

XCEL ENERGY

PERSPECTIVES ON LONG-DURATION ENERGY STORAGE

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Presented to 2026 EPRI TMCES Meeting





ABOUT XCEL ENERGY



REGULATED, INVESTOR-OWNED UTILITY SERVING EIGHT STATES

3.9 million

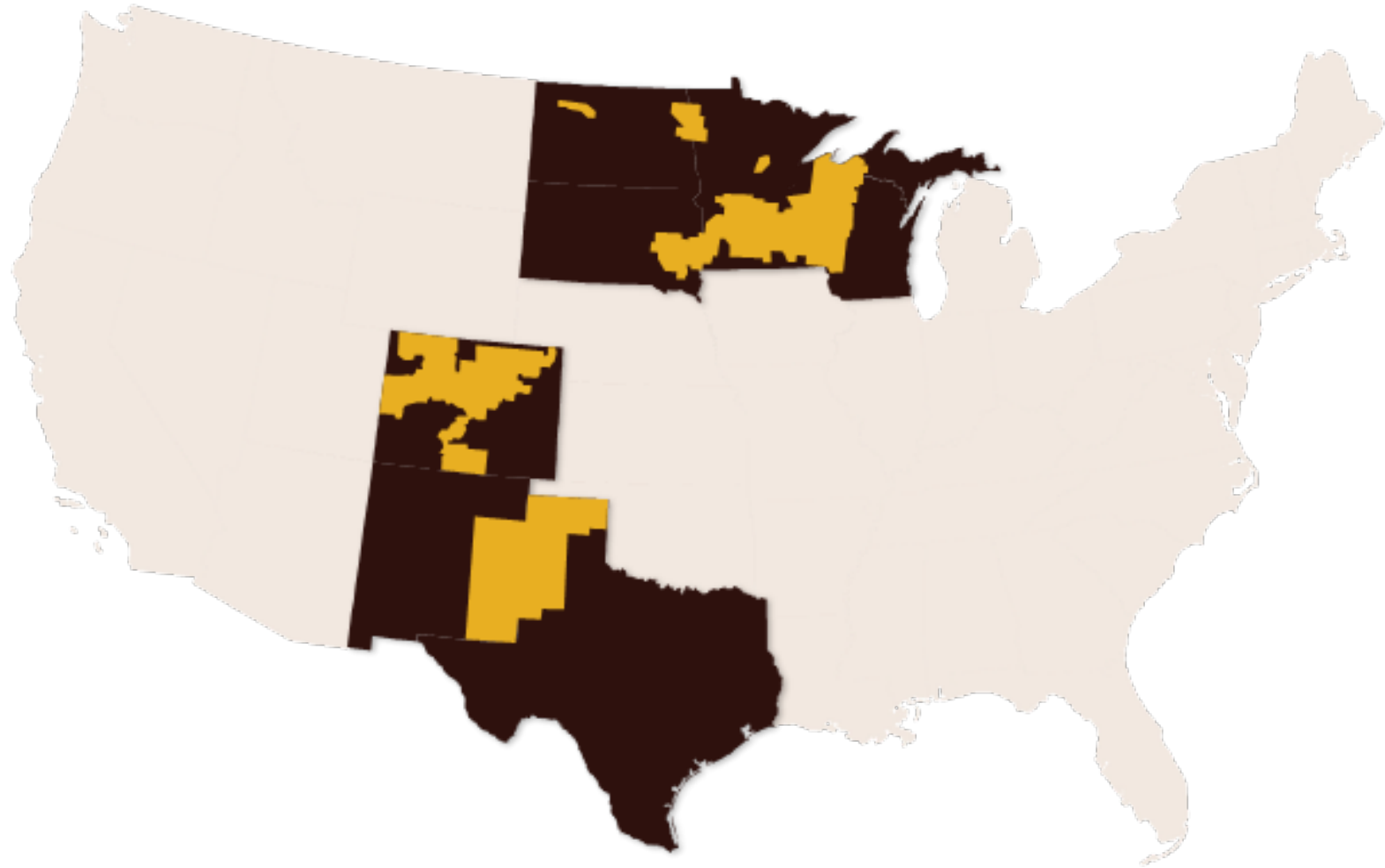
electric customers

2.2 million

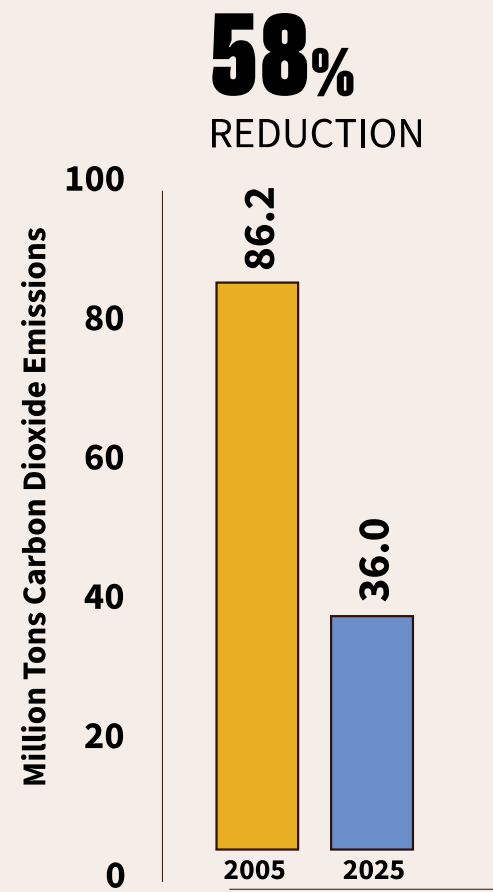
natural gas customers

National leader

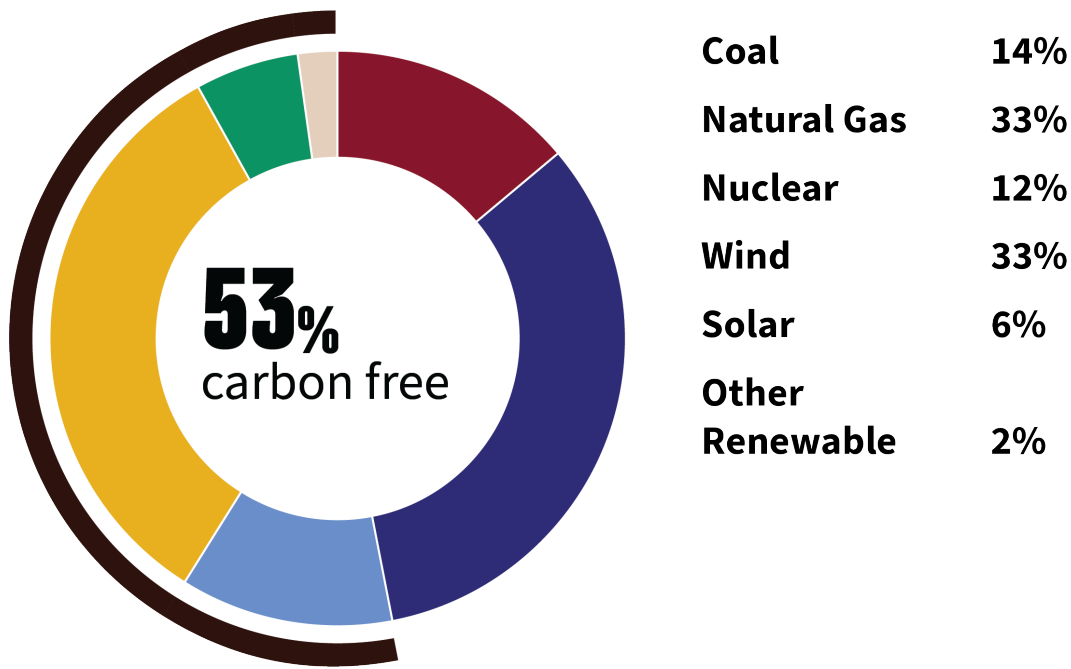
- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Storm restoration



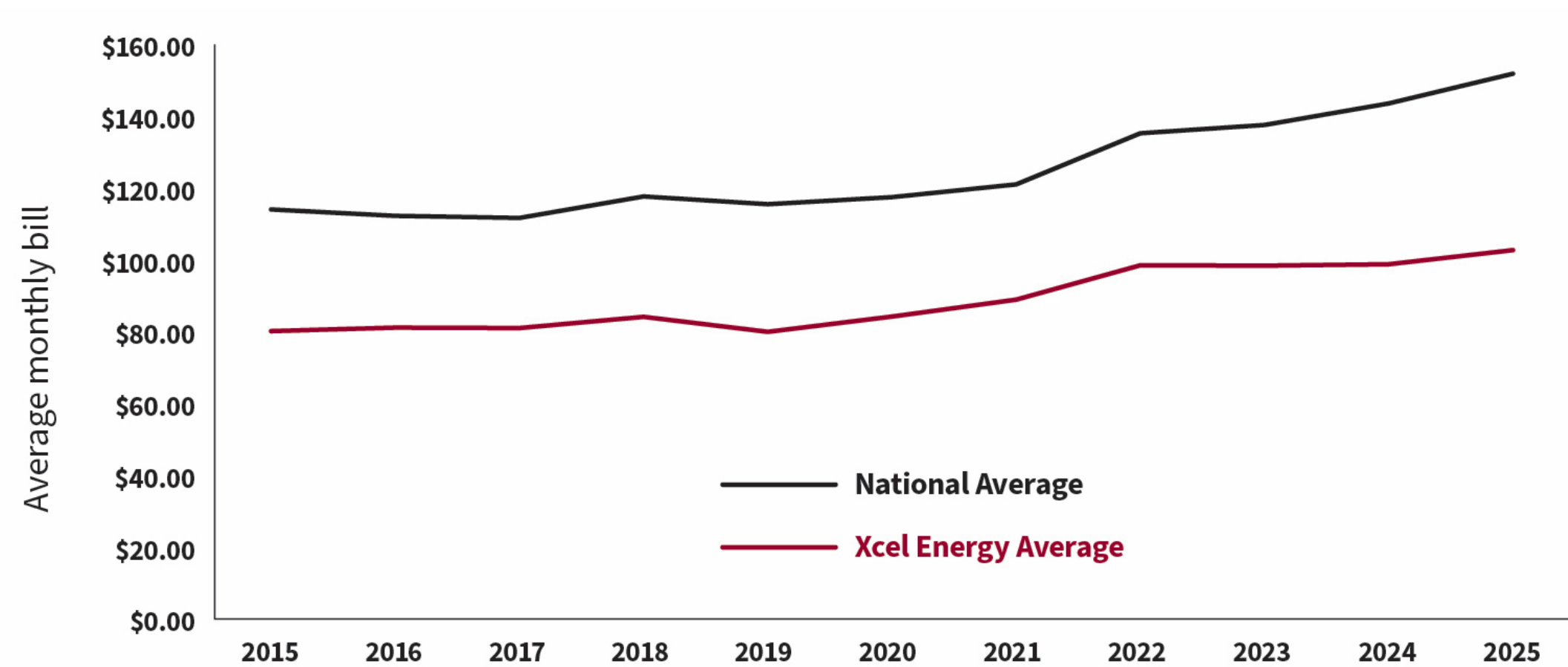
REDUCING CARBON EMISSIONS



2025 Energy Mix – Xcel Energy



OUR RESIDENTIAL ELECTRIC BILLS 32% BELOW NATIONAL AVERAGE



Source: U.S. Energy Information Administration

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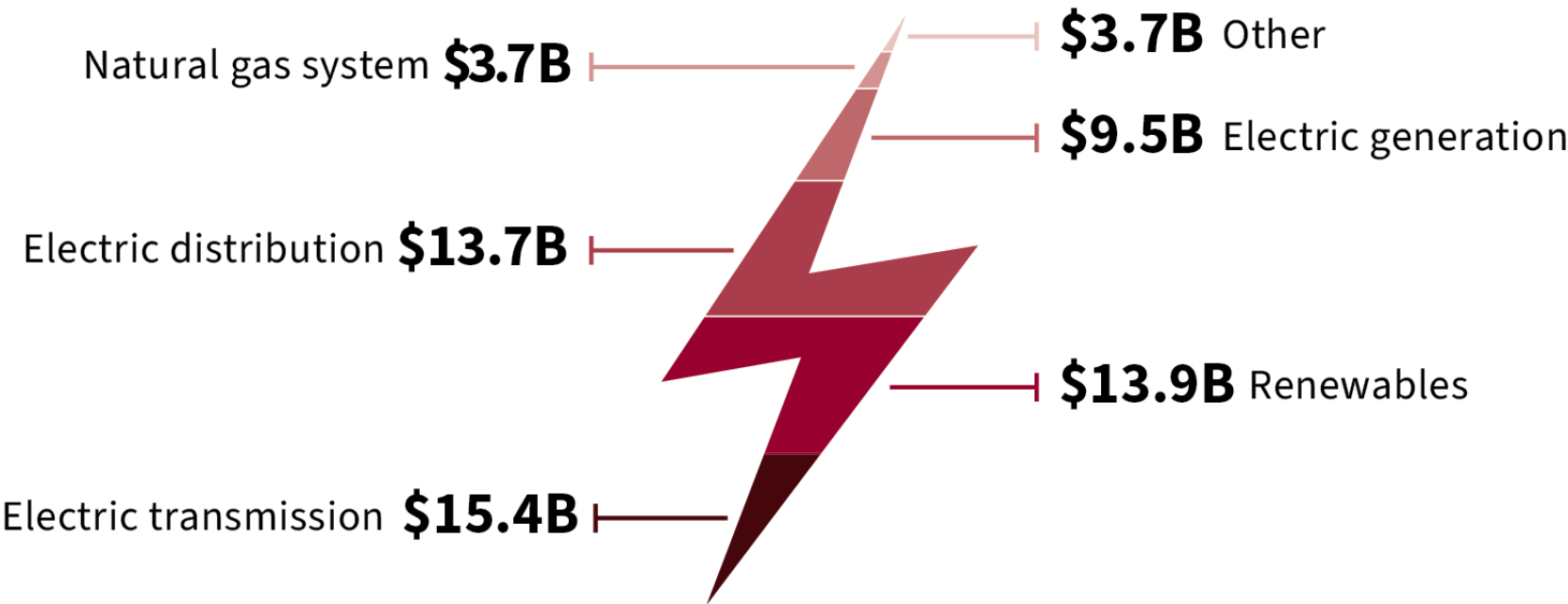
DECARBONIZATION GOALS OF XCEL ENERGY AND OUR STATES

Meeting or exceeding decarbonization goals of our states while maintaining reliable, affordable electric service.

	Milestone Requirements	Ultimate Objective
Colorado	80% GHG reduction vs. 2005: 2030	100% carbon-free: 2050
Minnesota	80% carbon-free: 2030 90% carbon-free: 2035	100% carbon-free: 2040
New Mexico	40% renewable: 2025 50% renewable: 2030 80% renewable: 2040	100% zero-carbon: 2045
Xcel Energy corporate	Meet or exceed state requirements	100% carbon-free: 2050 (or earlier)
ND, SD, TX, WI	No binding standards (TX RPS largely satisfied)	

INVESTING \$60 BILLION IN OUR REGIONS' ENERGY FUTURE

Investments will be made from 2026-2030





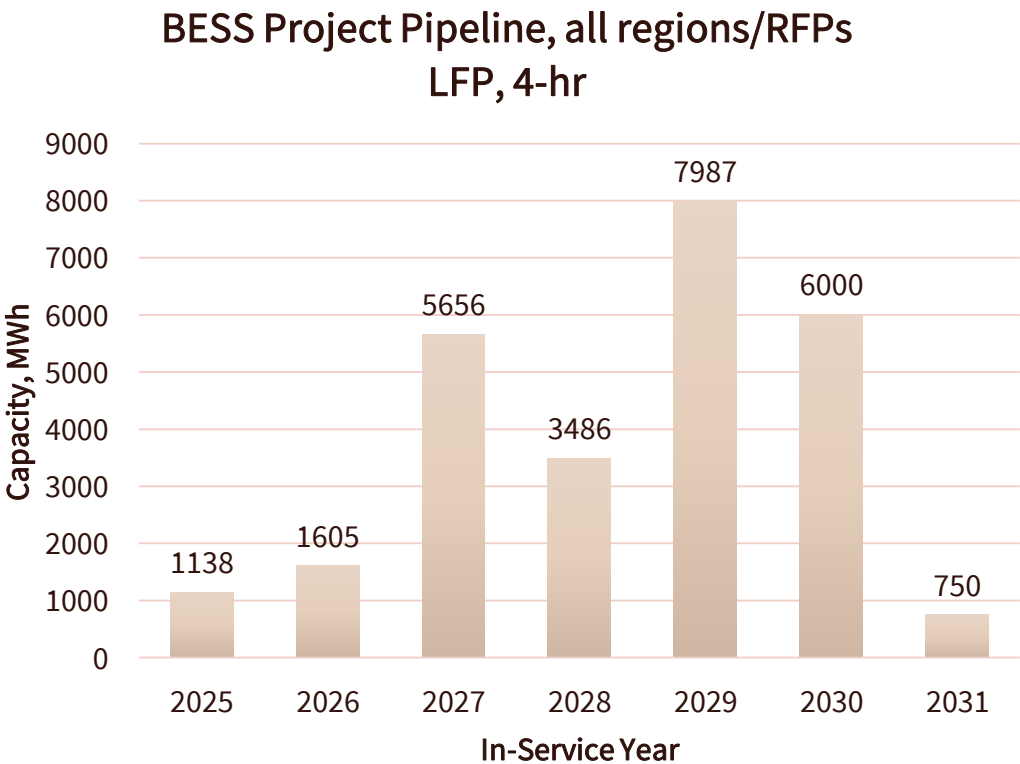
LONG-DURATION ENERGY STORAGE

LDES in support of Xcel's decarbonization objectives



EXISTING AND PLANNED STORAGE PROJECTS

Xcel Energy is an early leader in BESS and LDES deployment



Fe-Air

- 2027: 10 MW/1000 MWh pilot (MN)
- 2028: 10 MW/1000 MWh pilot (CO)
- 2029-2031: 3x 100 MW/10,000 MWh commercial plant (large load customer in MN)

Thermal

- Attempted to deploy a sensible thermal energy storage project in MN. We were unable to create an economic case despite exhaustive effort with numerous project configurations on behalf of a MN PUC order.

VALUE OF LDES ON THE BULK ELECTRIC SYSTEM

Electrical Energy: energy shifting, for example, by moving solar energy from daytime hours to evening peak load hours.

- LDES reduces short-run dispatchable capacity position (if system is energy adequate)
- Arbitrage energy price differences

System Resilience: preparation for extreme events to improve system reliability

- Microgrids or bulk power
- Backup power during long outages

Capacity: supplying additional energy when the grid is under stress

- Alternative to peaker plants
- Participation in capacity markets
- Resource adequacy
- Large load reliability reinforcement

Transmission and Distribution

Deferral: providing localized energy storage in a constrained area can avoid or postpone long term asset upgrades

Balancing Reserves: frequency regulation, spinning reserves, synchronous inertia, short-circuit capability, black-start capability

- Demand response and generation ancillary market participation

Low-Carbon Heat: decoupling heat load from instantaneous energy pricing

- Industrial electrification
- On-demand heat for buildings or electrical processes
- Challenging for IOU ownership

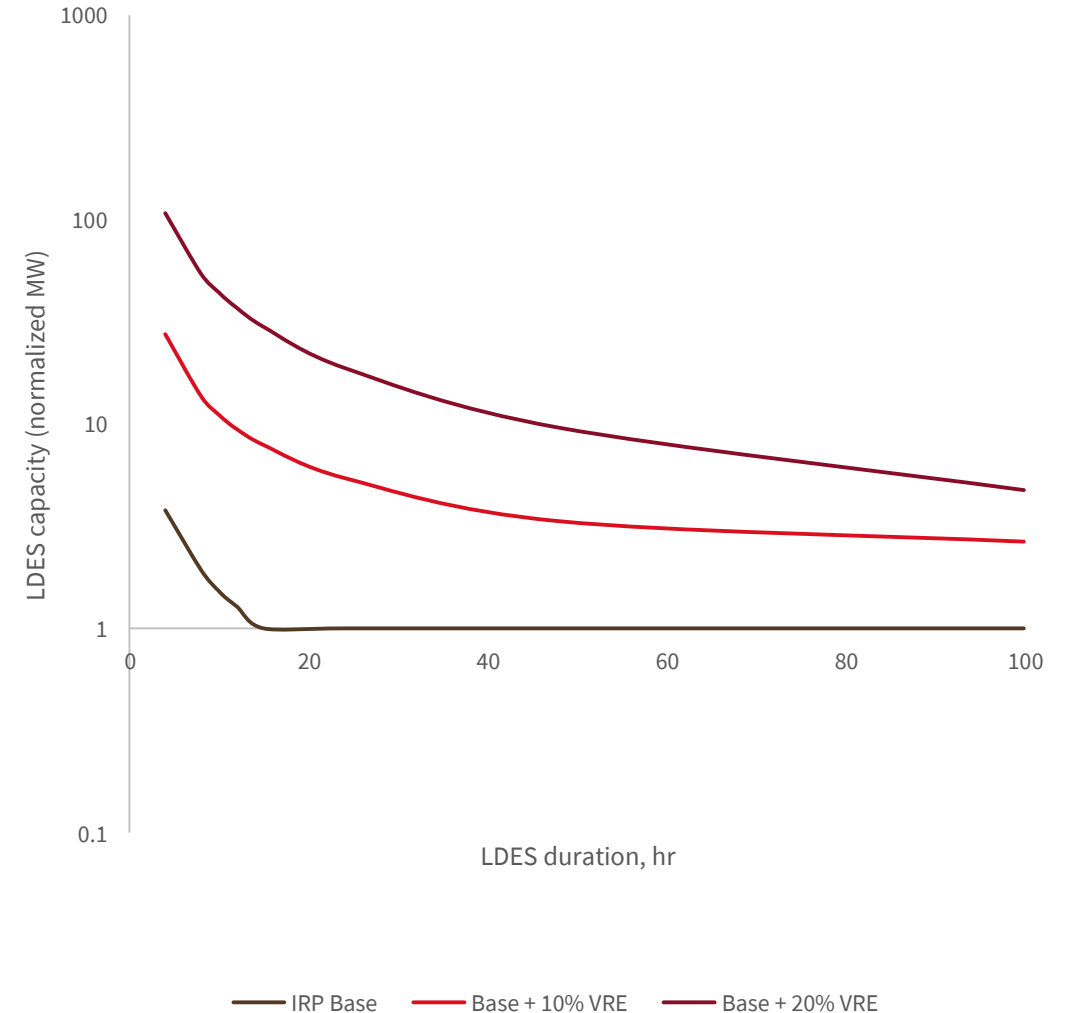


VALUE OF DURATION

Optimal storage duration strongly dependent on the system...

- Inter-regional transmission
 - VRE overbuild (energy oversupply)
 - Competing dispatchable resource mix
 - Economic constraints
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- Greater VRE contribution to the energy integral raises storage requirements *and* ideal duration (expected result!)
 - Ideal duration balances capacity and energy: more is not necessarily better.
-
- Major consideration for LDES deployment:
 - **LDES + VREs must be less costly than low-carbon dispatchables and/or inter-regional transmission**
 - **Cannot depend on free curtailed energy. Anything free will find a consumer, then it will not be free.**

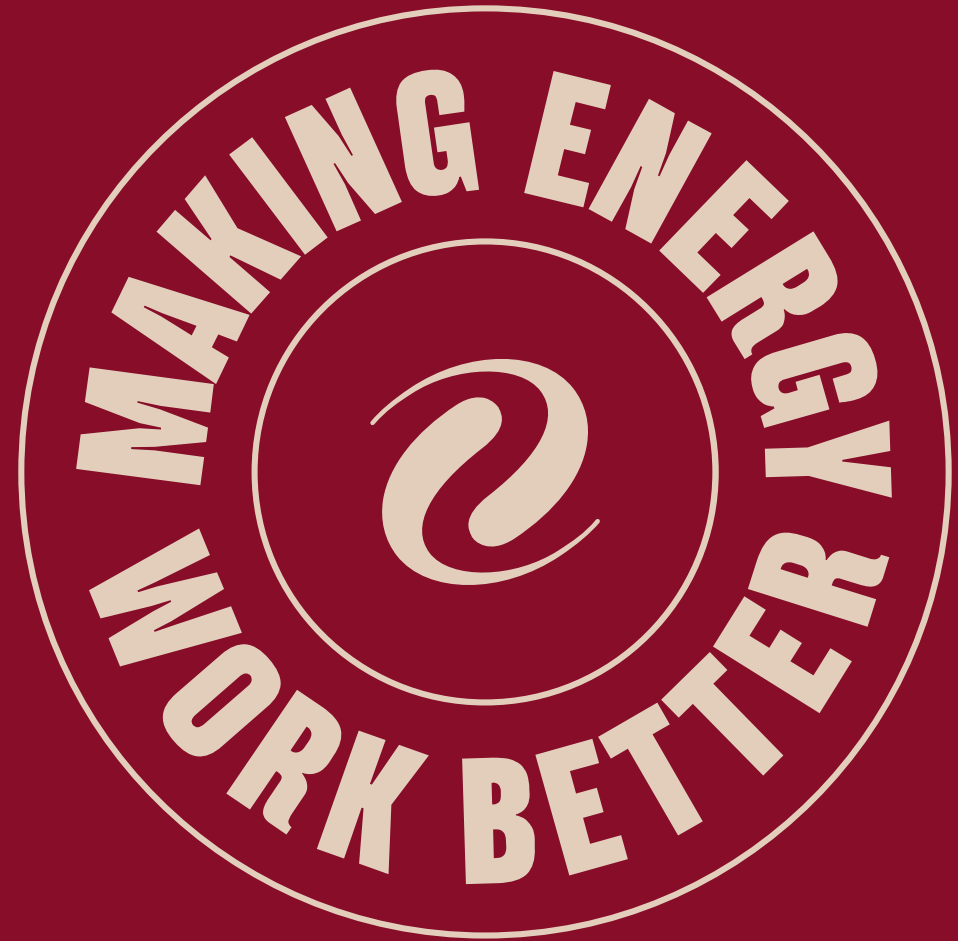
LDES value of duration. Basis data: 2024 SPS IRP
Ideal useful duration achieved at asymptote



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