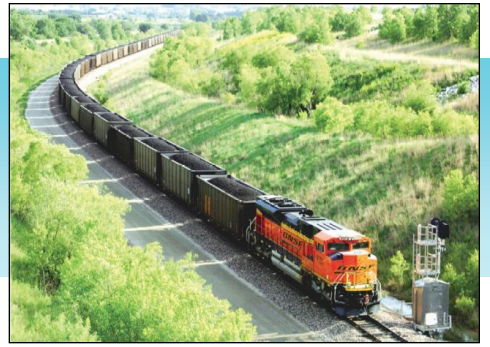
2018 SPS Integrated Resource Plan ("IRP")

Public Advisory Meeting #5

SPS Resource Planning



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

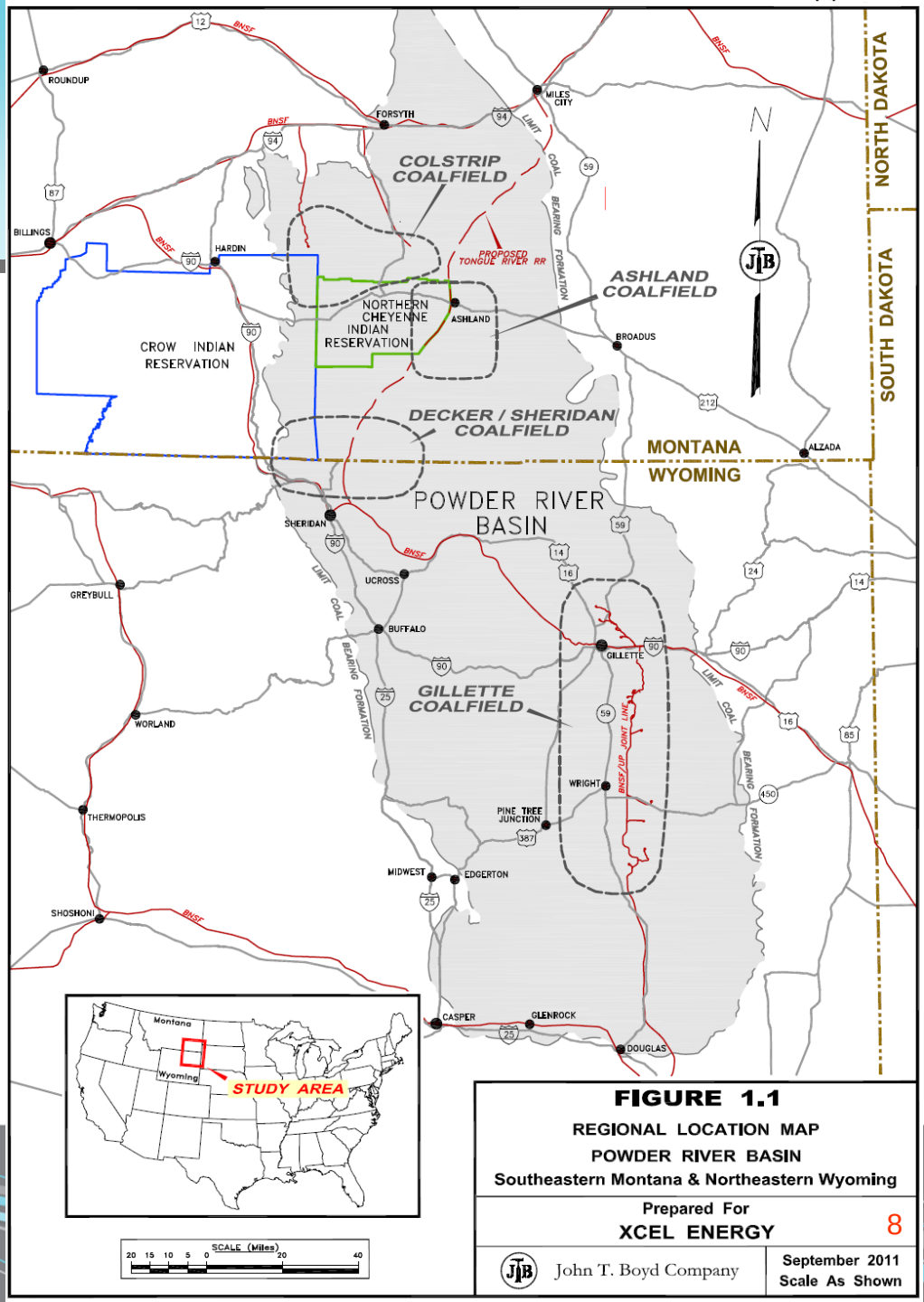
- Coal suppliers are Peabody Energy (North Antelope Rochelle), Cloud Peak Energy (Antelope) and Arch Coal (Black Thunder)
- Coal contracts are fixed price, term and quantity
- Coal supply agreements are short term and expire before the TUCO agreements

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

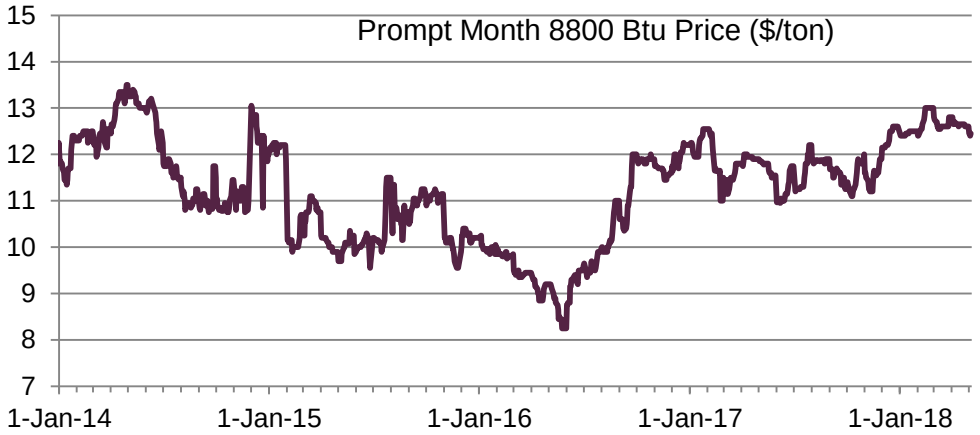
Powder River Basin

- 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?


Xcel Energy®
RESPONSIBLE BY NATURE™

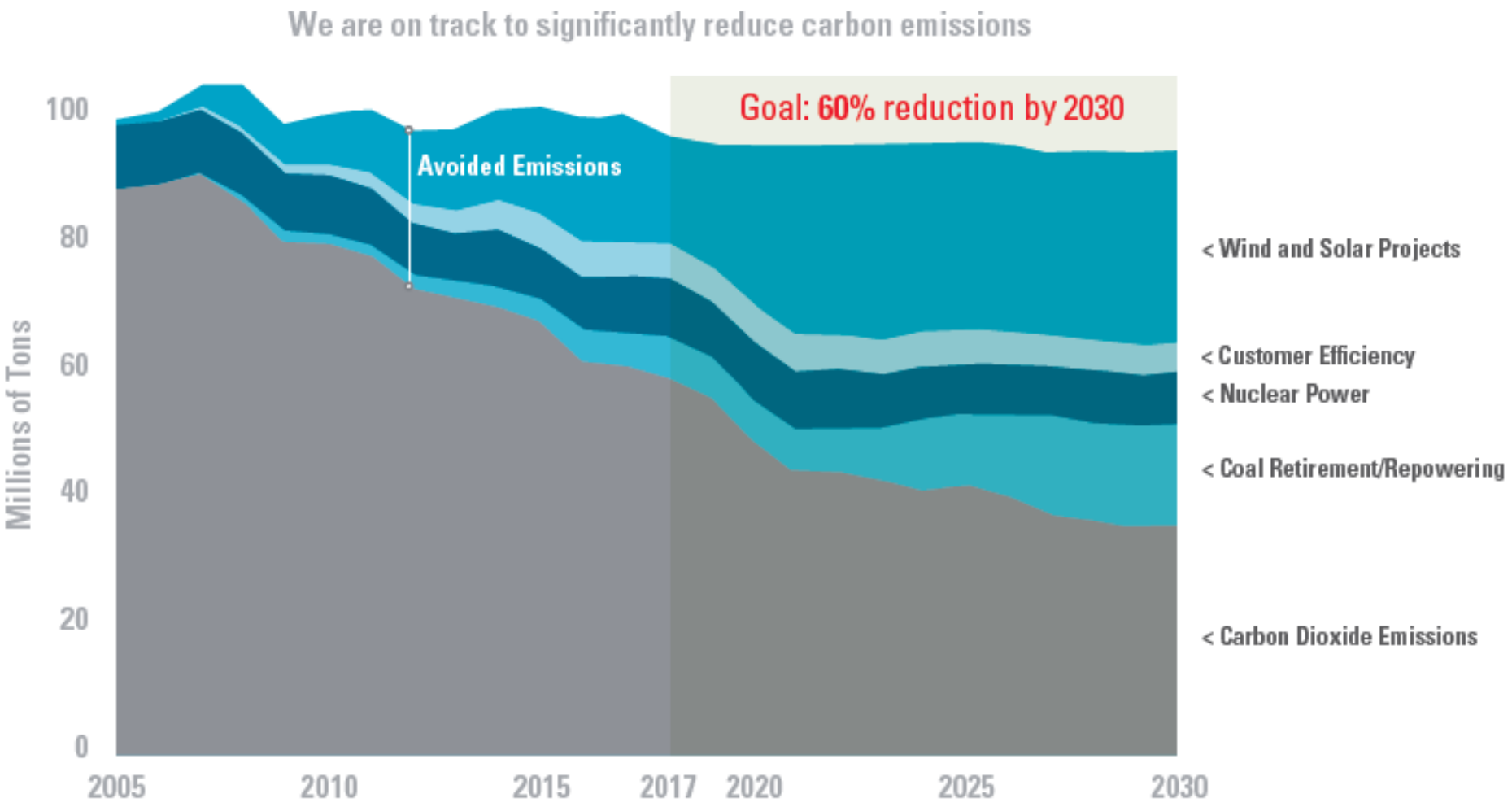
Energy Storage Overview

SPS New Mexico IRP Public Advisory Meeting

May 31, 2018


Xcel Energy®
Lead the Clean Energy Transition
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

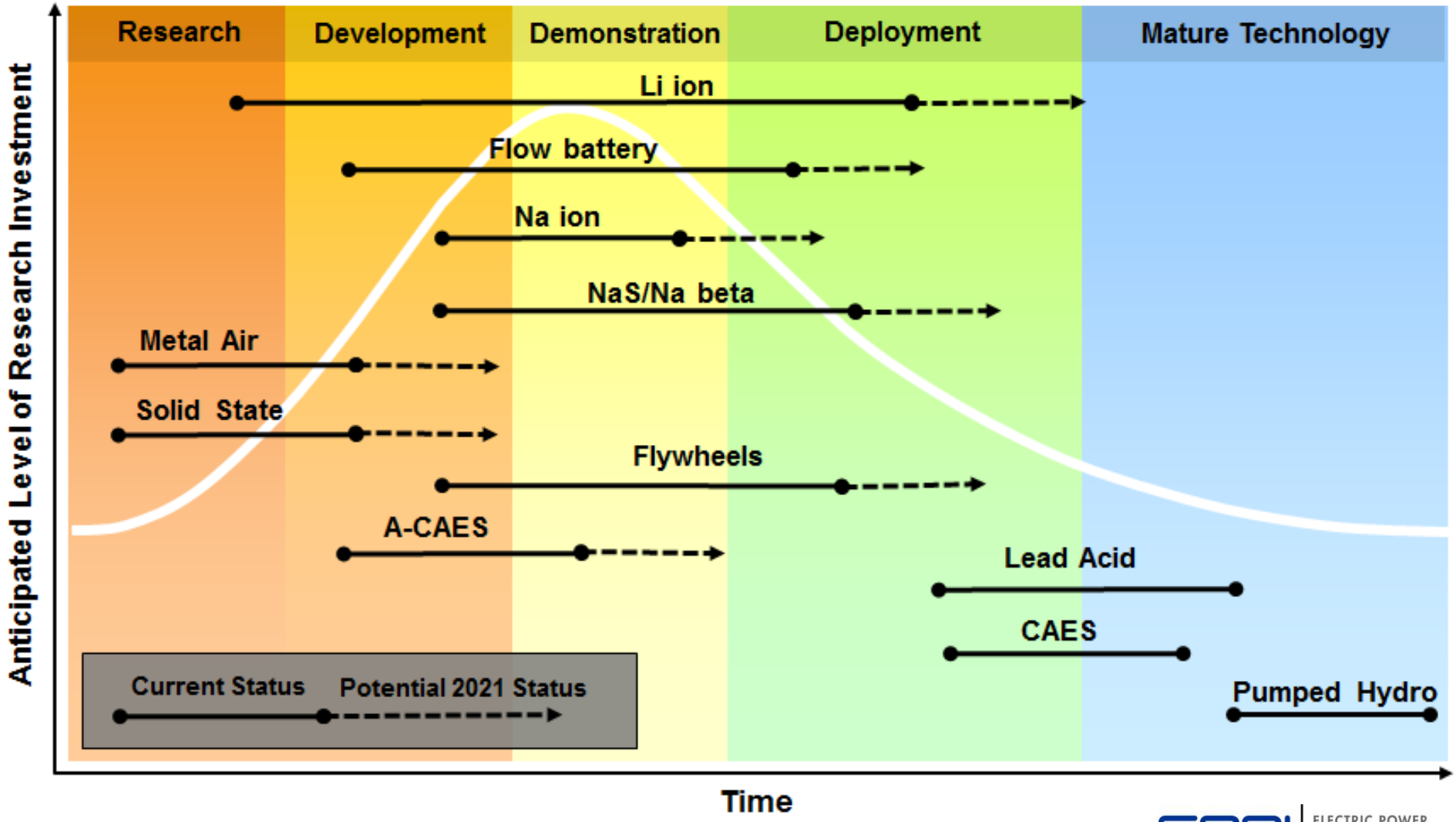
Thermal: Heat and cold are captured to create energy on demand

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

Storage Technologies

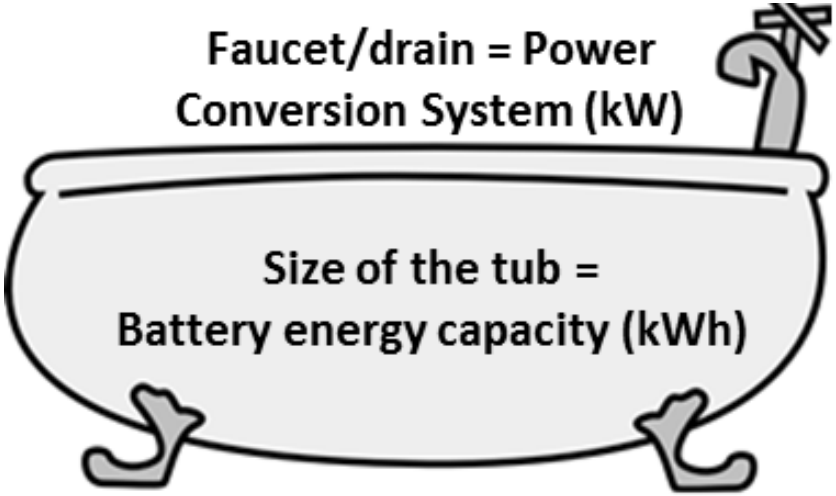
Technology	Benefits	Challenges	Applications
Lithium-Ion Battery	• Energy density • Power density	• Cycle life constraints • Safety concerns	Peak shaving, T&D investment deferral, renewable integration, ancillary services
Lead Acid Battery	• Familiar • Inexpensive	• Relatively low energy & power density • Poor cycle life • Often requires maintenance • 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 • Limited power capabilities	Peak shaving, T&D investment deferral, renewable integration
Flow Batteries	• Decouple power (reactor size) from energy (tank size) • Improved cycle life	• Low energy density • Added components with pumping	Peak shaving, T&D investment deferral, renewable integration, ancillary services
Flywheels	• Fast Response • High Power	• Low Energy • 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 • Capital intensive	Capacity/energy services, ancillary services, renewable integration

Storage Technology Development Status



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)

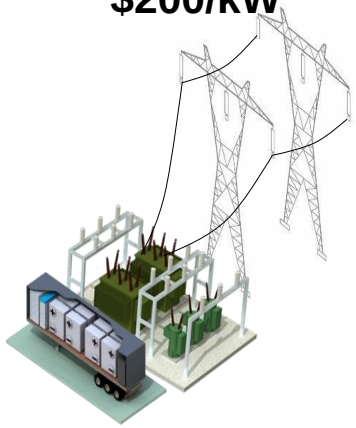
Stored Energy (kWh) = Power (kW) * Discharge time (hrs)

Storage Costs Example

Battery
$300/kWh*4hr
= $1200/kW

Power Conversion System (PCS)
$250/kW

Integration / Balance of Plant
$200/kW



$1650/kW for 4 hr Duration

Battery
$300/kWh*2hr
= $600/kW

Power Conversion System (PCS)
$250/kW

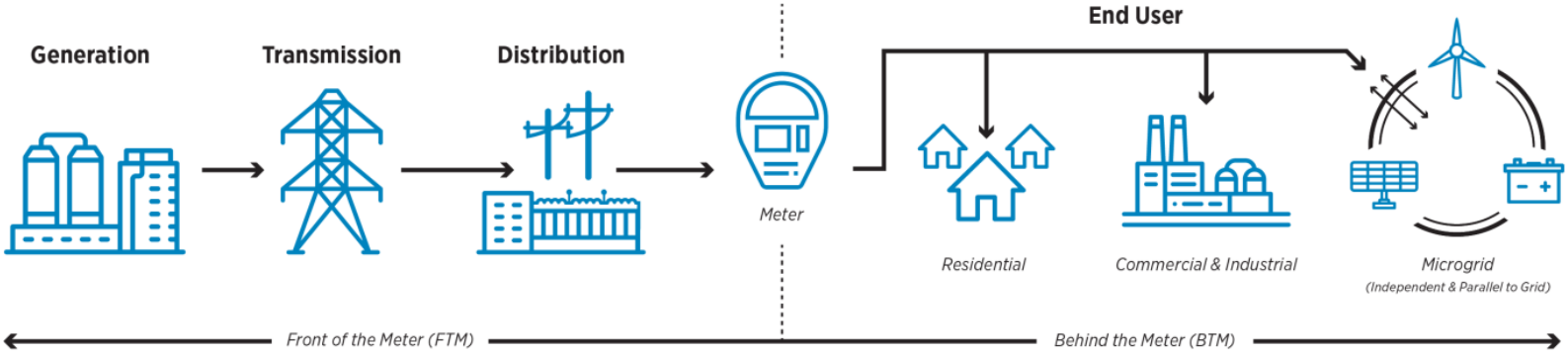
Integration / Balance of Plant
$200/kW

$1050/kW for 2 hr Duration

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 • Reduce the need for new generation	• Regulate frequency • Reduce spinning, non-spinning and supplemental reserve requirements • Voltage support • Black start electricity restoration	• Defer transmission and distribution upgrades • Relieve electricity congestion	• Higher power quality and reliability • 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

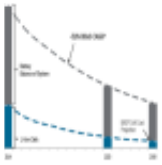
Resiliency improvements

+

Market and policy drivers

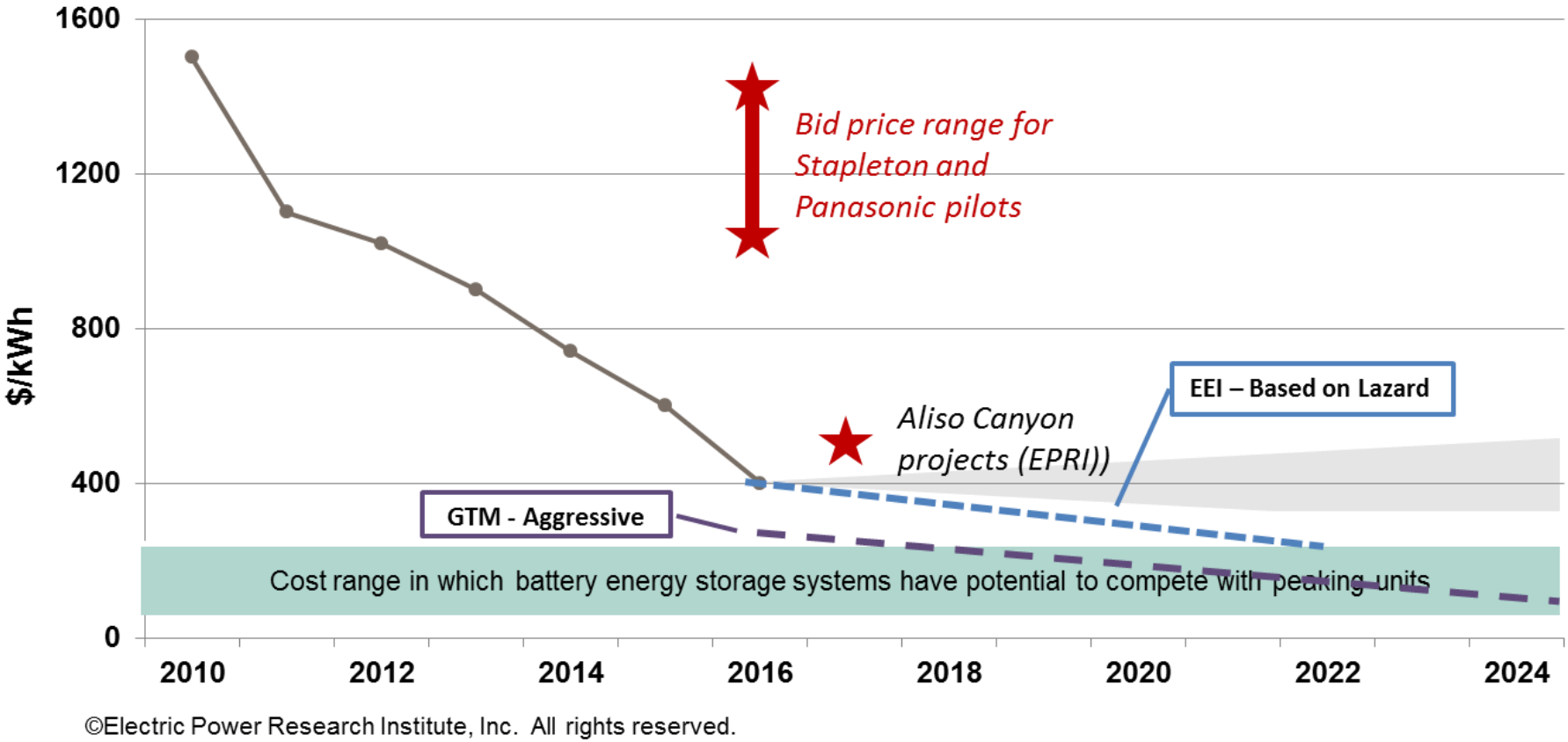
Policy changes

Technology advances



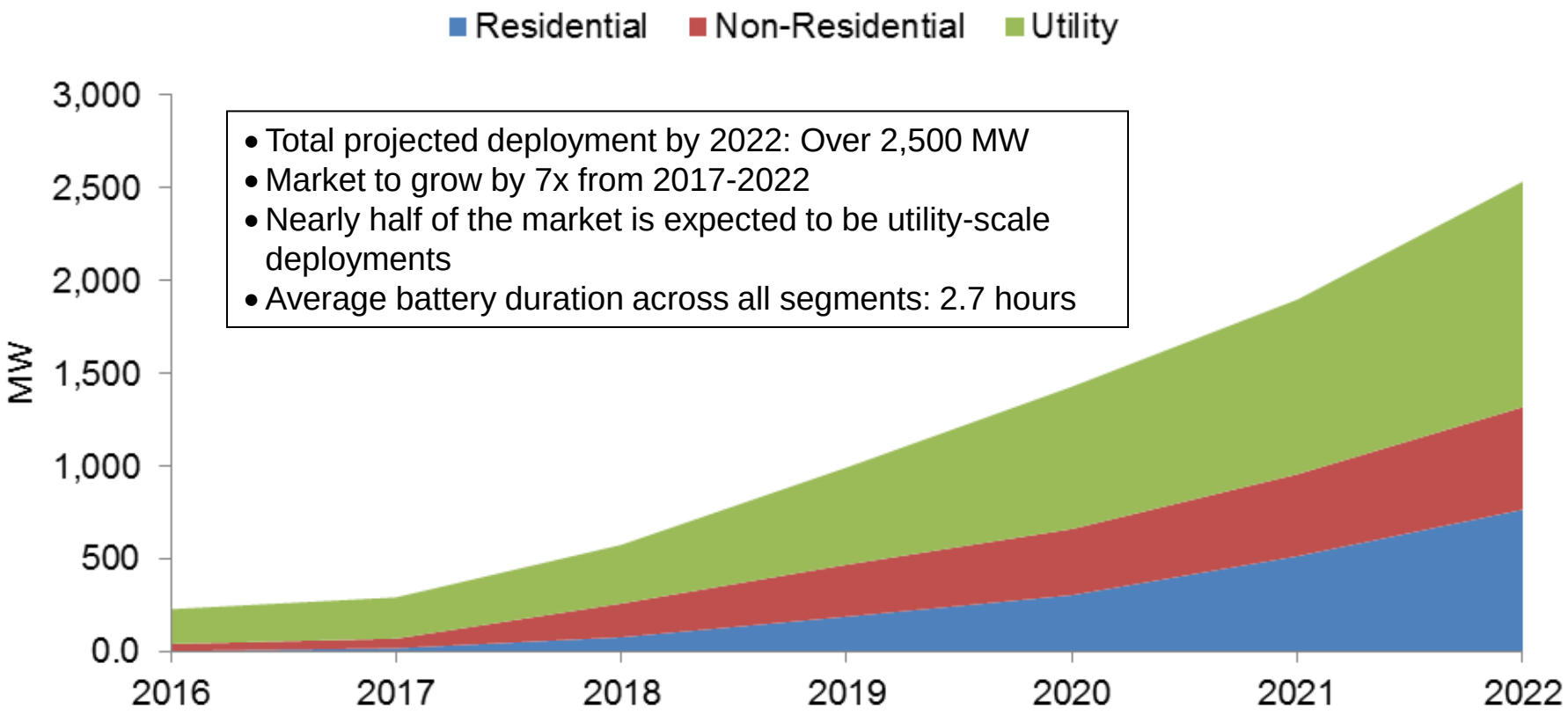
Cost declines

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

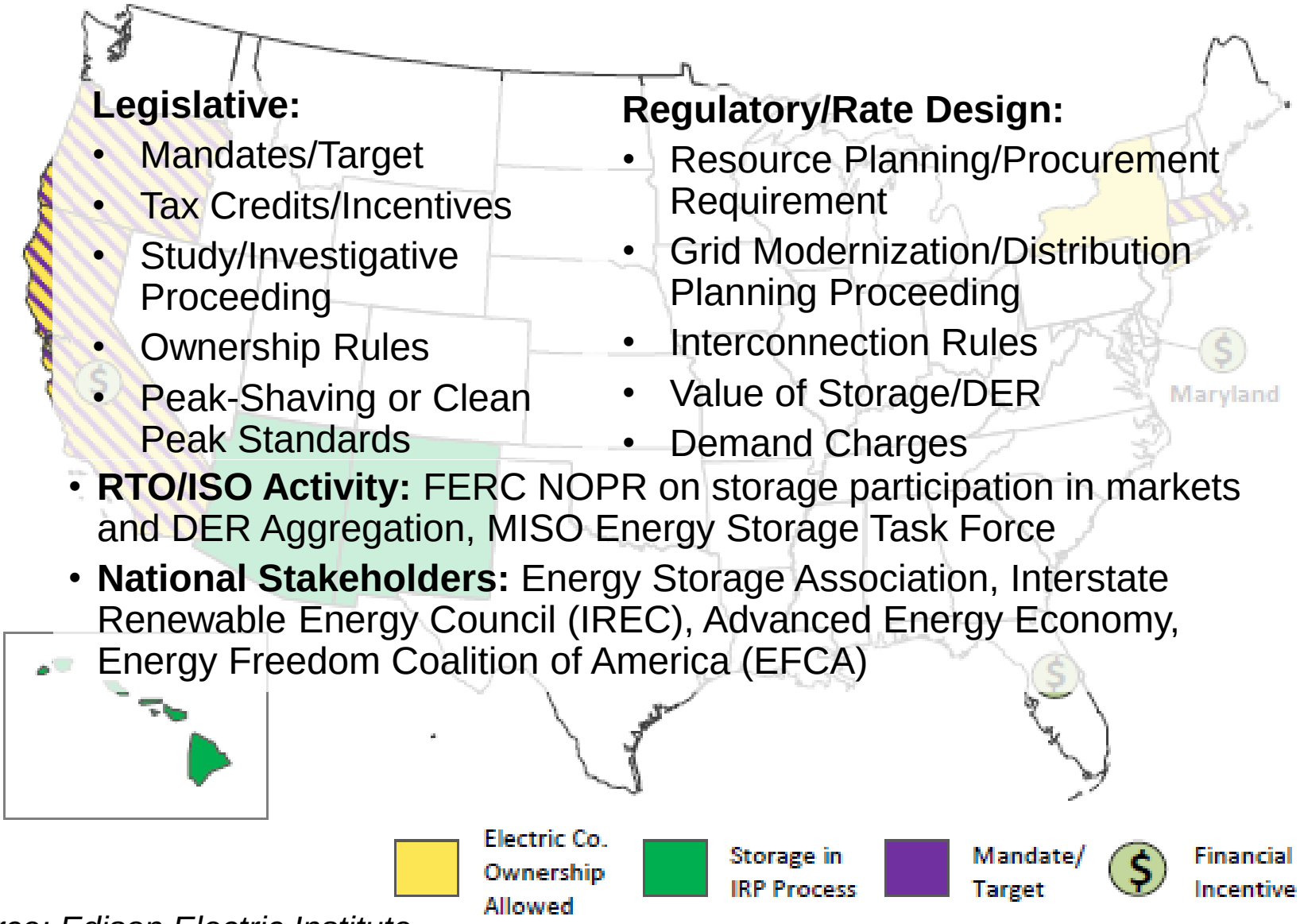
Legislative:

- 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)

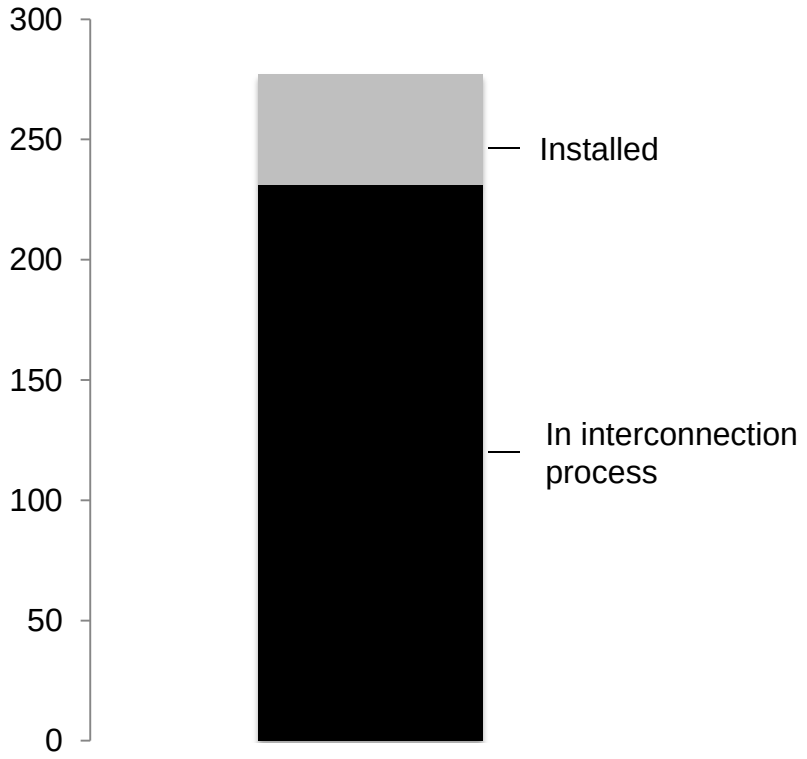


Source: Edison Electric Institute

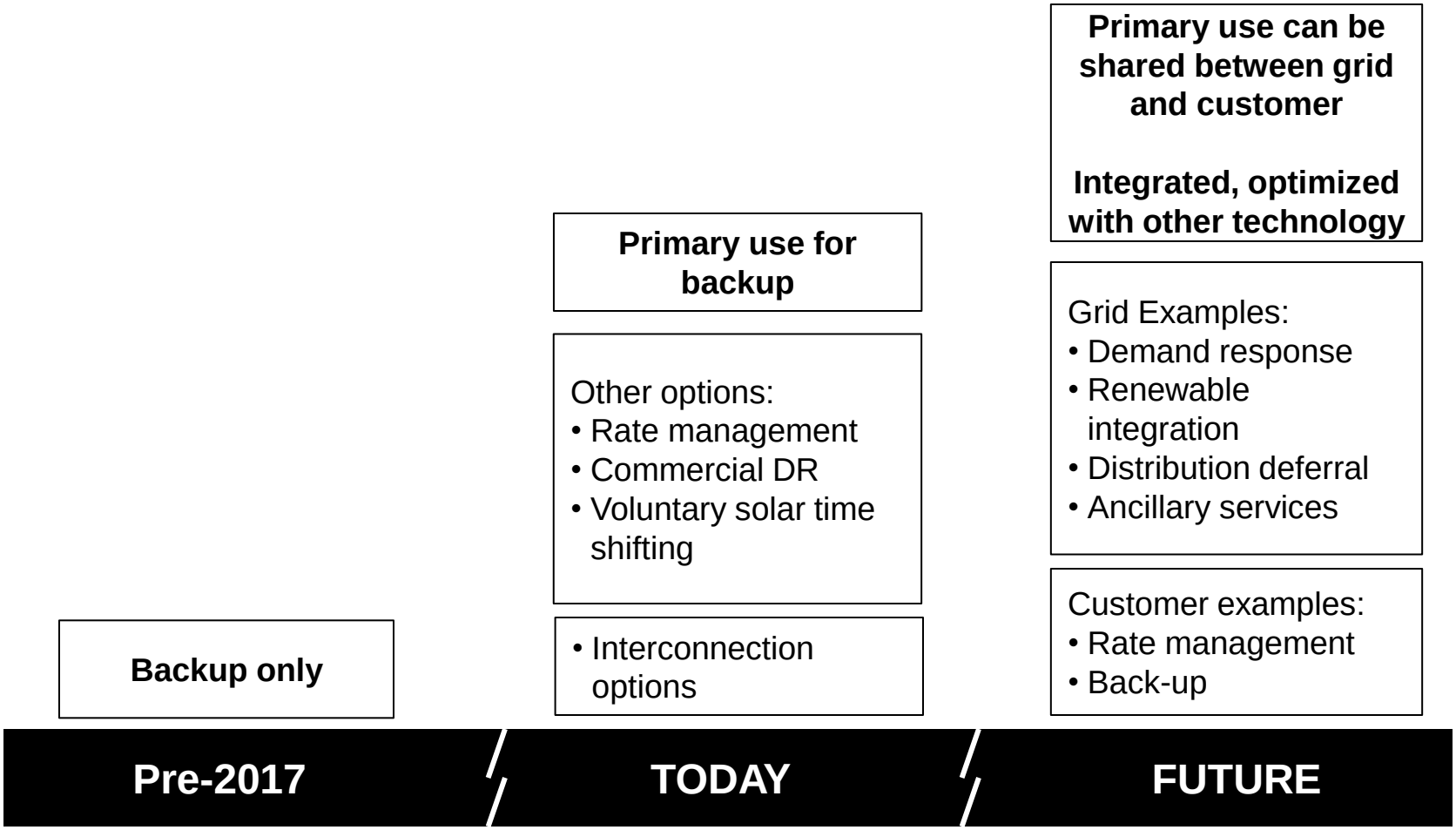
Residential batteries in Xcel Energy service territory today

Stapleton Pilot with Sunverge

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

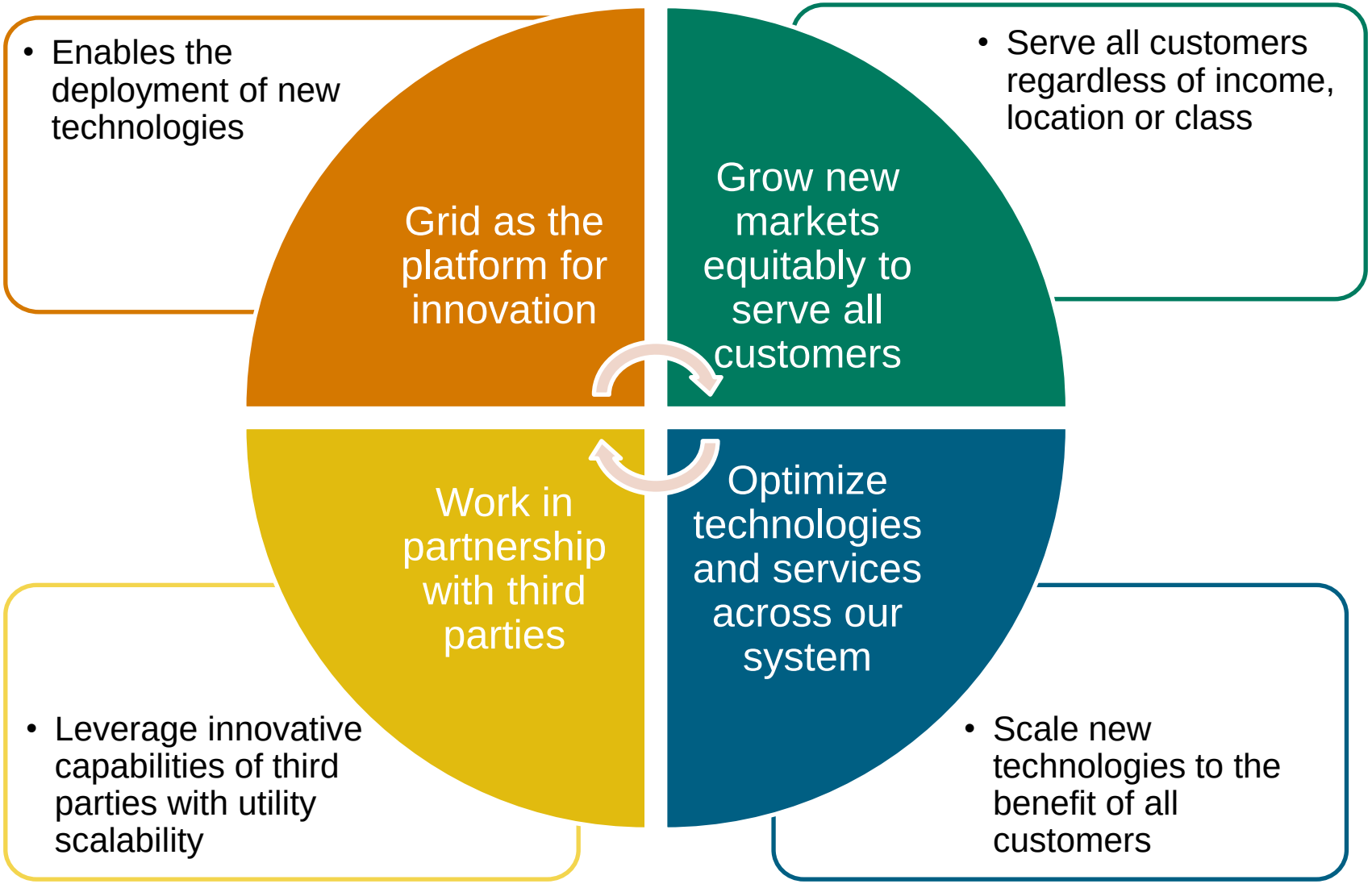


Where we are going



Utility Innovation & Emerging Technologies

Utilities can be Engines of Innovation



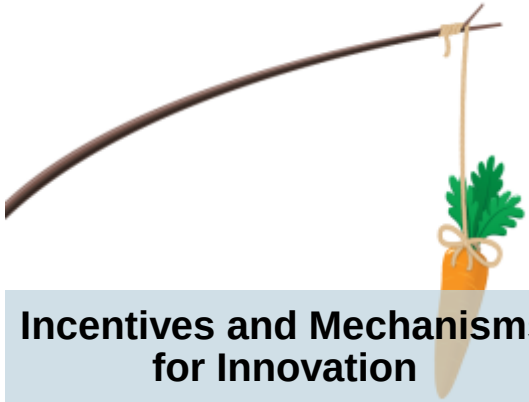
Strategies for Utility Innovation

Lead the Clean Energy Transition

Keep Bills Low

Enhance the Customer Experience

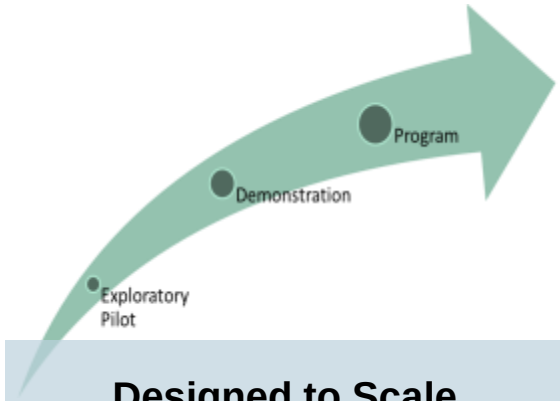
Tied to Strategic Vision



Incentives and Mechanisms for Innovation

Internal Coordination

Stakeholder Engagement

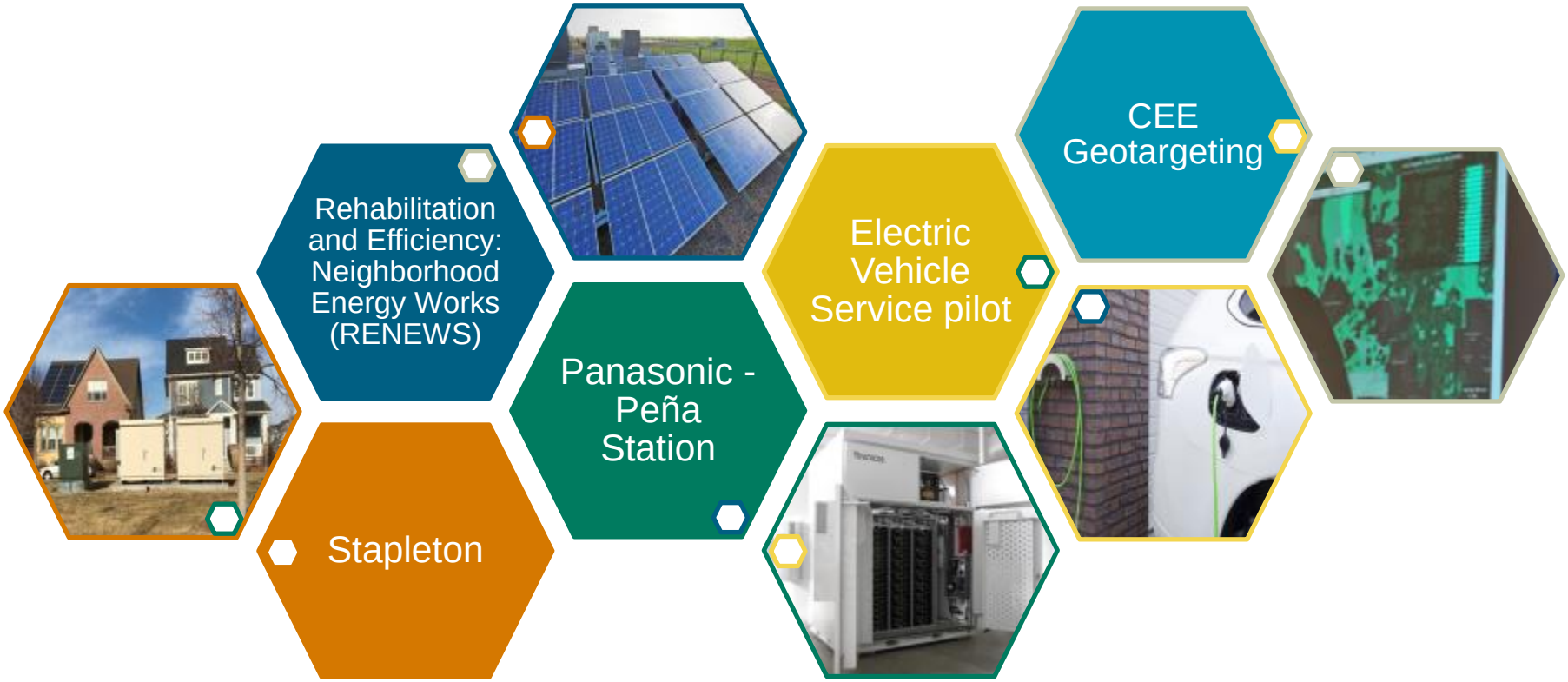


Designed to Scale

Partnerships

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

Pilot & Demonstration Projects



Panasonic – Peña Station Pilot

- 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

- 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

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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 upperleft-hand corner of the page, make sure that "New Mexico" is selected. Click on Public Advisory Meeting then click on the link for the fifth meeting

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