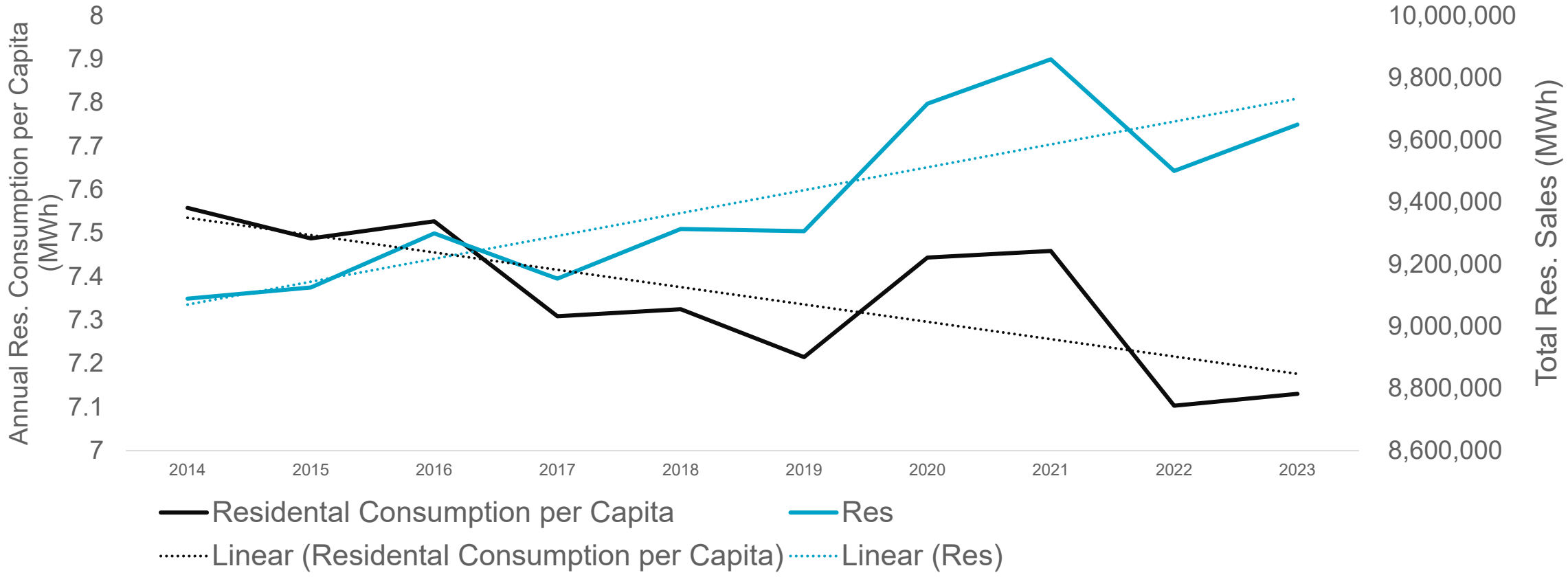
2. However, we have maintained the distribution system through a maintain & replace model. This has allowed us to focus on Generation & Transmission investment.

3. Customers have benefited from this approach we have taken in concert with state policy. We have aggressively added renewables and reduced carbon on our system.

Xcel Energy has long been a leader of the Clean Energy Transition. While we have made industry-leading progress is decarbonizing power sector emissions, our industry is at an inflection point and electric distribution utilities will be the foundation to help decarbonize other sectors of the economy including transportation, the built environment, and other end uses. **Expedient, proactive, and transparent grid planning will be critical to meeting new expectations on the distribution system.**

Achievements in Energy Efficiency Have also Largely Tempered the Need for Distribution Grid Investment

Per capita residential consumption has declined over the last 10 years, meaning sales and growth has been driven by customer additions.



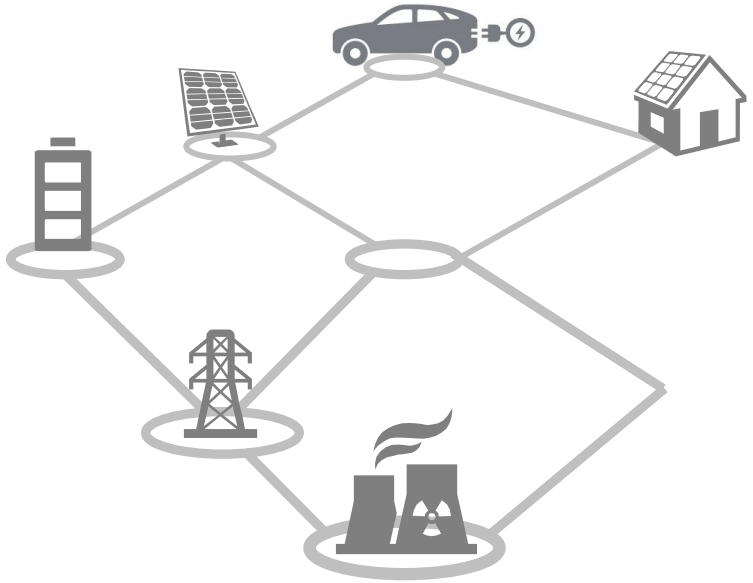
The Grid is Undergoing a Massive Transformation

In addition to adding new customers to the system, and new types of load (e.g. heat pumps and EVs) the grid has become operationally more complex.

THE GRID OF THE PAST

Customers received electricity via central generation, transmission, and distribution

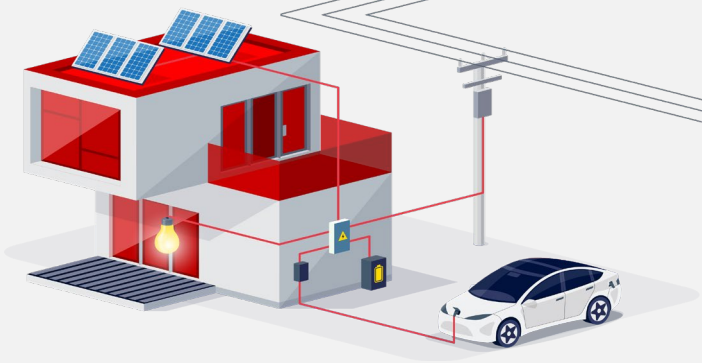
TODAY



More demand and energy at the grid edge, requiring a modernized approach to distribution system planning and operations.

Electricity usage for ‘home of the future’ could jump by ~84% by 2040

ILLUSTRATIVE



	Average home today[3] (2023)	Home of the Future (2040)
Typical characteristics:	• Gas furnace • Gas water heater • Gas stovetop • ICE vehicle • No rooftop solar	• Heat pump with electric resistance backup (~8kW) • Heat pump water heater (~5kW) • Electric/induction stovetop (~1.5 kW) • 2 x EV with 2 x L2 chargers (~12kW) • Rooftop solar (~7kW)

Avg. annual consumption (MWh)[1]

Average power consumption can increase by ~84% if a premise has solar but can go up to ~150% without solar

1. Based on average 2023 residential customer consumption by household; Load Research; 2 Self-consumption only; 3. 2,171 sq.ft.; 4. Base load includes all appliances installed in the house (e.g., fridge, etc,)

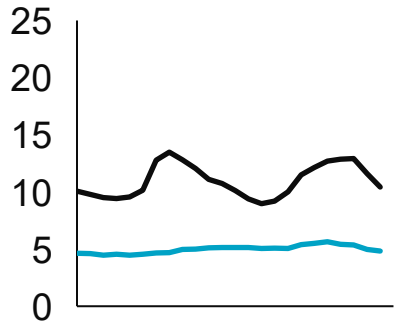
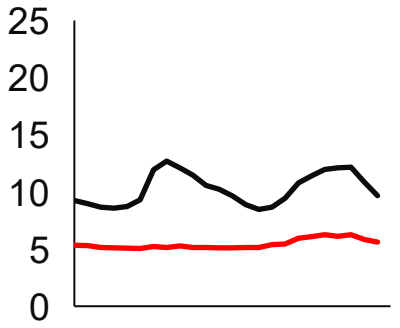
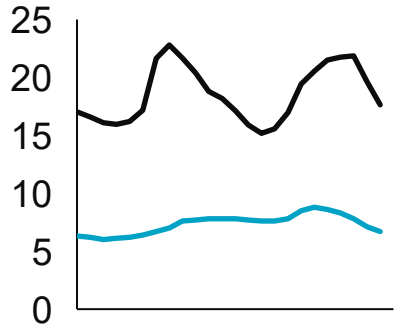
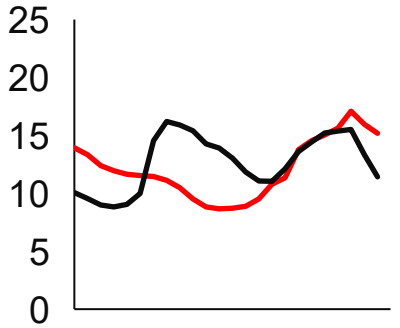
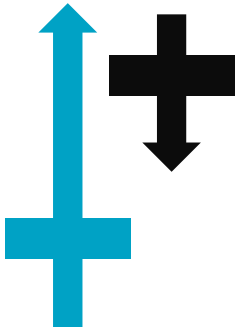
Source: Xcel Energy; EIA

Investment needs will be unevenly distributed across as different feeders will have varying levels of adoption

SCENARIO ANALYSIS

ILLUSTRATIVE

Electric (MW) — Gas (MW)[3] X% % change in electric peak X% % change in gas peak

Circuit	Description	2023 – winter peak day (MW)	2040 – winter peak day (MW)	Peak change (%)	Investment required
Greeley (GRLY1036)	• 2,200 premises (1,900 res, 300 C&I) • **Limited incentives available to drive adoption[2]** of behind-the-meter technologies				**Limited investment required**
Denver (SULL1801)	• 3,700 premises (3,600 res, 100 C&I) • **High anticipated adoption[1]** of solar, EV, and BE				~$8M in new Dx and Tx infrastructure

1. Assumes 20% of homes adopt solar, 50% of homes adopt EVs, and 50% of homes adopt heat pumps
2. Assumes 5% of homes adopt solar, 10% of homes adopt EVs, and 10% of homes adopt heat pumps
3. Gas demand converted to MW for simplicity of comparison (1 MMBTU = 0.293 MWh); gas load shape is based on the total heating load and T-based profile

Postcards from Colorado – History

- Downtown Denver has experienced rapid infill over the last two decades
- We are seeing several scrapes of single family homes being converted into large, multi-family developments leading to significant load increases as well as significant population growth.
- Existing customer arrangements (e.g. redundant feeders/ ATO) creating challenges for new capacity
- Distributed Generation policy framework does not encourage siting where it could provide Distribution System value

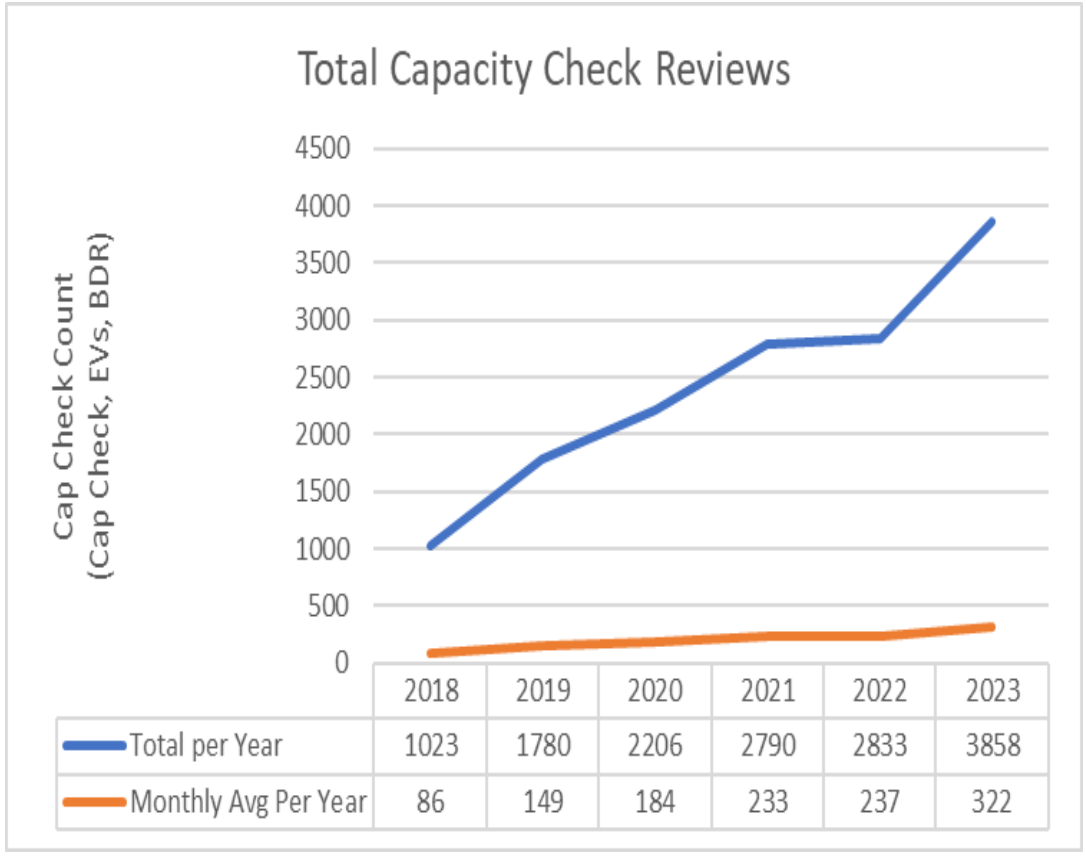
Postcards from Colorado – the Future

PHOTO COURTESY OF DENVERINFILL BLOG

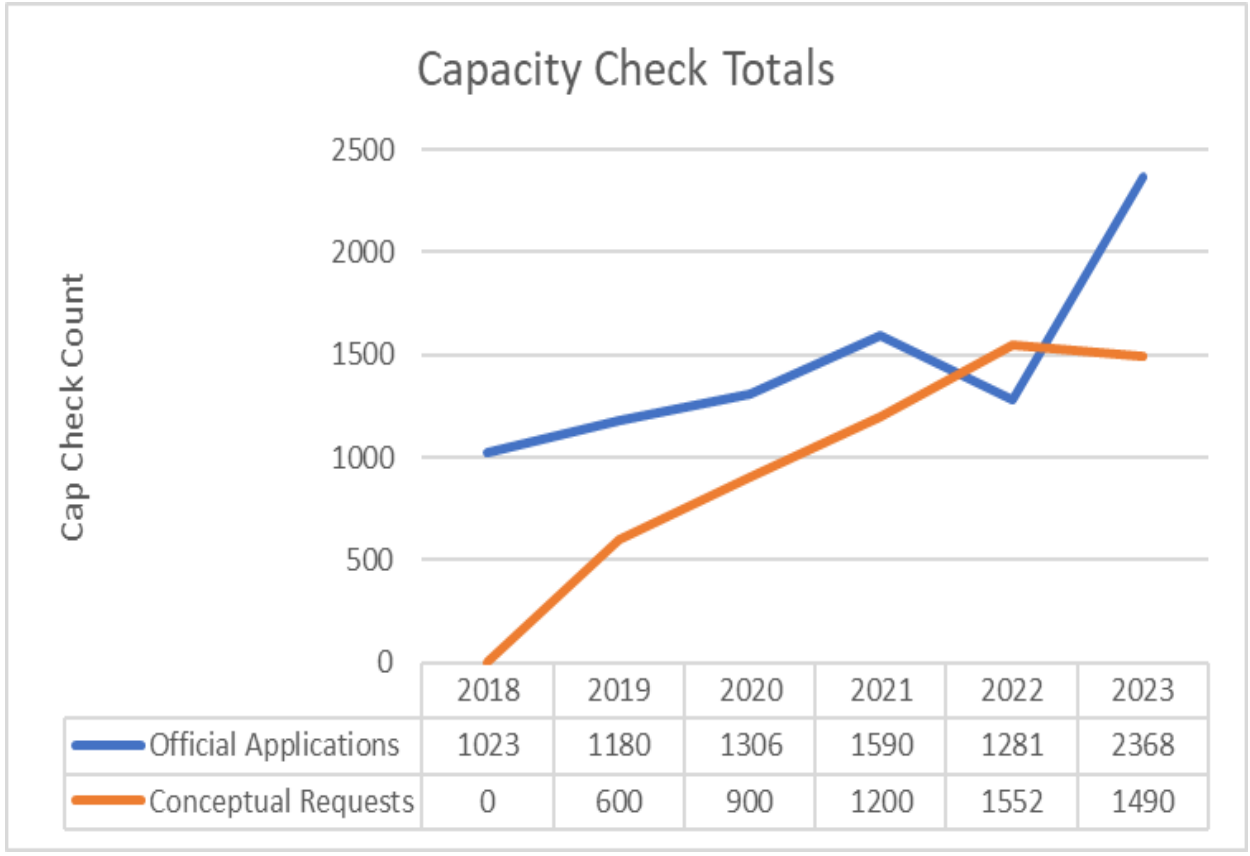
THE RIVER MILE – RENDERING COURTESY OF SHEARS ADKINS ROCKMORE

- Significant downtown development is creating increased demands and infrastructure siting challenges.
- Most recent load forecasts indicates the need for 34 new substation over the next 10 years (many will be required in the Denver metro area)
- Smaller data centers also creating challenges

How Load Growth is Manifesting Itself in Colorado



	2018	2019	2020	2021	2022	2023
Total per Year	1023	1780	2206	2790	2833	3858
Monthly Avg Per Year	86	149	184	233	237	322

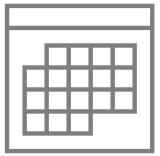


	2018	2019	2020	2021	2022	2023
Official Applications	1023	1180	1306	1590	1281	2368
Conceptual Requests	0	600	900	1200	1552	1490

Planning Challenges in the New Era of Load Growth

	CHALLENGE	IMPACT	SOLUTION(S)
	Load growth outpacing historical adoption patterns	Utilities must be proactively forecasting individual customer decisions	Use of more sophisticated forecasting and planning tools
	Inherent Uncertainty of Forecasts	Requires Increased Planning Margin	Adherence to Design Basis and Technical Planning Standards
	Limited Real-time Visibility and Dynamic Control	Distribution system must be planned/operated to static limits	Control system and Flexible Connection options that allow for Dynamic Management
	Multiple Priorities and Objectives	Requires Integrated Planning across value chain and orgs.	Establishment of Integrated System Planning Group

Solutions to Create Additional Capacity Going Forward



Already Deployed & Ongoing Efforts

- **Enhance Forecasting Processes**
- BTM Solar (other DER) offset
- Load Relief via switching
- Phase Rebalancing
- Project Phasing/Timing
- Var Flow/Capacitor Bank Deployment
- Load Diversification
- Public access to more information (e.g. detailed hosting capacity maps)

Short-term

- New substations and distribution feeders
- Distribution capacity projects
- Non-wires Alternatives
- Secure web portal with information on asset capacity
- **Operationalizing technology to more dynamically plan and manage the system**

Long-term

- Pursuing new substations to support growth
- Long-term Needs Identification
- Establish new reserve capacity contracts and tariff considerations
- Tariff and DER Compensation structures that are better aligned to grid value
- Plan to file more comprehensive DSP in 2024 to address these topics
- Identifying efficiencies with investment needs for Transportation Electrification and Wildfire

Our Vision for the Grid of the Future

Our vision reimagines the future of the energy delivery system in a manner that proactively meets the evolving expectations and needs of our customers, communities, and policymakers – both today and through 2050.

- The Grid of the Future provides transparency into a viable set of pathways and the needed investments for the long-term evolution to a highly integrated energy delivery system that will be critical to enabling economy-wide decarbonization; while ensuring our system can deliver the energy and services our customers expect in a safe, reliable, affordable, and equitable manner

1 Scenarios

- Set of scenarios **outlining the varying degrees to which the economy could decarbonize** by 2050 (e.g., % EV penetration, % industrial elec., etc.)

2 Sensitivities

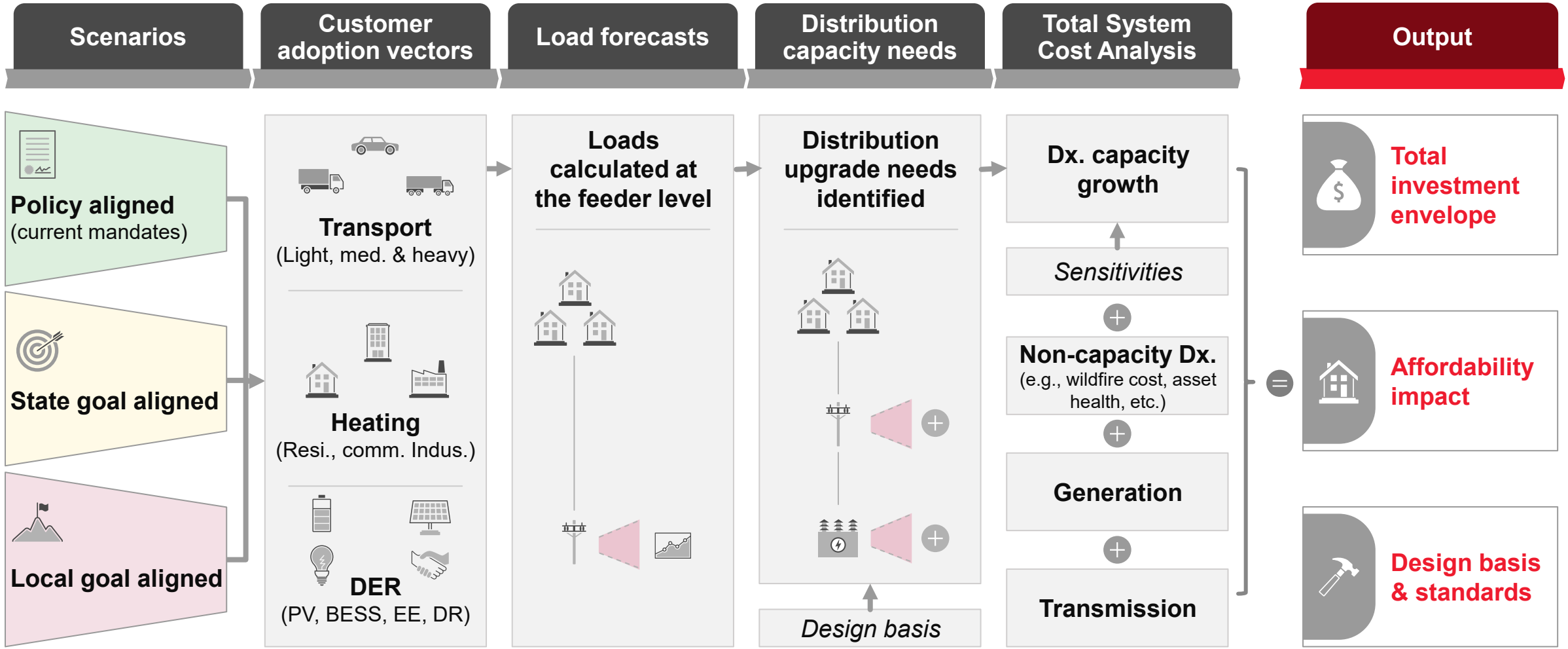
- Select mechanisms will be tested as "sensitivities" to **quantify the cost impact to certain solutions on the grid** (e.g., vehicle-to-grid charging, managed EV charging profiles, etc.)

3 Design basis

- Define a sub-set of **must-have** design standards that are **key modeling inputs**
- Additionally define a broader set of design standards to create a **standardized north star grid design** across Xcel (e.g., 90% of feeders with 20 standard designs)

Overall Modeling approach for the Grid of the Future

Scenarios informed by adoption vectors will be turned into load forecasts, then distribution capacity needs assessment that can be used to cost Dx. Expansion. Other costs will then be modeled on top to produce total investment envelope for the system.



Enhanced Forecasting

Output

Spatial Allocation

=

Integral Analytics

Future Potential Adoption Points

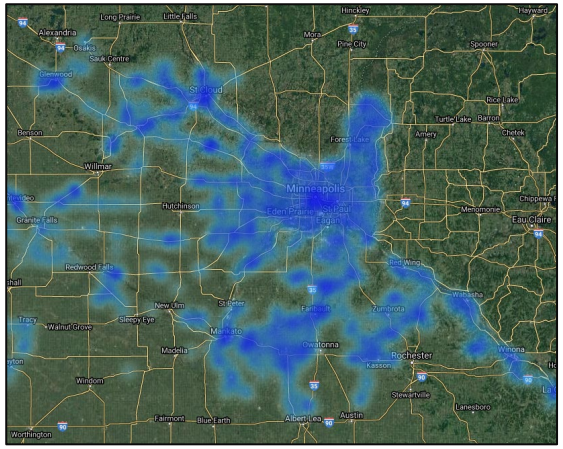
+

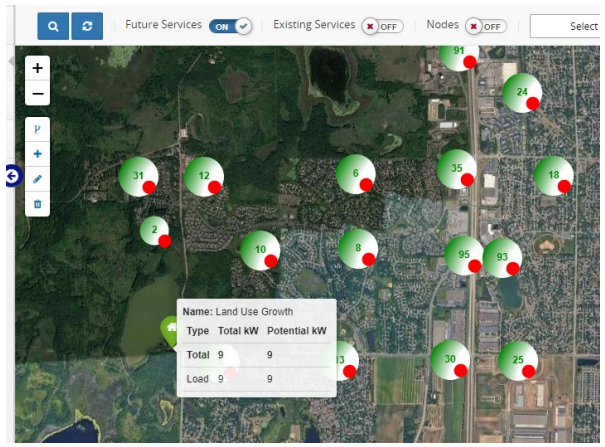
Xcel Energy

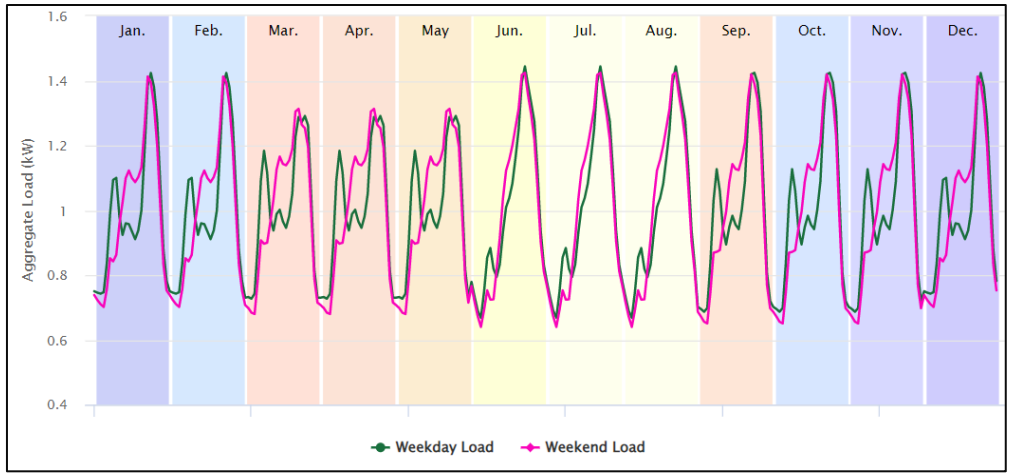
Shapes

+

Forecasts







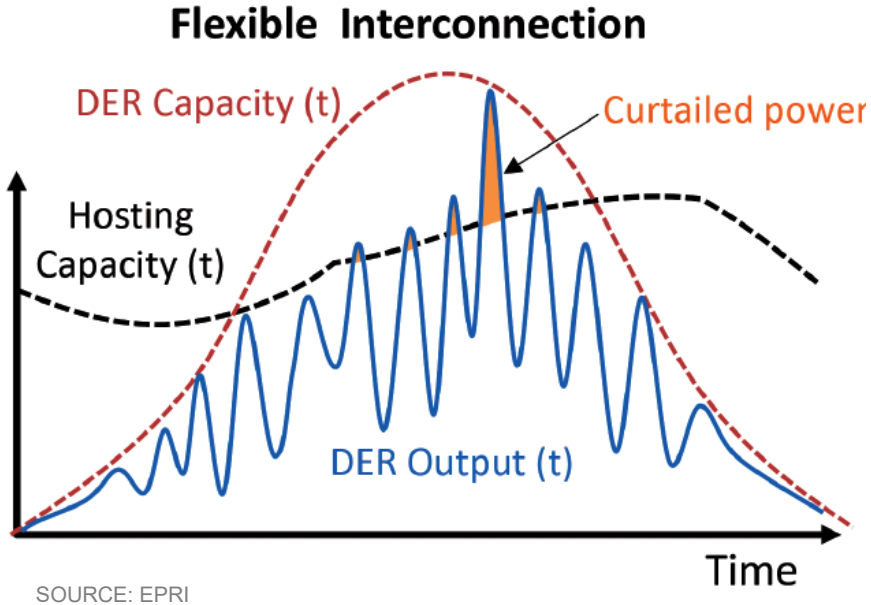
Exploring Machine Learning to Inform Adoption Propensity

Premise-level PV adoption probability in 2025 calculated by ML propensity model

- Estimated home value
- Zip code
- Home property indicator
- Land square footage
- Homeowner type
- Home square footage
- Year home was built
- Home type
- Value of improvement
- Home exterior wall type
- Air conditioning

Dynamic Management of the Grid

- Today, the distribution system is largely modeled and planned for deterministically
- Dynamic management through technologies like DERMS can facilitate real-time and near real-time control leading to less conservative operation
- Can facilitate bringing customers/DERs online faster and potentially at lower cost
- Currently exploring capabilities and use cases to enable flexible load and generation connections
- Regulatory constructs/tariffs and customer agreements will also need to evolve at a more rapid pace



SOURCE: EPRI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