Montana Generation and Transmission Working Group

The webinar will begin shortly.

DEQ MONTANA ENERGY OFFICE

December 14, 2020

Montana Generation and Transmission Working Group

DEQ MONTANA ENERGY OFFICE

December 14, 2020

Webinar Notes

- All attendees (except speakers) will be in listen-only mode.
- Please type questions for the presenters into the Q&A window.
- This webinar is being recorded and will be available on DEQ's website at: https://deq.mt.gov/Energy

DEQ MONTANA ENERGY OFFICE

AGENDA

10:00 AM – Opening Remarks
Chris Dorrington, Administrator, Air, Energy, and Mining Division, Department of Environmental Quality

10:05 AM – Panel 1: Green Hydrogen: A Resource for Montana?
- Dr. Laura Nelson, Green Hydrogen Coalition
- Michael Ducker, Mitsubishi Power

Facilitated by Dan Lloyd, Montana Energy Office

10:45 AM – Panel 2: Innovation in Energy Delivery: Demand Response, Distributed Storage and Energy Efficiency
- Darcy Neigum, Montana Dakota Utilities
- Brandi Hellwinkel and Jon Shafer, NorthWestern Energy
- Dan Rogers, Missoula Electric Cooperative

Facilitated by Kyla Maki, Montana Energy Office

11:40 AM – Project Spotlight: Cabin Creek Solar Project
- Joan Dietz and Andy Buntrock, Basin Electric Power Cooperative
- Jared McKee and Tom Fitzgerald, Clenera

Facilitated by Ben Brouwer, Montana Energy Office

Noon – Webinar concludes

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Montana Generation and Transmission Working Group

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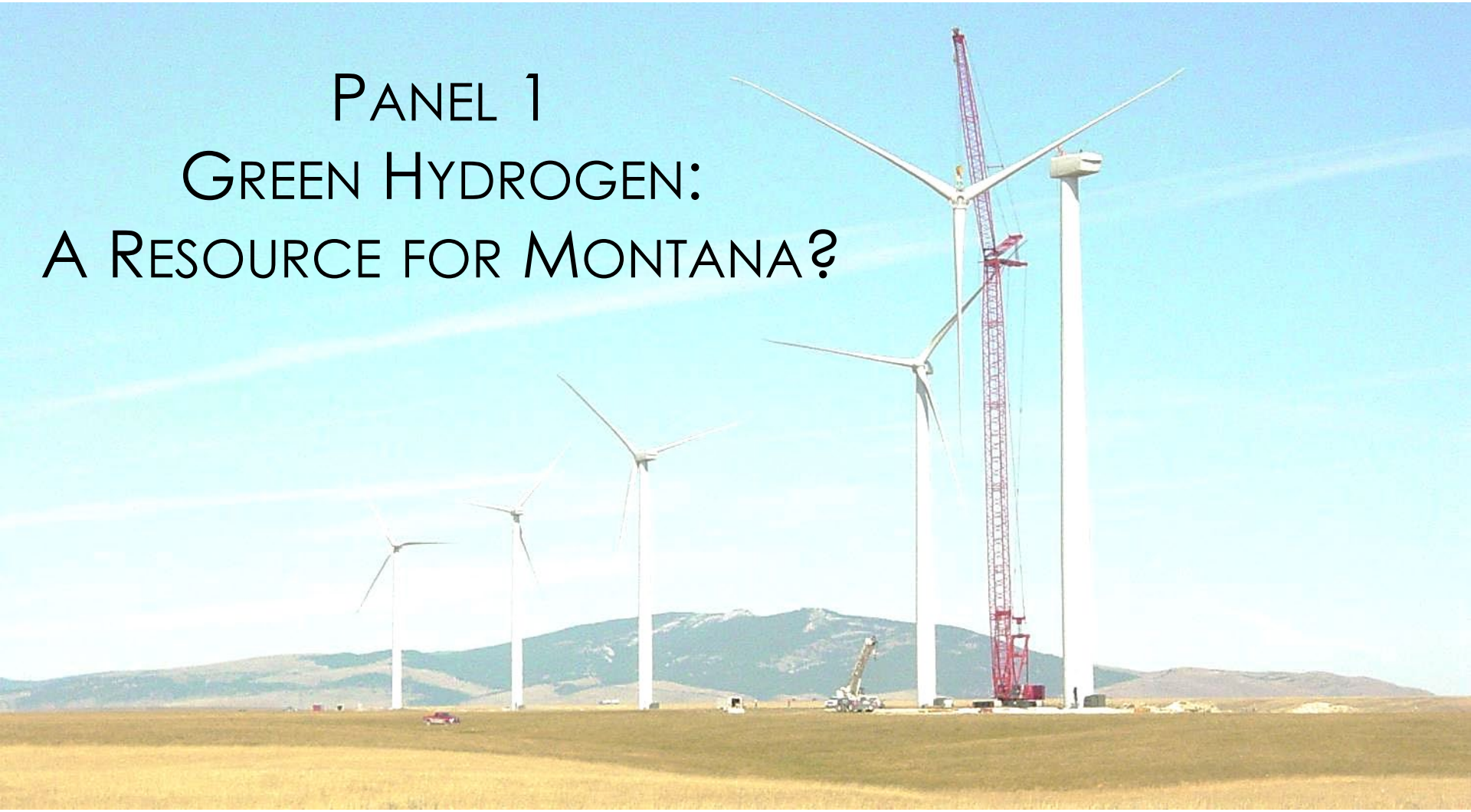
Panel 1
Green Hydrogen:
A Resource for Montana?



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Green Hydrogen:
New Technology Growing The Clean Energy Economy

GREEN HYDROGEN COALITION

Dr. Laura Nelson
Executive Director
Green Hydrogen Coalition

Prepared for the Montana Generation and Transmission Working Group
December 14th

GREEN HYDROGEN COALITION

Green Hydrogen
is the gamechanger to fight climate change and provide a clean energy economy for everyone

GREEN HYDROGEN COALITION

About Green Hydrogen Coalition

MISSION:

Facilitate policies and practices to advance the production and use of Green Hydrogen in all sectors where it will accelerate a carbon free energy future

APPROACH:

Prioritize Green Hydrogen project deployment at scale; leverage multi-sector opportunities to simultaneously scale supply and demand

GREEN HYDROGEN COALITION

*The GHC is a 501c3 Educational Non Profit

GHC SUPPORTERS

8minute Solar Energy

Intersect Power

LA DWP Los Angeles Department of Water & Power

Mitsubishi Power

Dominion Energy
Actions Speak Louder

Magnum Development

True North Venture Partners

Photosol US

Bloomenergy

SoCalGas
A Sempra Energy utility

BrightNight

Hatch

MCE My community. My choice.

Nexceris where energy meets environment

Ørsted

ZeroAvia

Hydrogen is a globally traded commodity

Today's Global Hydrogen Value Chains

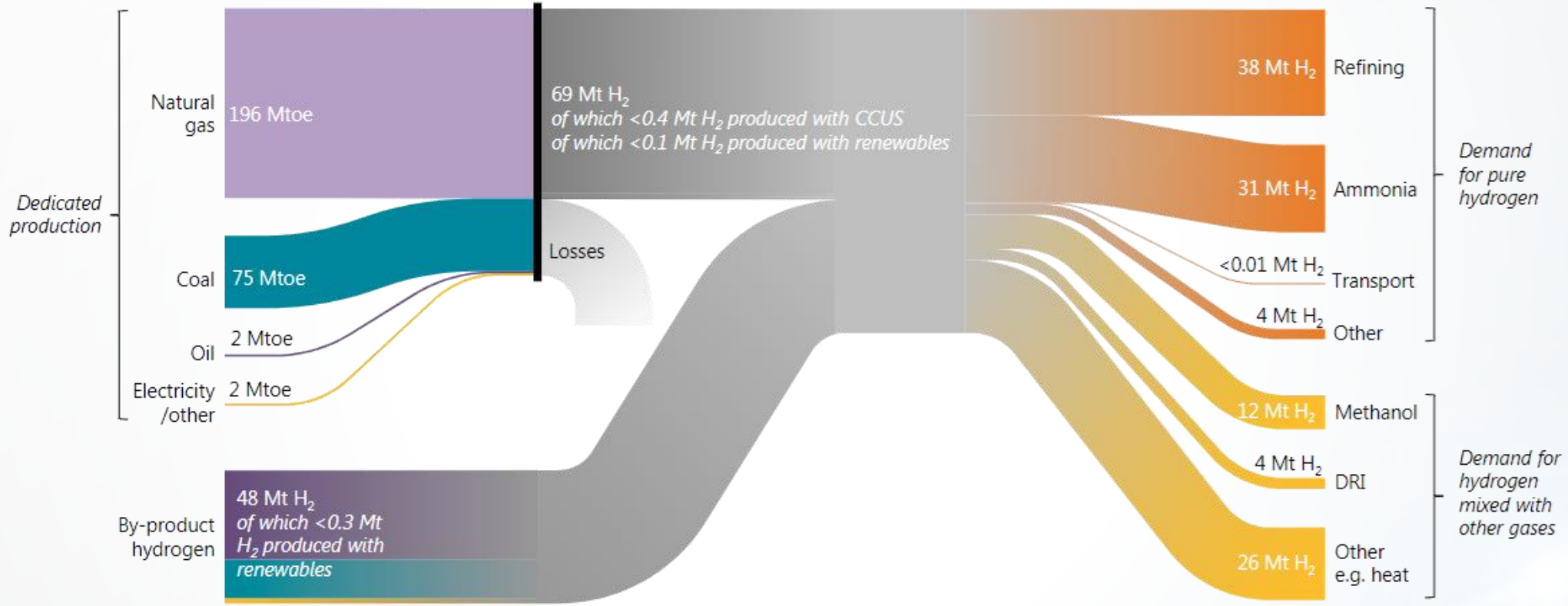

Image from "The Future of Hydrogen: Seizing today's opportunities" report prepared by IEA for the G20, Japan.
Mtoe=million tons of oil equivalent. Mt=million tons

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>99% is made from fossil fuels

About Green Hydrogen

Green hydrogen is hydrogen that is not produced from fossil fuel feedstock sources and does not produce incremental carbon emissions during its production.

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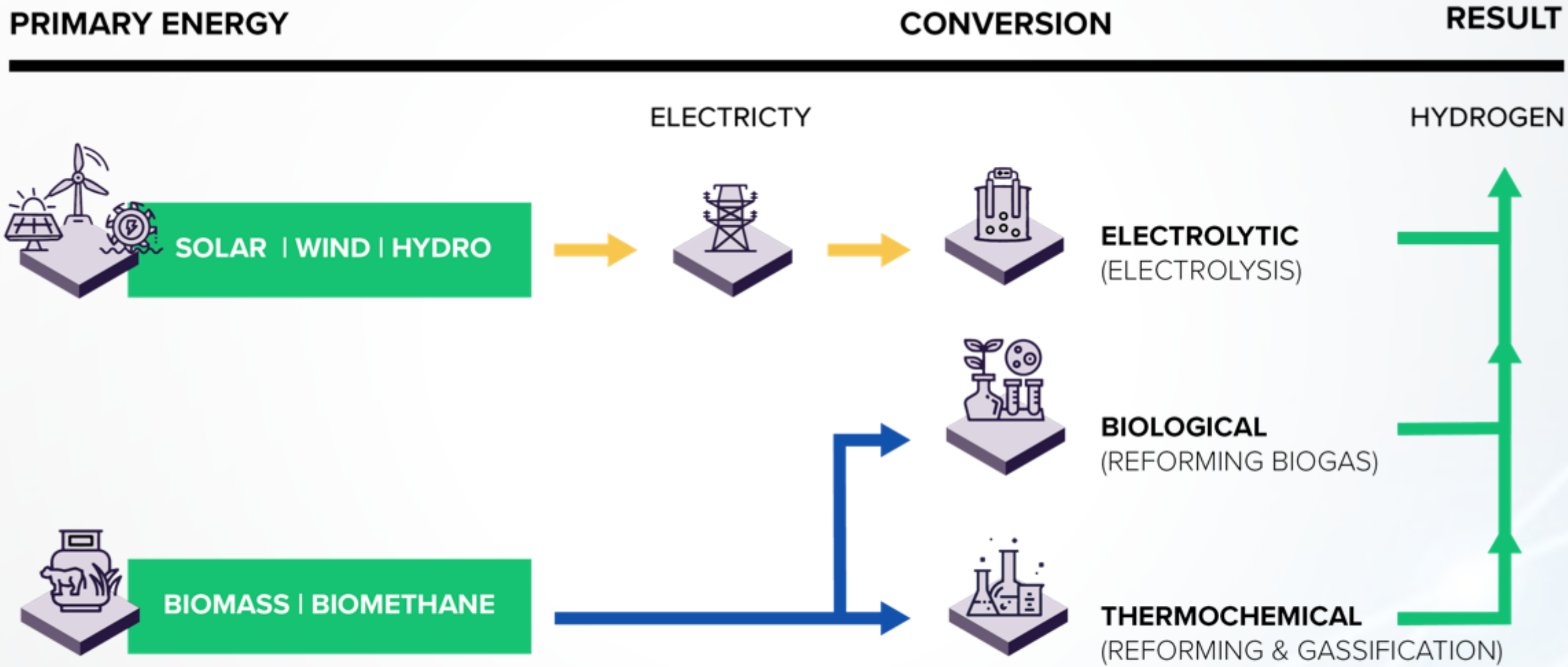
*The GHC is a 501c3 Educational Non Profit

There are many ways to make Green Hydrogen...



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Green Hydrogen has versatile applications

TRANSPORT

POWER

INDUSTRY

CHEMICAL

AGRICULTURE

Hydrogen has the potential to reduce emissions across many sectors

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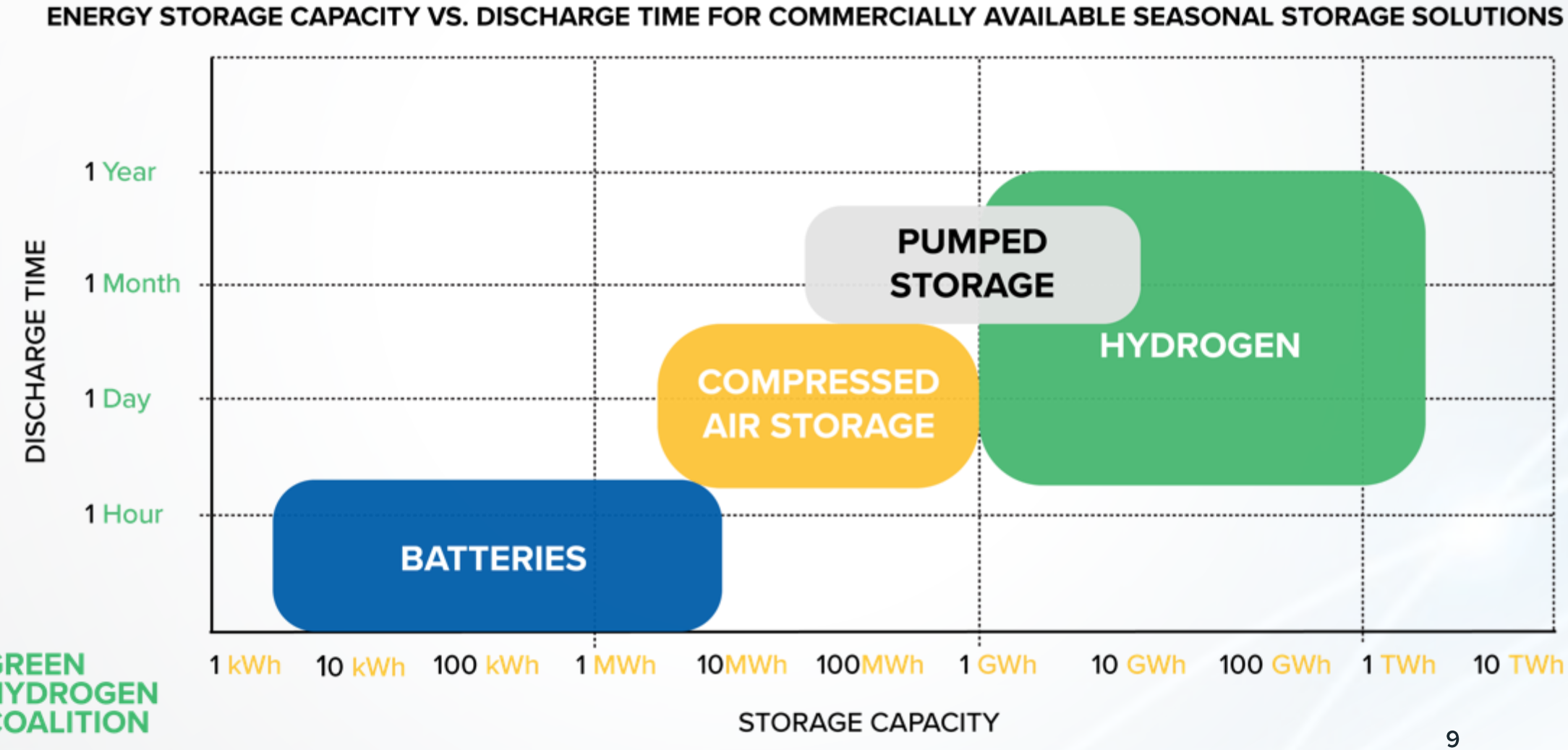
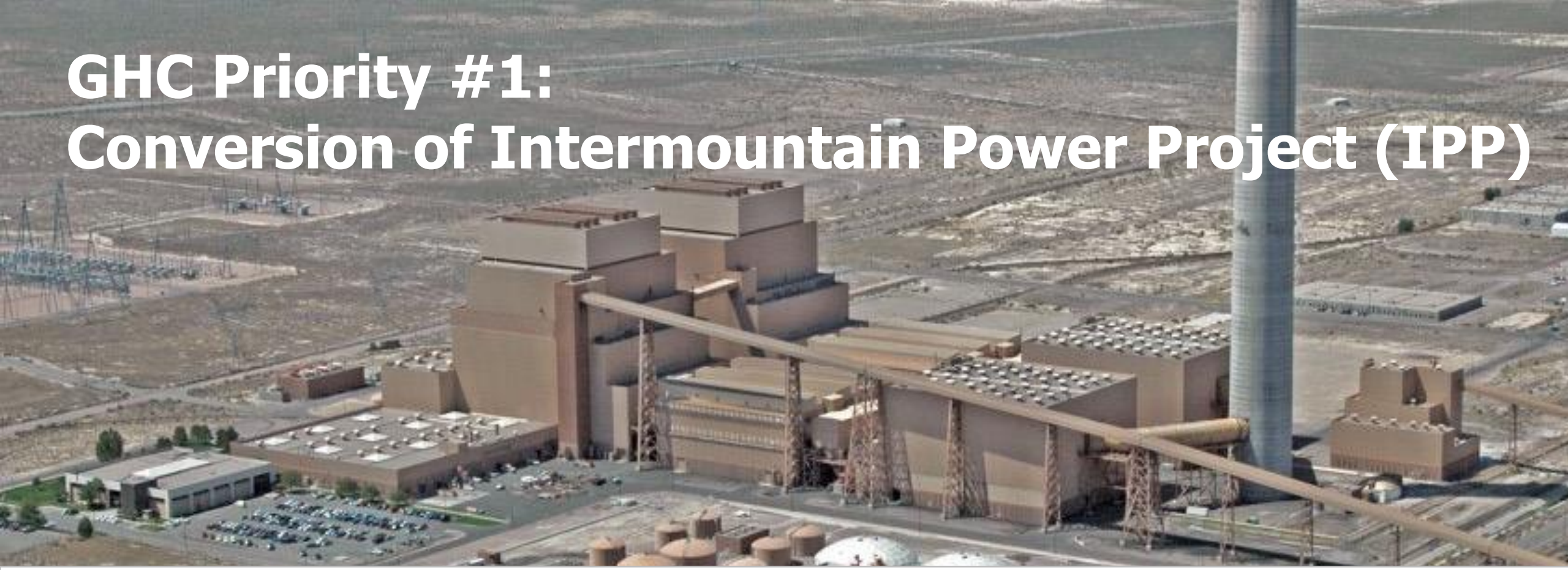
Green Hydrogen is the only commercially viable seasonal storage solution available today



GREEN HYDROGEN COALITION



GHC Priority #1:
Conversion of Intermountain Power Project (IPP)

PROJECT OVERVIEW:

Leverage curtailed and low-cost purpose-built wind and solar to produce Green Hydrogen at scale, displacing natural gas at IPP and providing renewable regional reliability (Green Hydrogen stored in purpose-built salt caverns on site).

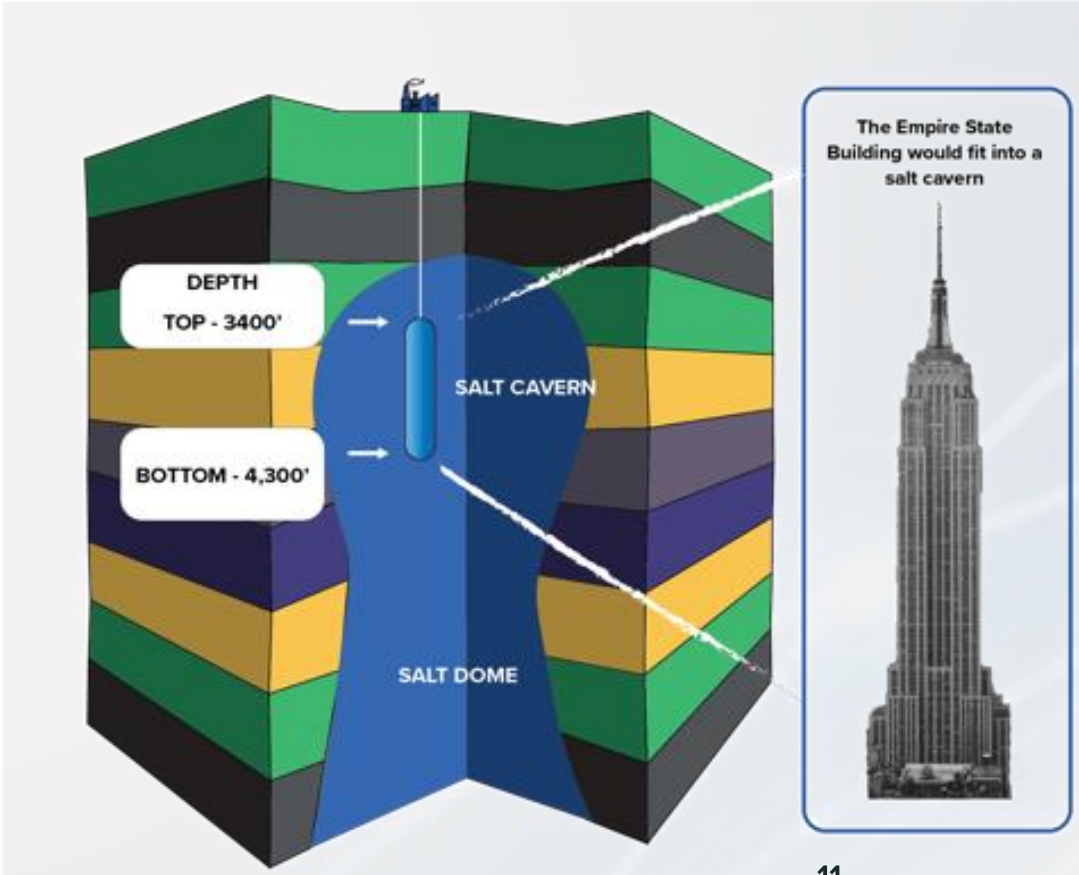
PROJECT GOAL:

Demonstrate large-scale thermal plant conversion to 100% Green Hydrogen and develop a regional renewable reliability reserve for Western US.

IPP is Sited on Western US Strategic Renewable Reliability Reserve:

Hydrogen Storage in Underground Caverns

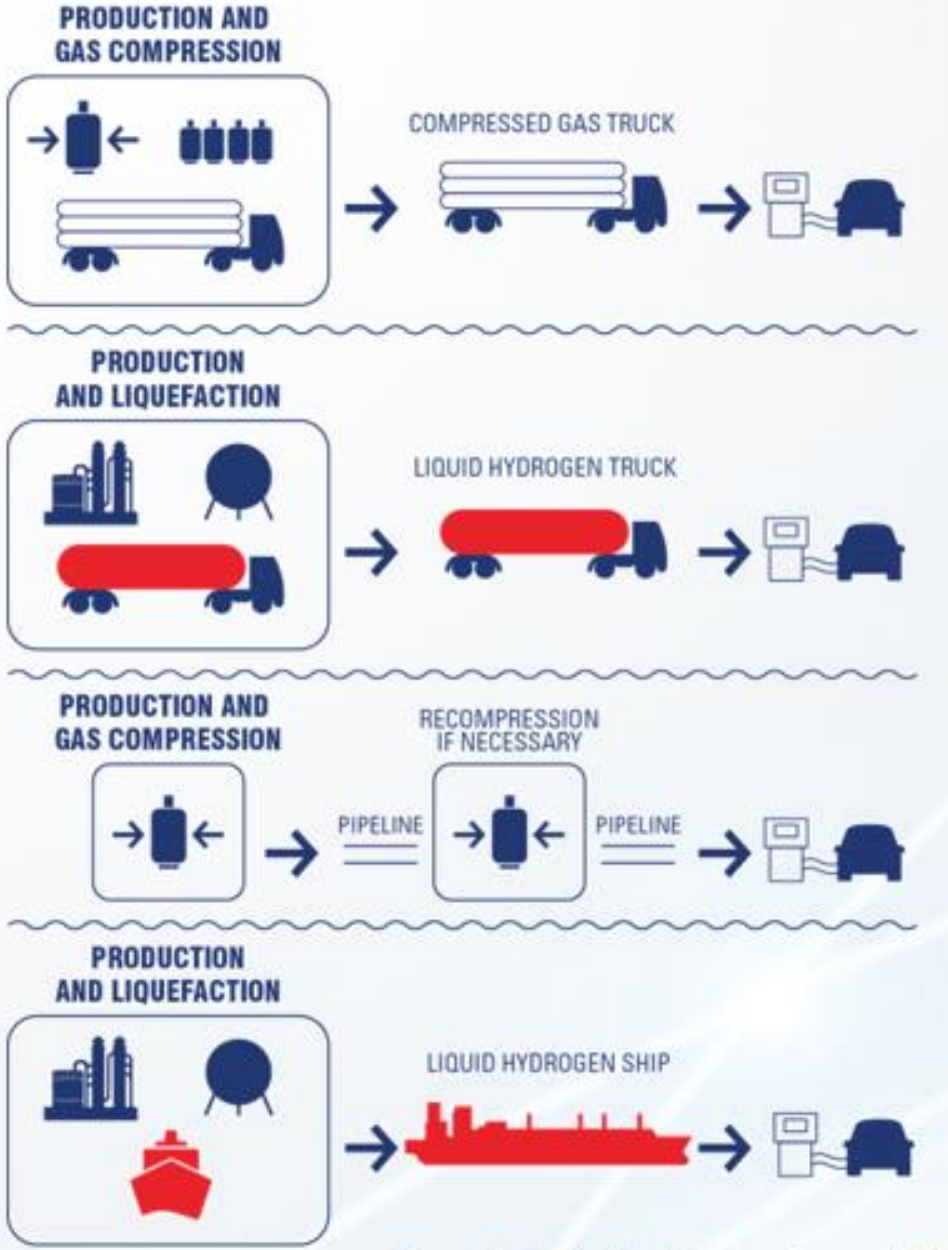
- A typical cavern size at IPP = 4,000,000 barrels
- 1 cavern = 5,512 tons of H_2 (operational limit)
- This is equivalent to:
  - 200,000 hydrogen buses
  - 1,000,000 fuel cell cars
  - 14,000 tube trailers used for delivery
- Over 100 caverns can be constructed in the IPP salt dome
- Storing H2 in salt caverns is already done commercially around the world



GREEN HYDROGEN COALITION

Transportation

- Tanks and cannisters on trucks
  - Can take advantage of already-built natural gas infrastructure
- Pipelines
- Carriers
  - Stored in other chemical forms (e.g. methanol)
- Transmission and distribution lines in place – distributed production



Source: Hydroville, How is hydrogen transported?

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Market Design Innovation to Scale Green Hydrogen

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A NEW PARADIGM IS NEEDED

- System-wide transformation
- Planning across sectors
- Valuing benefits, not just costs!

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Appropriate energy market design by regulators is necessary to enable and accelerate progress.

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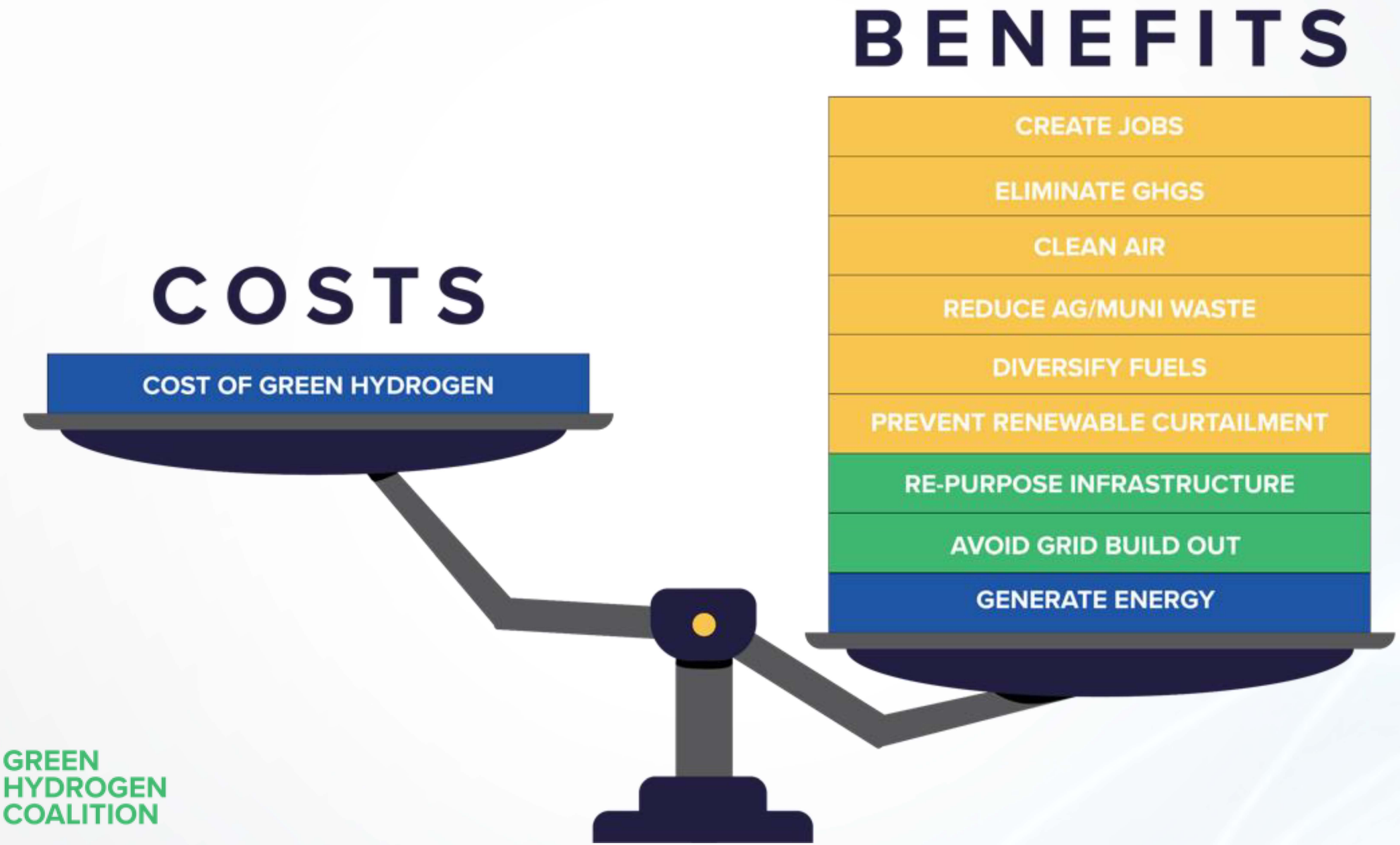


GREEN HYDROGEN COALITION

GREEN HYDROGEN COALITION

NASEO
National Association of State Energy Officials

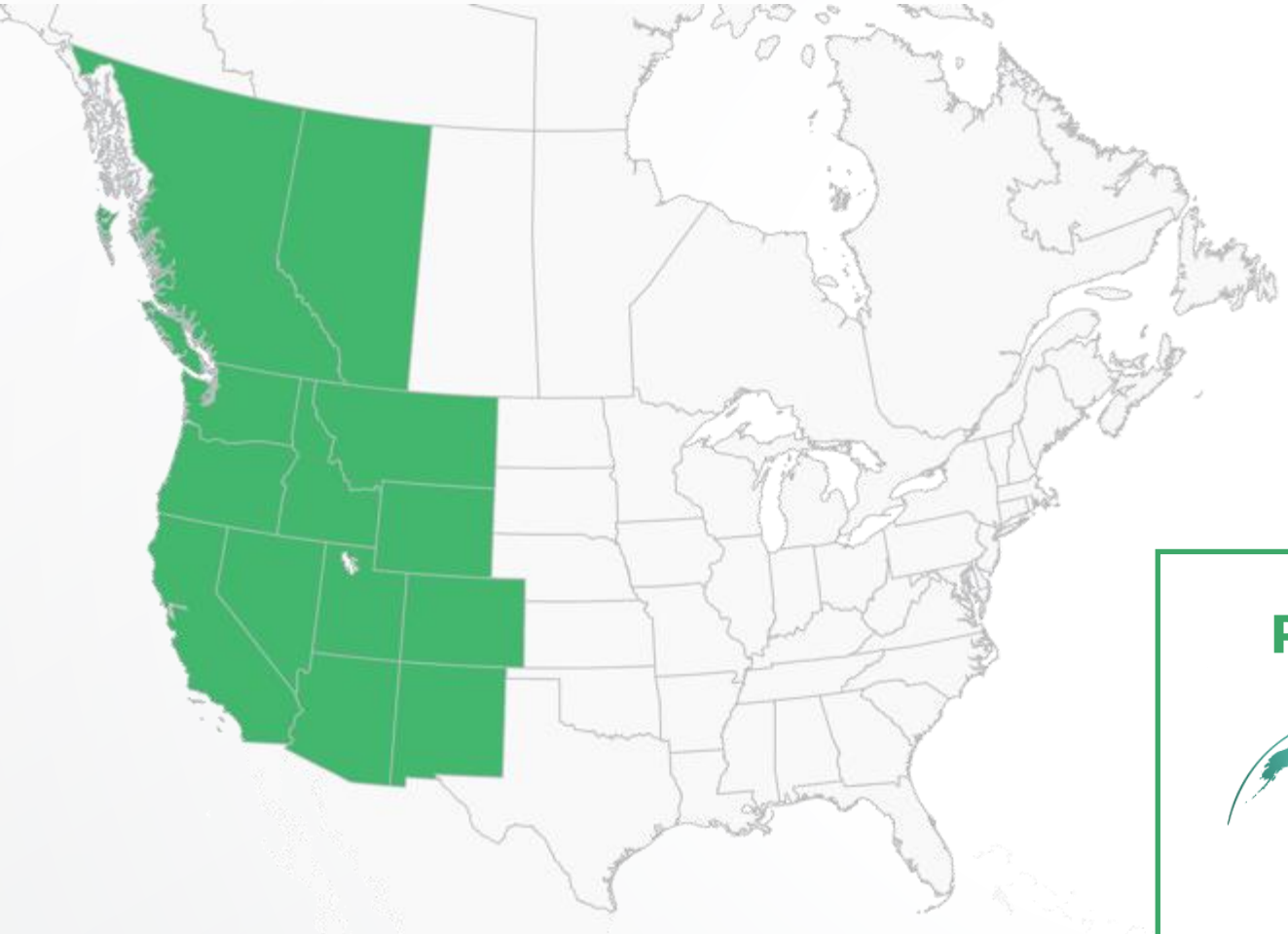
Western Interstate Energy Board

Western Green Hydrogen Initiative

WGHI is a public-private partnership to advance and accelerate deployment of green hydrogen infrastructure in the Western region for the benefit of our economies and environment.

www.WesternGHI.org

Western Green Hydrogen Initiative (WGHI)



- **Objective:** Through multi-state and stakeholder collaboration, WGHI will serve as a steering committee to achieve a Comprehensive Regulatory, Policy and Commercialization Roadmap and advance GH2 projects at scale
- **Key Players:** State Policy Offices, NASEO, WIEB, Regulators and policymakers and GHC 50K+ sponsors as Advisory Council
- **Projects:** IPP, MT GH2 production, I-15 corridor infrastructure, and others identified by states

Public Partners

Western Interstate Energy Board

NASEO
National Association of State Energy Officials

Private Partners and Funders

MITSUBISHI POWER

SoCalGas
A Sempra Energy utility

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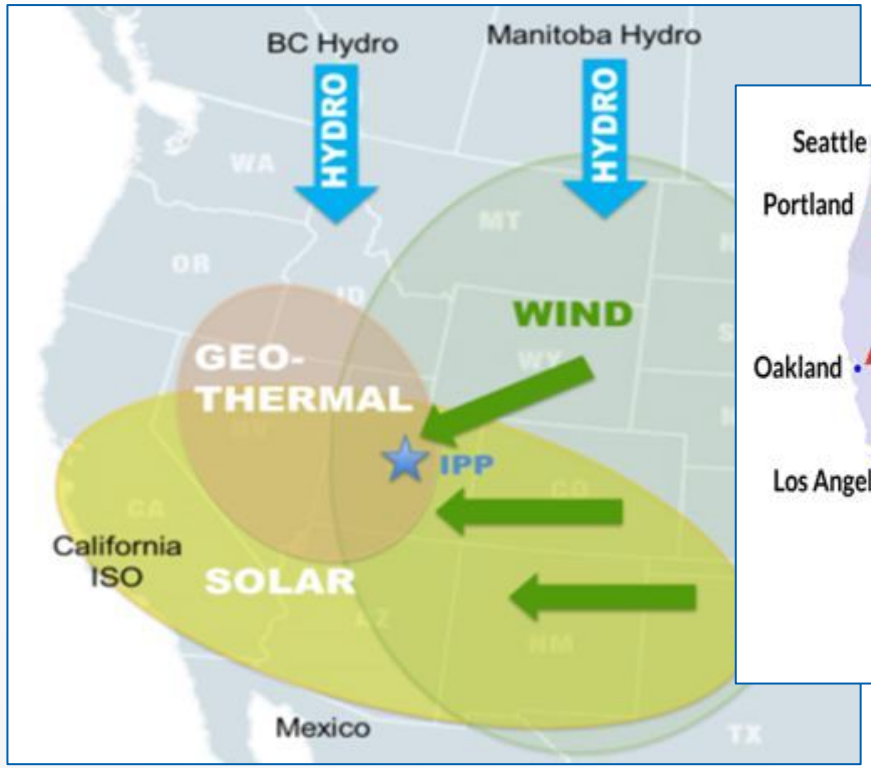
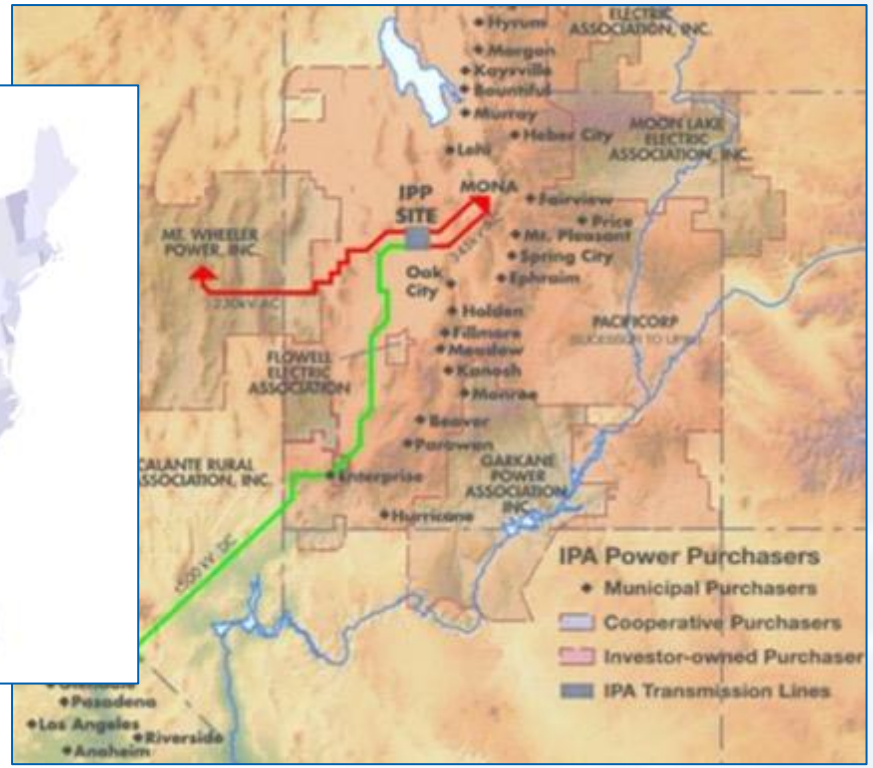
Potential Ares of Collaboration: SoCal and Utah Inland Port





Enabling Green Hydrogen Collaboration Across the West

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Regional Collaboration Key to Supporting Scaled Development and Demand Aggregation

- To focus on accelerating green hydrogen infrastructure development
- Share best practices for regulatory and policy options across states
- Leverage state actions to accelerate the growth of at-scale commercial deployment of renewable hydrogen production, storage, and utilization and RD&D
- Promote grid reliability and resilience
- Provide a comprehensive green energy solution that spans multiple sectors, in particular, power and thermal applications

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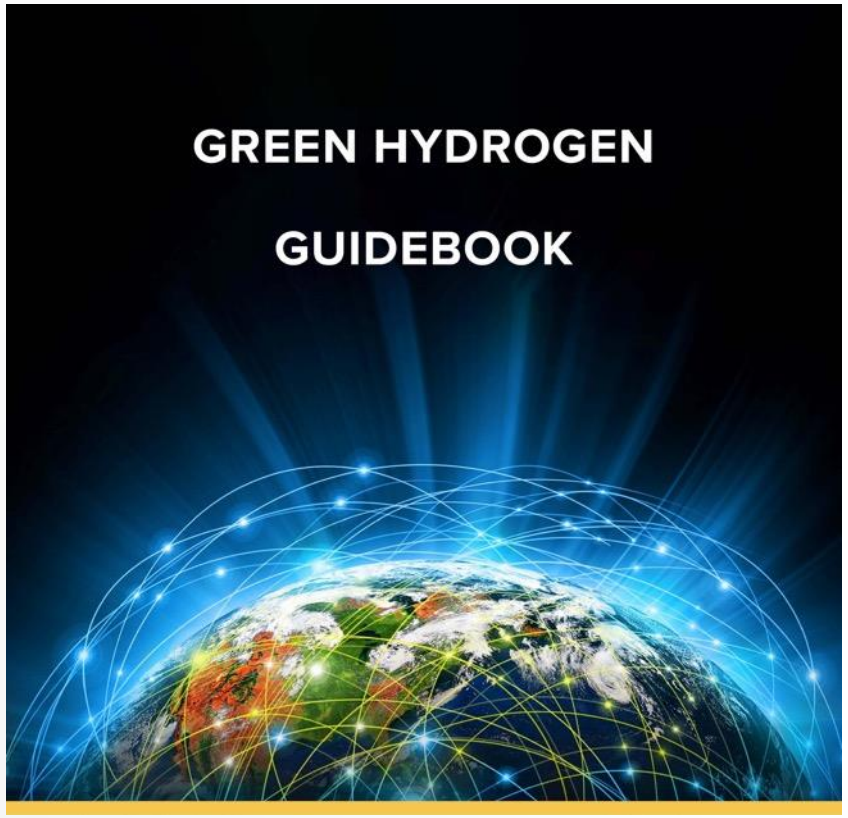
Stay In Touch



Download Our Guidebook

GHCoalition.org/guidebook

Connect With Us

GHCoalition.org
WesternGHI.org

Support Our Work

GHCoalition.org/fund

GREEN HYDROGEN COALITION

CONTACT:

DR. LAURA NELSON
Executive Director
lnelson@ghcoalition.org
+1 801 419 2787

Appendix

1) Ways to Collaborate with the GHC
2) Market Design: Policy and Regulatory Innovation
3) International Projects

Pathways for Collaboration

Objective	Pathway for Collaboration
• Shape market design for green hydrogen project development, obtain latest news, information and global best practices about green hydrogen market development	• Membership – join GHC!
• Non profit and government organizational collaboration – information sharing, messaging, events and networking	• Become a GHC Supporting Partner
• Learn about green hydrogen pathways and innovation. Stay informed, at a high, level on green hydrogen news and market developments	• Attend GHC events, sign up for newsletter

Goal: Efficient collaboration to accelerate progress and momentum for green hydrogen

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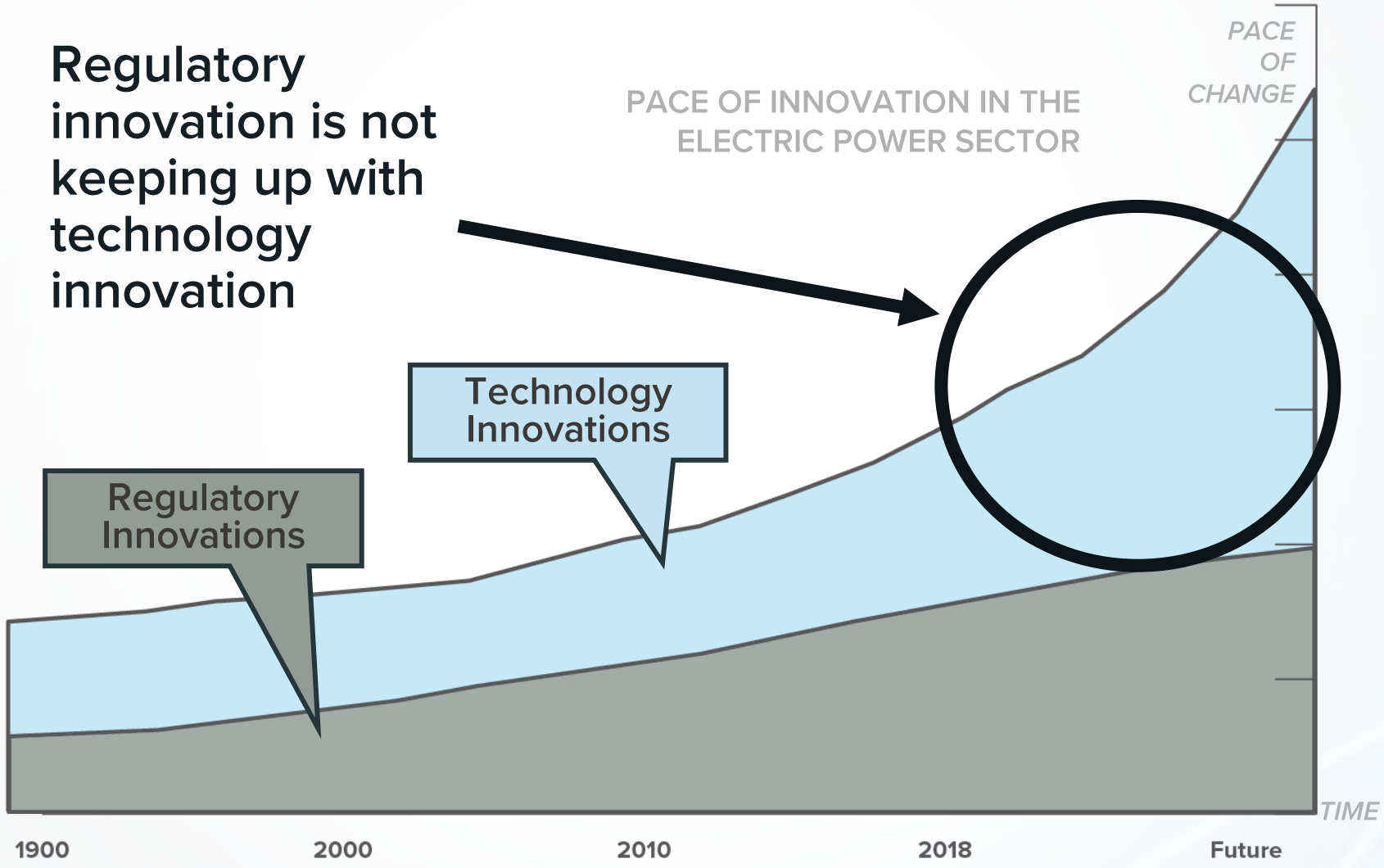
Market design innovation is the key



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Policy Recommendations

- Define green hydrogen broadly
- Clarify eligibility toward meeting state policy and IRP goals
- Establish multi-sector emissions certification and tracking to Incorporate green hydrogen into power and gas system planning models and procurement processes
- Reform wholesale markets to enable green H2 participation
- Fund green hydrogen RD&D, including better system planning tools
- Develop sector-specific decarbonization targets and green H2 roadmaps
  - Green H2 for the gas sector
  - Green H2 as alternative thermal electric generation fuel
  - Green H2 as alternative to diesel and gas for critical power
  - Green H2 for transportation (land, air and sea)
  - Green H2 for industrial applications (ammonia/fertilizer, oil refining)
  - Green H2 for mining

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Progress requires multi-jurisdictional focus

International Green Hydrogen Projects at Scale

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January 2020: Canada, Chetwynd Hydrogen - 3% pipeline injection

Description:

- Coupled electrolysis plant and wind farm to produce green hydrogen to inject into natural gas pipelines at 3% concentration

Project Plan:

- Build dedicated wind farm as well as the electrolysis plant
- Negotiate agreement to inject hydrogen into natural gas pipeline

Goal:

- 22,000 tons green hydrogen produced/year

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https://fuelcellsworks.com/news/canada-macquarie-capital-to-finance-new-200-plus-million-renewable-hydrogen-plant-in-chetwynd

May 2019: Heide Oil Refinery in Germany - Westkust 100 700MW off-shore wind electrolysis project

Description:

- Green hydrogen production from offshore wind energy to produce aviation fuel

Project Plan:

- 2019 – Proposal to Federal Ministry of Economics
  - Initial: 30 MW electrolysis plant to gather information on operation, control
  - Scale-up: 700MW electrolysis plant

Goal:

- Continuous stream of green hydrogen for industrial use

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https://www.heiderefinery.com/en/press/press-detail/cross-sector-partnership-green-hydrogen-and-decarbonization-on-an-industrial-scale/

November 2019: World's largest green hydrogen steel plant began operation in Austria - 6MW renewable electrolysis

Description:

- Researching the industrial production of green hydrogen as a means of replacing fossil fuels in steel production over the long term.

Project Plan:

- Built in 2019, currently in operation

Goal:

- Test whether green hydrogen is suitable for industrial-scale use in the steel industry, refineries, and other industrial sectors requiring large volumes of hydrogen

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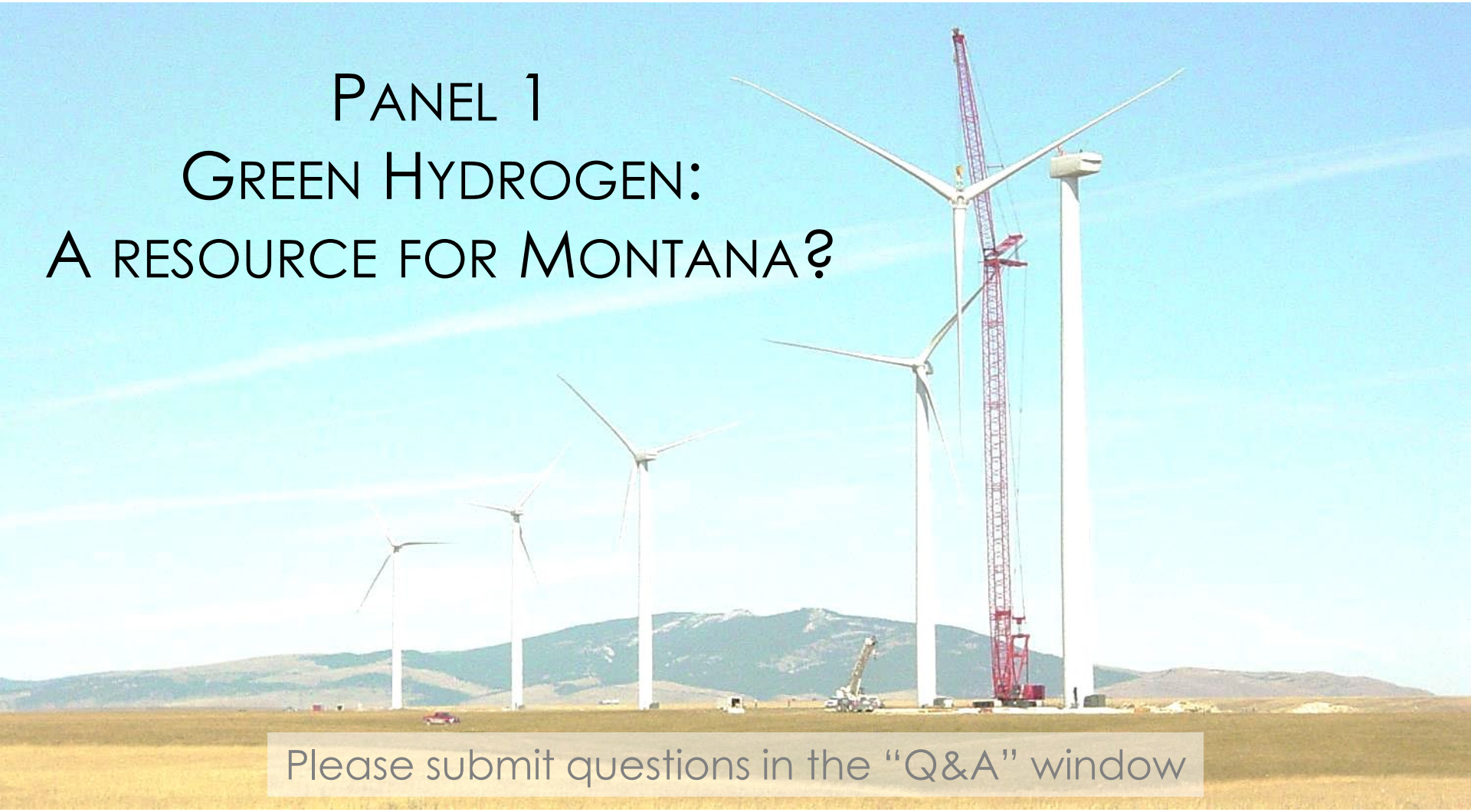
https://www.powerengineeringint.com/2019/11/19/worlds-largest-green-hydrogen-pilot-begins-operation-in-austria/

Upcoming: Future City of Neom in Saudi Arabia - 4 GW

- **Description:**
  - 4 GW facility, powered by wind and solar, is a collaboration by Air Products, Saudi Arabia's ACWA Power and Neom. It will be capable of producing 650 tons of green hydrogen per day- around enough to power 20,000 hydrogen buses.
- **Project Plan:**
  - Completion date is 2025
- **Goal:**
  - The hydrogen produced can be shipped globally as ammonia and then converted back to hydrogen.

GREEN HYDROGEN COALITION

https://www.greentechmedia.com/articles/read/us-firm-unveils-worlds-largest-green-hydrogen-project /



Panel 1
Green Hydrogen:
A resource for Montana?

Please submit questions in the "Q&A" window

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MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

Green Hydrogen:

A New Resource for Energy Reliability and Economic Growth in a Post-2020 World

Michael J. Ducker
Vice President, Renewable Fuels
Mitsubishi Power

MITSUBISHI POWER

Our Mission in the Americas

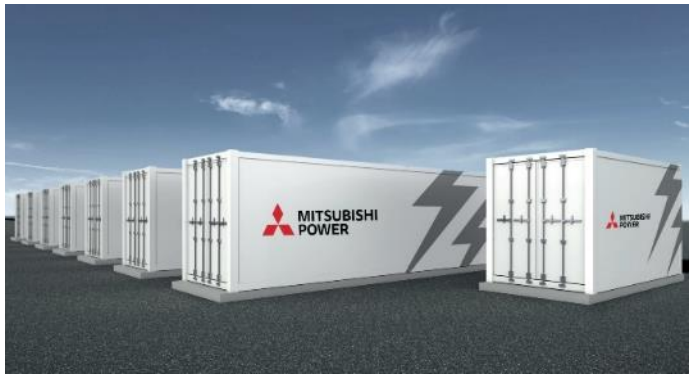
We will provide power generation and storage solutions to our customers, empowering them to affordably and reliably combat climate change and advance human prosperity.

Mitsubishi Heavy Industries: Solutions for a Change in Power

Hydrogen Ready Gas Turbines

PV Solar

Offshore Wind



Lithium Ion Batteries

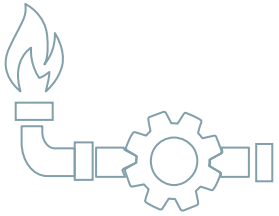
Hydrogen Energy Storage

Carbon Capture, Utilization & Storage

Power Grid Decarbonization

PHASE 1

The retirement and replacement of coal-fired power plants with:



Natural Gas

Renewables

PHASE 2

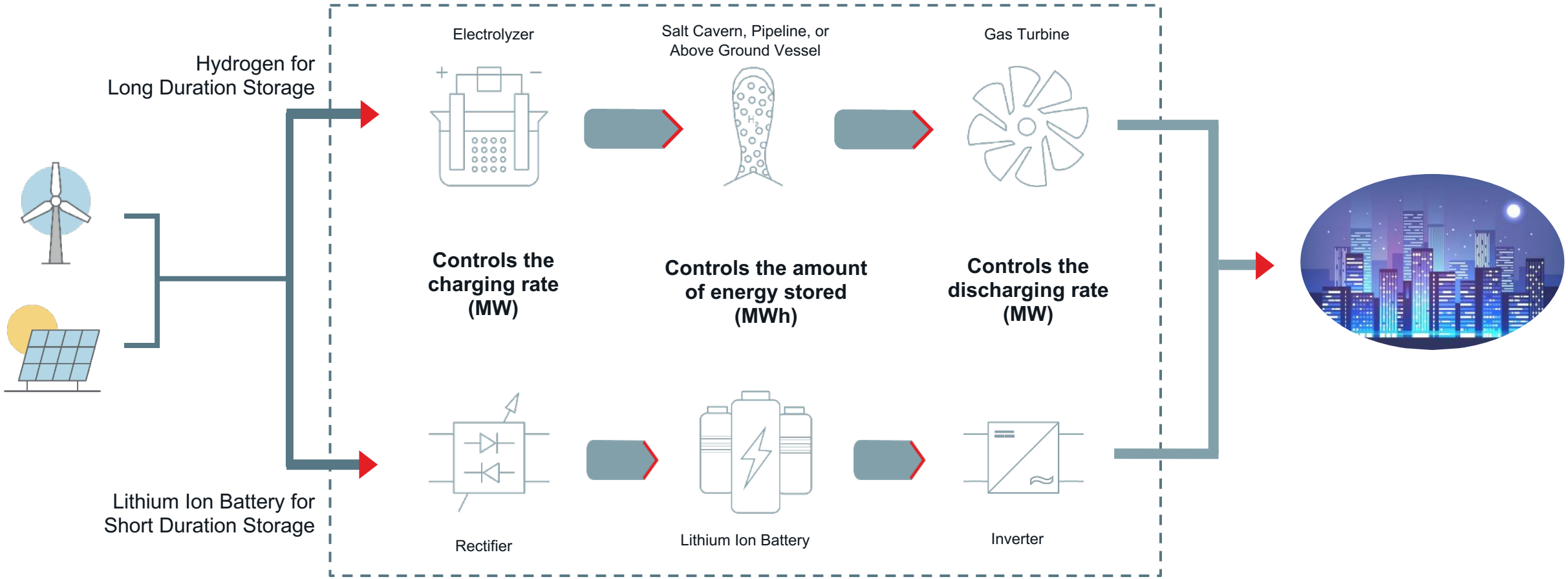
Tackle long-term intermittency, currently managed by natural gas power generation:

Energy Storage

Renewables

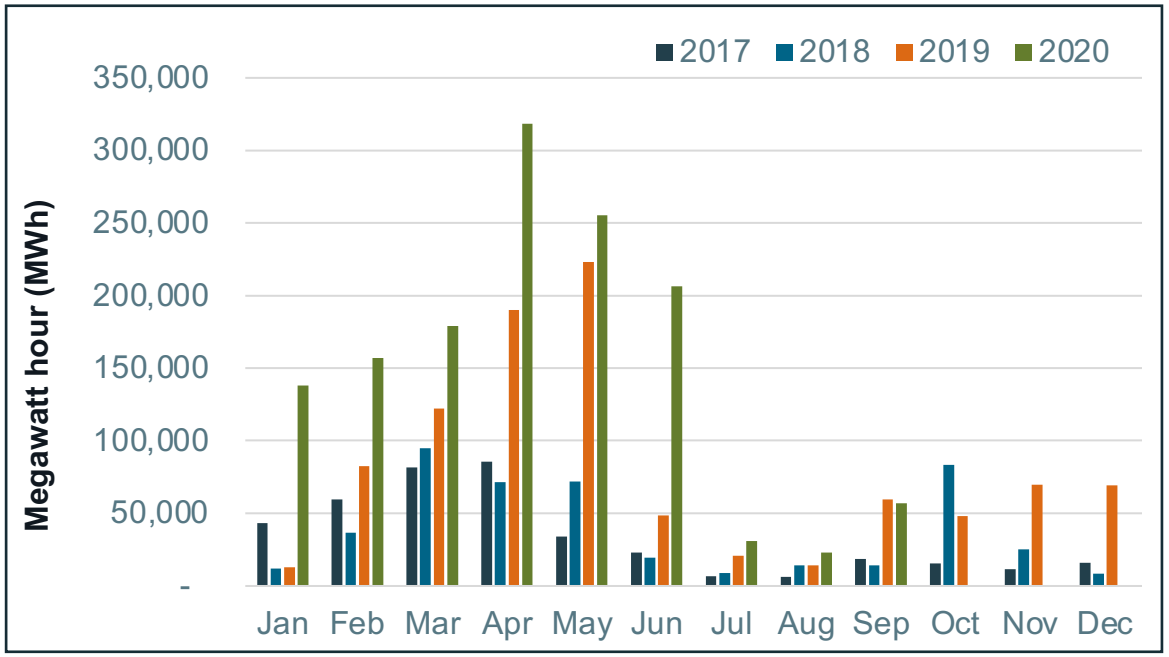
To Store Energy via Hydrogen or to Store via Lithium?

Comparison of Green Hydrogen Energy Storage Systems and Battery Energy Storage Systems



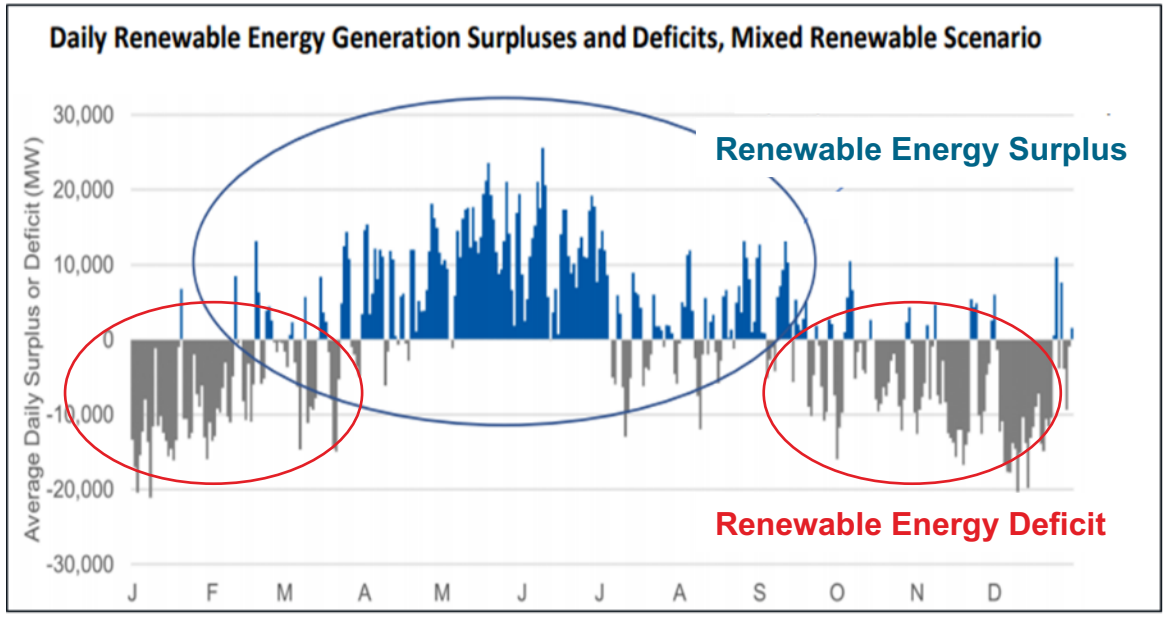
Surplus and Deficit Signal the Need for More Storage Options

CALIFORNIA WIND AND SOLAR CURTAILMENTS HIT RECORD HIGH IN APRIL 2020



Source: CAISO, Data compiled July 2020
http://www.caiso.com/informed/Pages/ManagingOversupply.aspx

CALIFORNIA SURPLUS AND DEFICIT PATTERNS UNDER A 100% RENEWABLE ENERGY SCENARIO



Source: Armonk Cohen Testimony

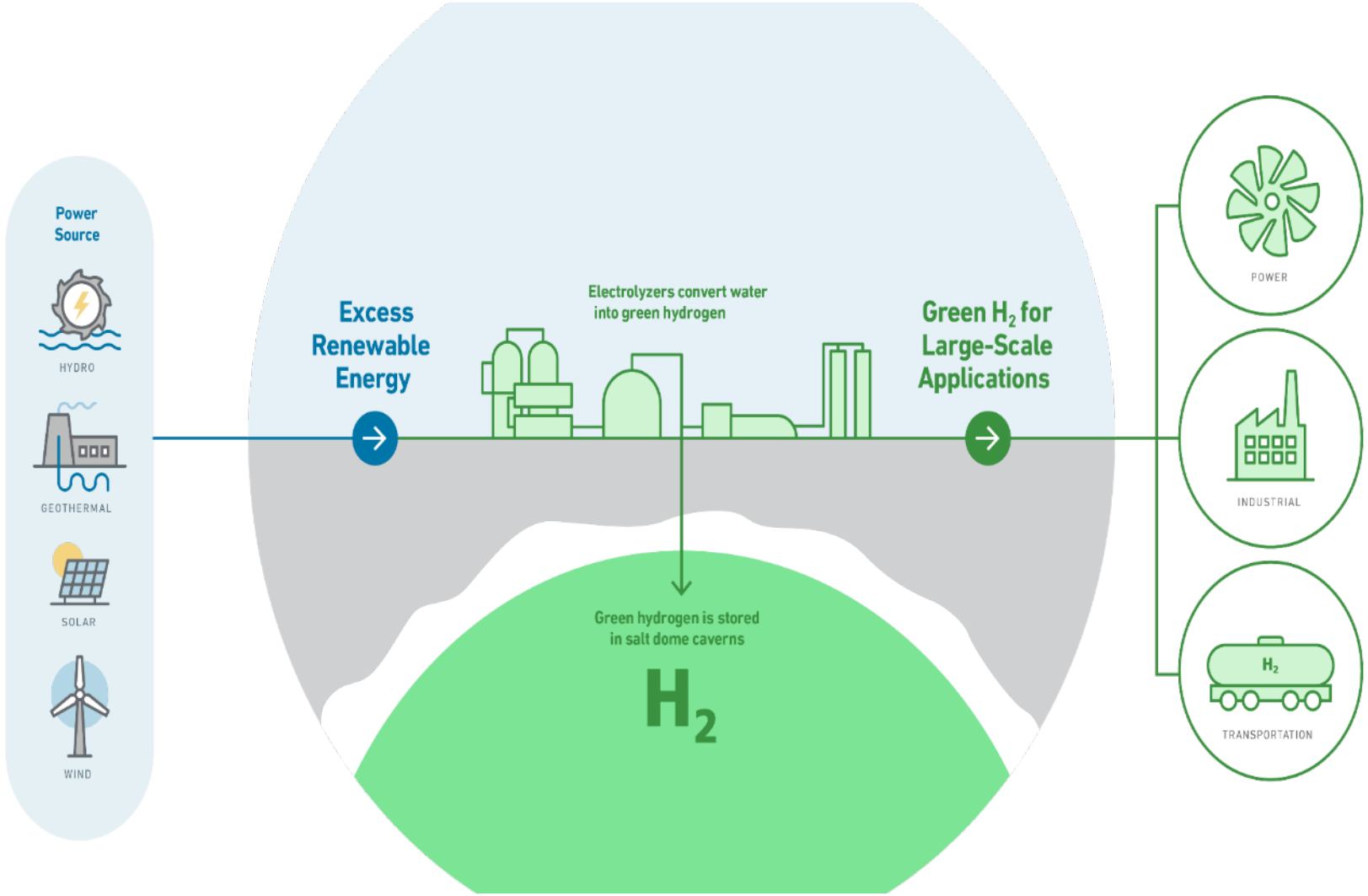
- At just 30% renewable integration, peak monthly curtailment exceeds 300,000 MWh
- Seasonal surplus and deficits signal need for long-duration energy storage “beyond the duck curve”

Intermountain Power Project: Meeting California's 100% Carbon-Free Goals

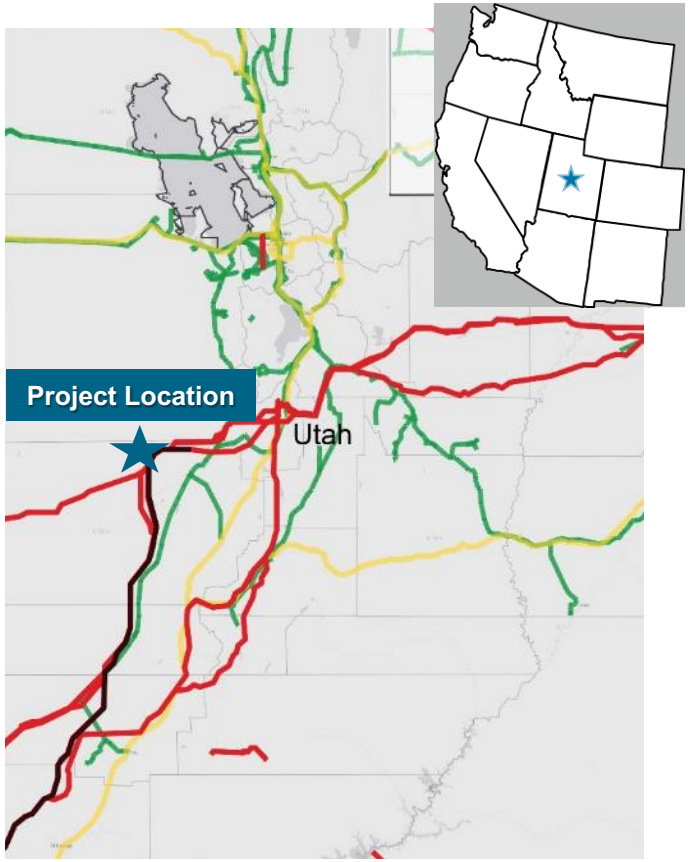
- March 10, 2020 - Mitsubishi Power (formerly MHPS) awarded contract for 2 hydrogen gas turbines
- The **1st Advanced Class Gas Turbine project** specifically **designed for Green Hydrogen fuel**
- **840MW of reliable energy** to Los Angeles and municipalities in other parts of California and Utah
- **In 2025, 30% Green Hydrogen** & 70% natural gas fuel mix when plant operations begin
- By **2045**, **100% Green Hydrogen** capable to support California carbon-free goals

Advanced Clean Energy Storage Project

Hydrogen Storage Using Salt Caverns & Gas Turbines



Green Hydrogen Regional Solution – Advanced Clean Energy Storage



U.S. Counties
U.S. States
DC Line
High Voltage Transmission Lines
U.S. Major Highways
U.S. Railroads

EXCLUSIVE RIGHTS TO DELTA SALT DOME

- Only known “Gulf Coast” style domal-quality salt in the west capable of large caverns
- Large-scale storage necessary for the west coast to decarbonize via green hydrogen

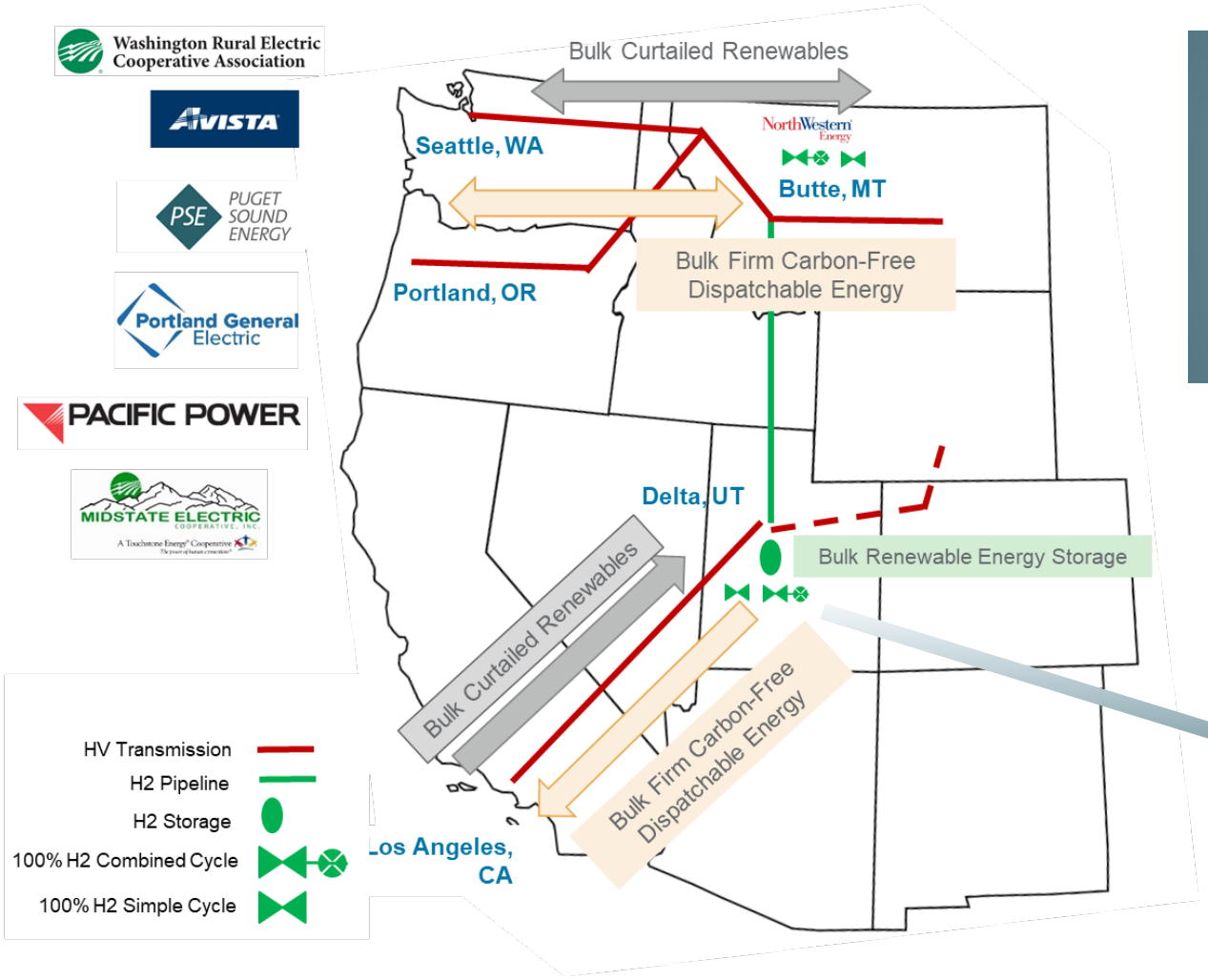
SITE CENTRALLY LOCATED TO WECC

- California through HVDC Transmission Line
- Major WECC Utilities through AC Tie
- TransWest Express Transmission Line will tie site into WY and Las Vegas

H_2 INFRASTRUCTURE TO DECARBONIZE “HARD TO ELECTRIFY” VERTICALS

- Transportation (Heavy Duty/Long Haul Vehicles, Rail, Aircraft, Maritime)
- Datacenters
- Military
- Industrial and Manufacturing
- Ammonia and Derivatives
- Pipeline Injection
- Shipping and Exports (including to Asia)

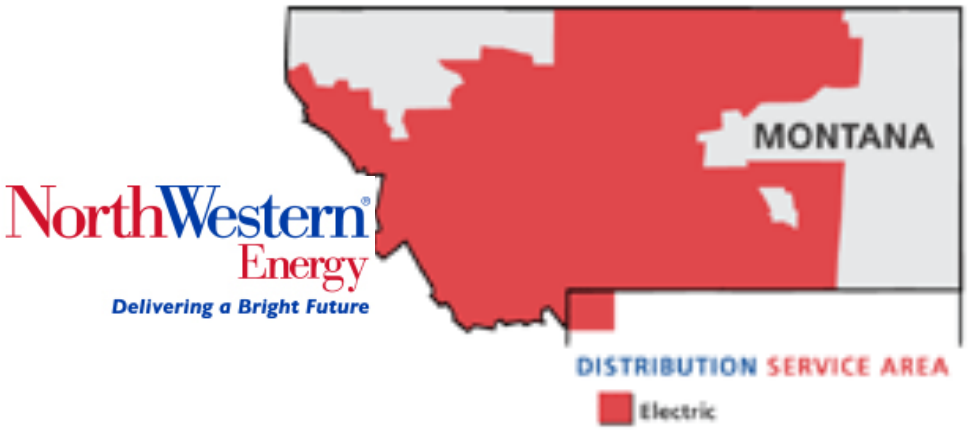
Interconnecting the West



Hydrogen Spokes Connected with Western Renewables & Transmission

- Electrical Infrastructure and Hydrogen Infrastructure Connects Western United States
- Enables Regional carbon-free generation and storage
- Seasonal Shifting across the region

Montana Status



Current Situation

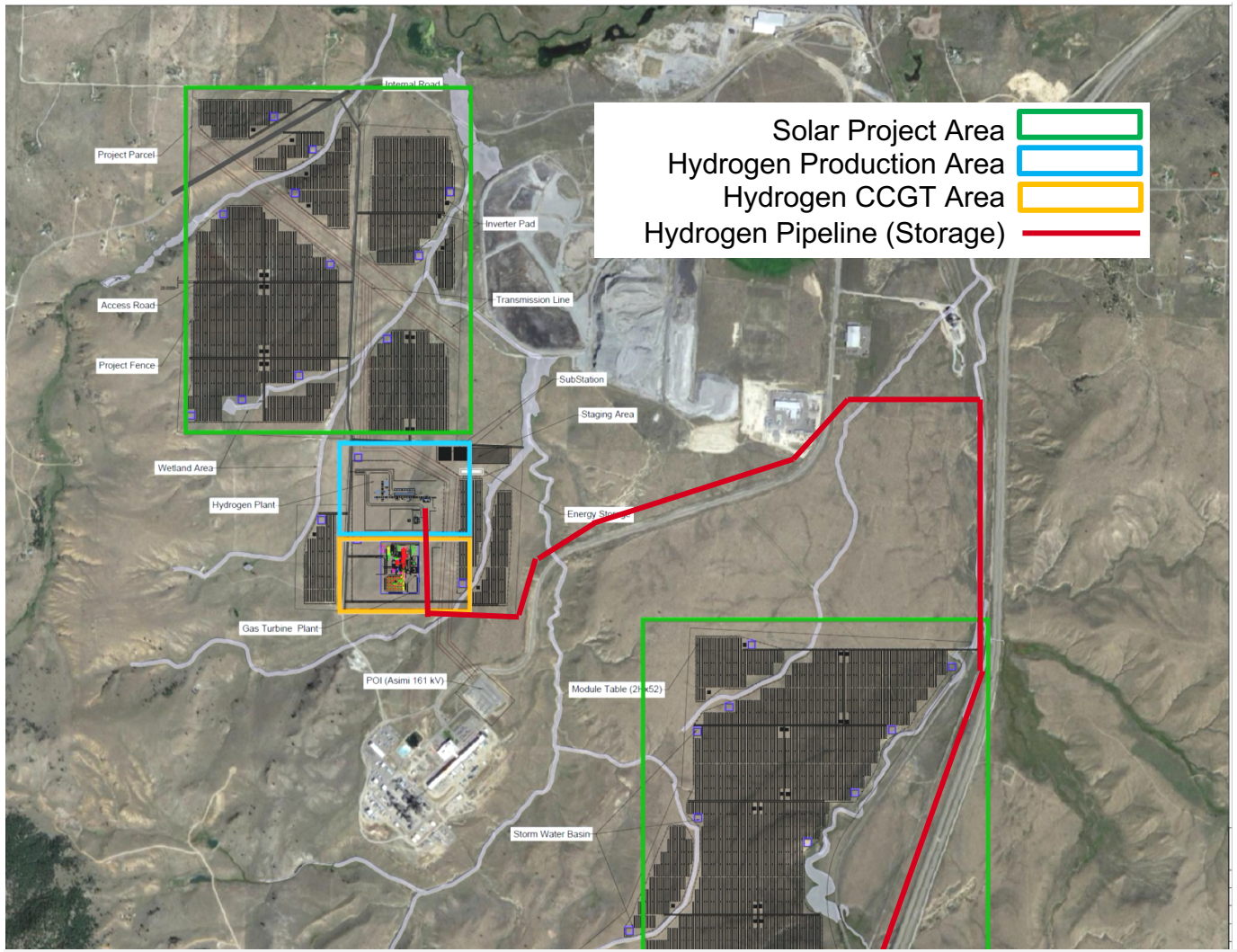
- Colstrip 1 & 2 (716 MW) anticipated to shut down 2022; recent decision made to shut down early - December 2019
- 2025-2030 “financial exits” from Puget Sound/Portland General/Avista/Pacificorp (Unit 3)
- Current NWE IRP shows 200 MW addition per year x4 years
- High Potential for Green Hydrogen Infrastructure

Adjacent Opportunities (Berkeley Pit)

- Former open pit copper mine located in Butte, MT
- Acidic water leaches significant heavy metals to groundwater
- Water treatment plant and polishing plant operate at ~10 MM Gal/day “in perpetuity” to protect Clark Fork of the Columbia watershed
- Potential to leverage as Water Supply for Green H2 Production

Opportunity to support jobs, economic growth, resource adequacy, and overcome historic and future environmental challenges?

Montana Hydrogen Center



Long-term opportunity to…

- Position Montana as national leader in resource adequacy and decarbonization efforts
- Turn an environmental challenge into an environmental opportunity (Berkeley Pit)
- Create H_2 foundation to attract new regional green industries/jobs and demand growth

…while still meeting near-term capacity and energy needs

- Provide affordable and reliable energy to Montana ratepayers
- Improve flexibility of grid with mix of resources
- Reliable & cost effective ‘partial’ gas generation “today” transitioned to 100% green “tomorrow” (Intermountain Power model)

Butte, MT was the hub that electrified the world a century ago…
And now we hope to position the region as a hub to bring green hydrogen to the world today.

Western Green Hydrogen Initiative

WGHI is a public-private partnership to advance and accelerate deployment of green hydrogen infrastructure in the Western region for the benefit of our economies and environment. The WGHI will serve as the steering committee enabling the establishment of a regional green hydrogen strategy to develop a large scale, long-duration, renewable energy storage reserve.

Mitsubishi Momentum for Energy Storage Projects Continues

Advanced Clean Energy Storage & IPA H_2 – Intermountain Power, UT

Johanna BESS
LIB – Hecate, CA
20 MW / 80 MWh

Danskammer
H_2 - Agate Power, NY

Harrison Power
H_2 - EmberClear, OH

Chickahominy Power
H_2 - Balico, VA

Entergy JDA
H_2 and LIB

KCE/ERCOT BESS
LIB – KCE, TX
200 MW / 200 MWh

Mitsubishi Power Snags Hydrogen Integration Contracts for 2 GW of New Gas Power

Three major gas-fired power projects—a total of 2.1 GW—in Eastern competitive markets that are slated to come online between 2023 and 2025 have chosen hydrogen pathways to ensure their long-term viability as states increasingly emphasize energy system decarbonization.

The plants, which represent a total investment of $3 billion, will adopt integrated green hydrogen solution packages developed by Mitsubishi Power, a Japanese power equipment giant known until Sept. 1 as Mitsubishi Hitachi Power Systems (MHPS). The gas-fired projects include: Balico's 1,600-MW Chickahominy Power Project in Virginia; EmberClear's 1,084-MW Harrison Power Project in Cadiz, Ohio; and Danskammer Energy's 600-MW plant in Newburgh, New York.

Mitsubishi Power Launches Hystore, Hydaptive Packages

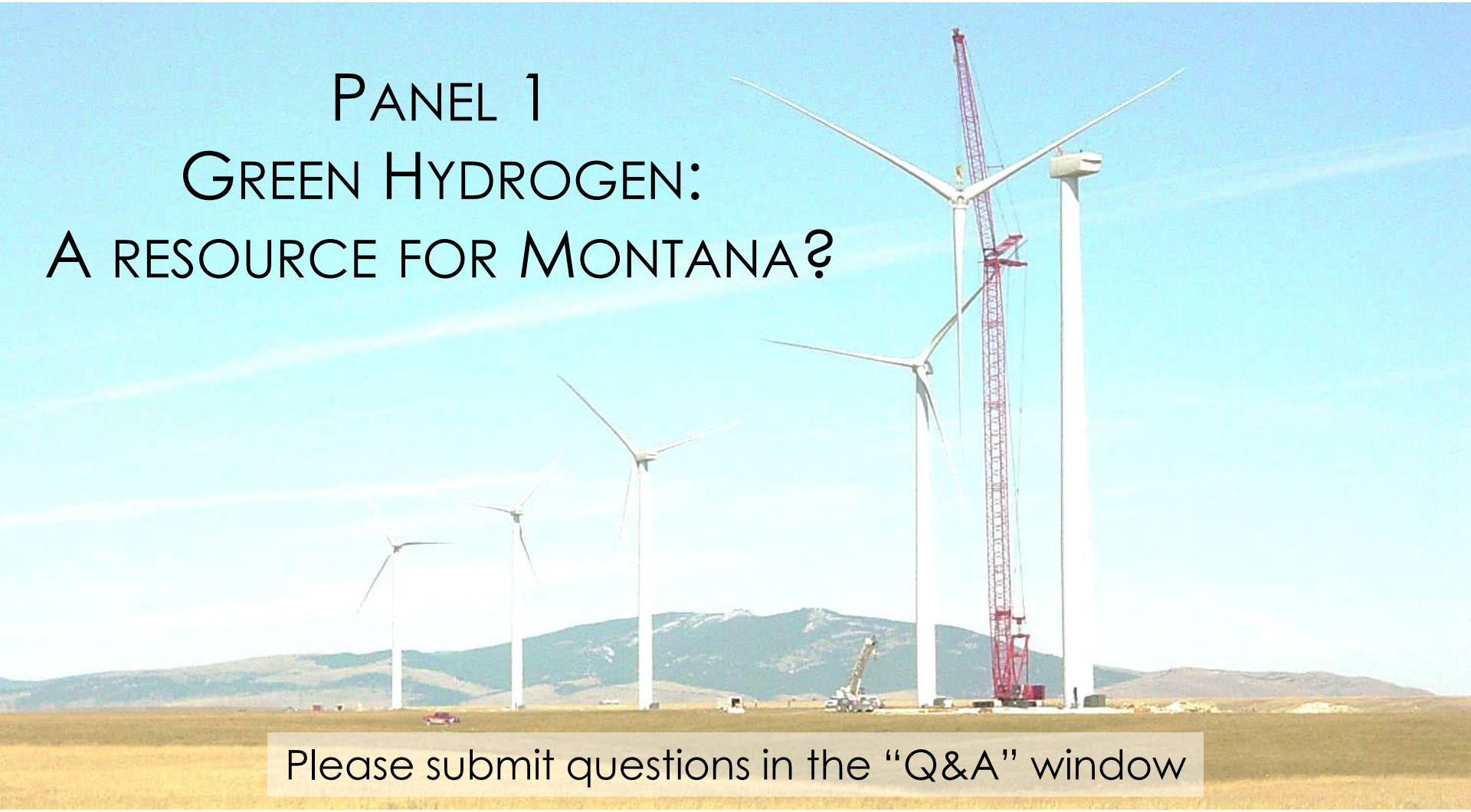
The contracts mark a substantial boost for Mitsubishi Power's foundational "Change in Power" campaign, which takes into account a recently rejiggered business strategy to respond to rapid changes across the power landscape, help its customers combat climate change, and generally "advance human prosperity." But they are just one part of Mitsubishi Power's larger global strategy to leverage hydrogen's potential and cement the company's place in a hydrogen economy, with impacts that could extend far beyond power generation, to the transportation and manufacturing industries, for example.

Entergy Moves Heavily on Hydrogen for Gas Turbines, Nuclear

Entergy Corp., an integrated energy company with a 30-GW power generating fleet, took a bold step toward decarbonization on Sept. 23, announcing it would join forces with Mitsubishi Power to integrate green hydrogen into utility businesses in Arkansas, Louisiana, Mississippi, and Texas.

Entergy will focus on developing hydrogen-capable combined cycle gas turbine (CCGT) facilities and related infrastructure to enable hydrogen production, storage, and transportation. Entergy and Mitsubishi Power also said they would create "nuclear-supplied electrolysis facilities with energy storage," as well as develop utility-scale battery storage systems.

Some of these solutions will integrate Mitsubishi Power's freshly announced standardized hydrogen packages, Hydaptive and Hystore. The Hystore package is inspired by Mitsubishi Power's ongoing projects to outfit the 840-MW Intermountain Power Project (IPP) in Millard County, Utah, with hydrogen-capable turbines, as well as the company's massive Advanced Clean Energy Storage (ACES) project, a project that promises to store up to 1 GW of renewable energy as hydrogen gas (and is strategically located near the new IPP facility). The Hydaptive package is focused on site integration, spanning the electrolyzers to the gas turbines.



Panel 1
Green Hydrogen:
A resource for Montana?

Please submit questions in the "Q&A" window

DEQ
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Panel 2
Innovation in Energy Delivery: Demand Response, Distributed Storage and Energy Efficiency

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Montana Generation and Transmission Working Group

Energy Innovation Panel

December 14, 2020

Montana-Dakota Utilities Co.

Darcy Neigum

Director System Operations & Planning

In the Community to Serve®

Utility Resource Planning

1. Economically and reliably meet customer peak demand requirements plus planning reserve margin

2. Economically and reliably meet customer hourly energy supply needs

Peak Demand Requirements

- Dependable generation output at time of peak system demand
  - Dispatchable generation available at time of peak
  - Expected generation from intermittent sources at time of peak
- Customer load reduction programs
  - Reduce peak demand requirement (net of load) or supply-side resource
  - Compensate customers to reduce load during event or peak demand conditions versus building new generation or purchasing capacity from another utility

Demand Response

- Historically only direct contract customers
- Customer owned on-site standby generation
- Customer may have been responsible to supply fuel when called upon to run on-site generation and curtail load
- Customer may have had an hourly limit per year for participation
- Customer may have been assessed a penalty for non-participation during an event
- Customers received reduced utility service rate for participating under an interruptible tariff service rate

Commercial and Industrial Customer Demand Response Programs

- Direct Interruptible Customer Program
  - Larger customers with standby generators
  - Tariff rate service in Montana – MDU Rate 38
- Commercial Demand Response Program
  - Power Purchase Agreement (PPA) with demand response aggregator
  - Target load only customers or customers with small standby generators

Commercial and Industrial Demand Response Program Aggregator

- Meet requirements of a designated capacity resource (set by capacity sharing group)
- Customer load participation requirements
  - Non-residential customers with load greater than 50 kW (MDU requirement)
  - Up to 4-hour load reduction event within 24-hour period
  - 1-hour event notice
  - 50 hours of service interruptions per year
  - Must participate in seasonal test events

Commercial and Industrial Demand Response Program Aggregator

- Responsible for signing and contracting with customers in program
- Power Purchase Agreement with utility
  - Fixed demand rate ($/kW) to be available to interrupt load during event
  - Energy rate ($/kWh) to cover cost of lost business opportunities during event
  - 30% of dollars received under the PPA stay with the aggregator as an administrative service fee
  - 70% of the dollars go to participating customers

Commercial and Industrial Program Aggregator

- Develop potential studies and load reduction plans for customers (lighting, HVAC, standby generator, other interruptible load)
- Work with customers to understand their responsibilities of being in program
- MDU provides one notice to start and stop events and aggregator makes all the participating customer contacts
- Aggregator responsible for all the customer contracts and billing
- MDU works with aggregator to develop potential customer lists and marketing materials

Commercial and Industrial Program

- Initial program targeted to reach 25 MW
- Loads participating in program:
  - Schools
  - Hospitals
  - Nursing homes
  - Banks
  - Jails
  - Oil field loads
  - Industrial process customers

Commercial and Industrial Program Aggregator

- Achieved original 25 MW goal
- Expanding program by another potential 25 MWs
- Designing ways for smaller customers to participate
  - Metering equipment costs covered by program versus coming out of customer proceeds

Demand Response Program Performance

- Currently 7.5 percent of MDU customer peak demand requirements come from customer demand response programs
- Potential to achieve 10 percent of MDU customer peak demand requirements by demand response programs

Residential Customer Programs

- Interruptible residential load programs associated with:
  - Electric space heat
  - Electric hot water heaters
  - Air conditioner cycling (studying)
- Involve timers or physical program control devices for interruption

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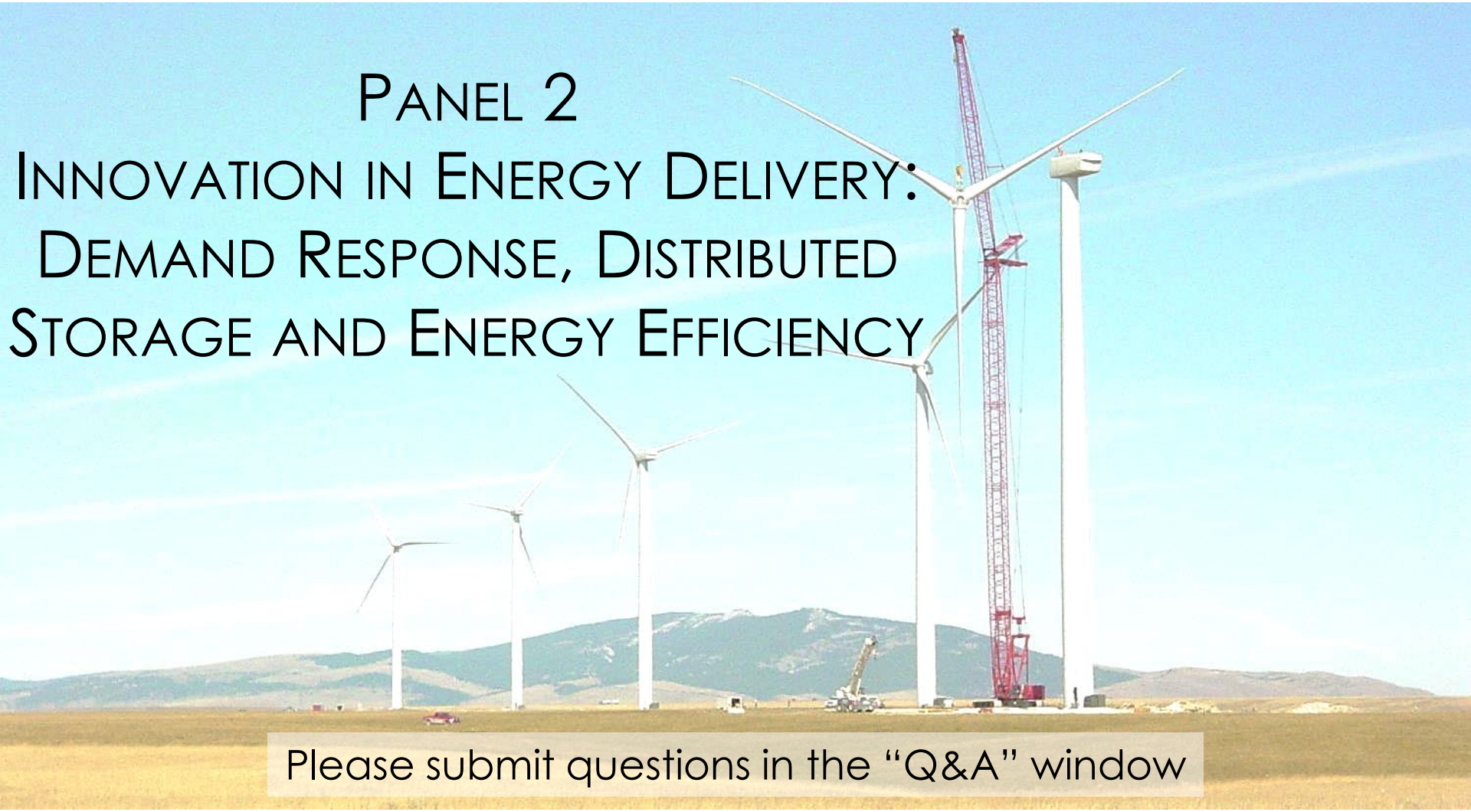

Panel 2
Innovation in Energy Delivery: Demand Response, Distributed Storage and Energy Efficiency

Please submit questions in the "Q&A" window

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DEQ - NWE Innovation Slides

NorthWestern® Energy

Delivering a Bright Future

Journey Map v2.0

The Grid's Digital Transformation

NorthWestern® Energy

Delivering a Bright Future

Data, Data, Data with STANDARD PROCESS TO ANALYZE

Actionable Data Utilization
Historical Data Capture

Available Data
Metering, Maintenance, Growth, Assets, Service Orders, Calls, Etc.

EVOLVE BUSINESS MODEL

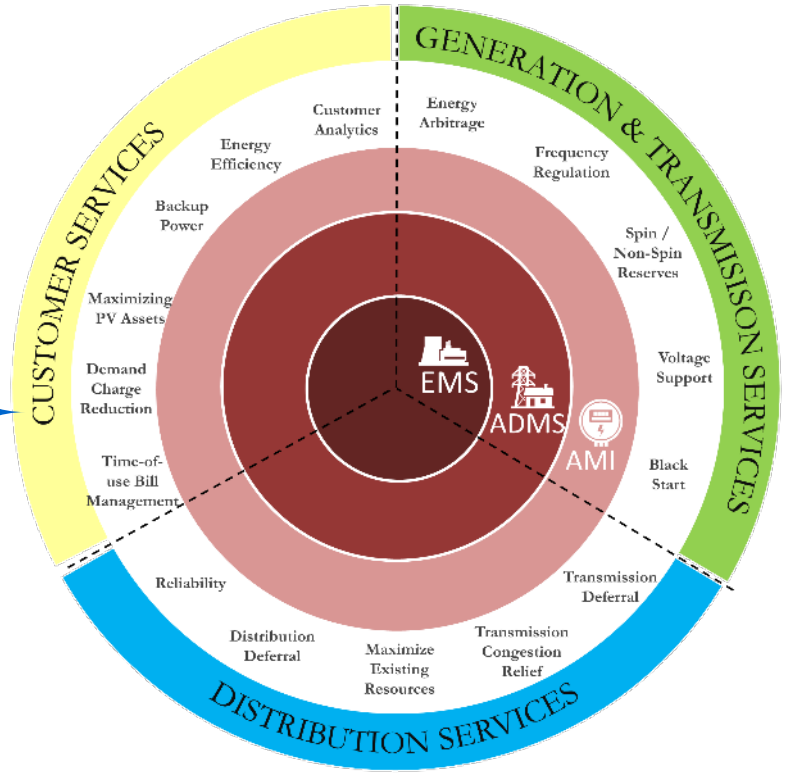
Opportunities

1. Changing Customer Expectations
2. Renewables
3. Distributed Energy Resources
4. Energy Storage
5. Environmental Stewardship

ADD VALUE STREAMS

- Reliability
- Distribution Deferrals
- Maximize Existing Assets
- Distributed Generation
- Customer Experience
- Carbon Neutral Generation
- Billing Options
- Energy Arbitrage

Accomplishments 2020	Plans 2024	Future
• Mobile Work Force Management (MWM) • Advanced Distribution Management System (ADMS) • SD/NE Advanced Meter Infrastructure (AMI) • Distribution Operations Center (DOC) • Distribution Equipment is Automation Ready • Smart Switch Program • Missoula Educational Solar Pilot Project • Bozeman Community Solar Pilot Project • West Thumb • Smart Grid Demonstration Project	**System Efficiencies:** • ADMS Enhancements: FLISR, DER Integration **Operational efficiencies:** • DOC transitions to control • Montana AMI **Customer Experience** • Customer Portals • Smart Apps **Actionable Data** • Internal KPI's • Predictive analytics • Enterprise connectivity	**New Technology** • EV Charging • Microgrid Management System (MGMS) • Advanced DER Integration • Smart Cities **Customer Experience** • Advanced Apps & Controls • Predictive analytics (i.e. customer bills) • Home Area Network • Customized solutions, etc. **Data Sharing** • Multitenant solutions • Transactive Controls

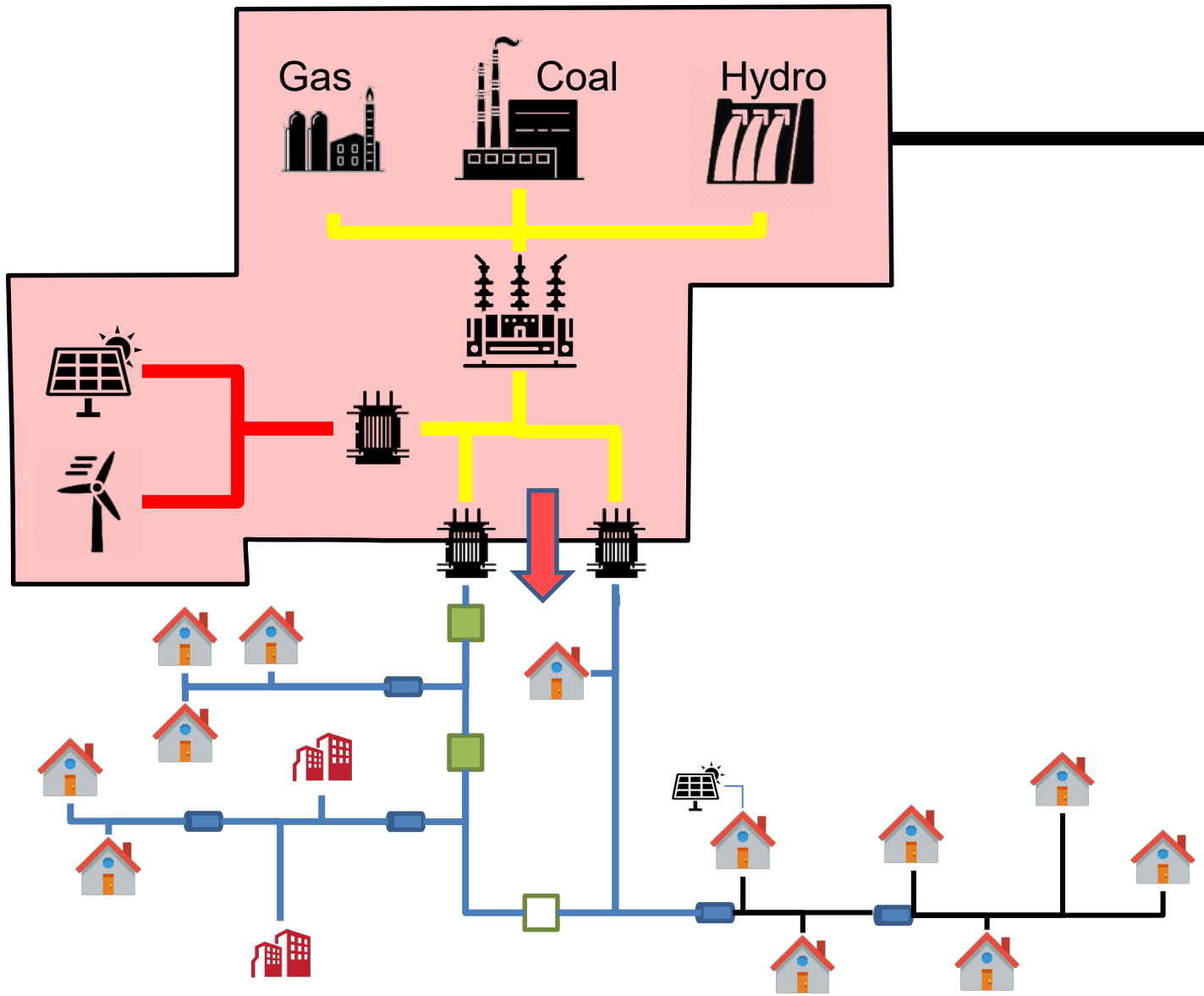


VISION: Turning risks into opportunities by evolving the business & adding new value streams.

Requires transitioning the internal culture from a utility mindset to one of innovation & creativity.

Foundational Systems

Today's Energy System – Control supply to meet load



Energy Management System

- Single Control System for transmission
- 1-way energy flow to distribution system

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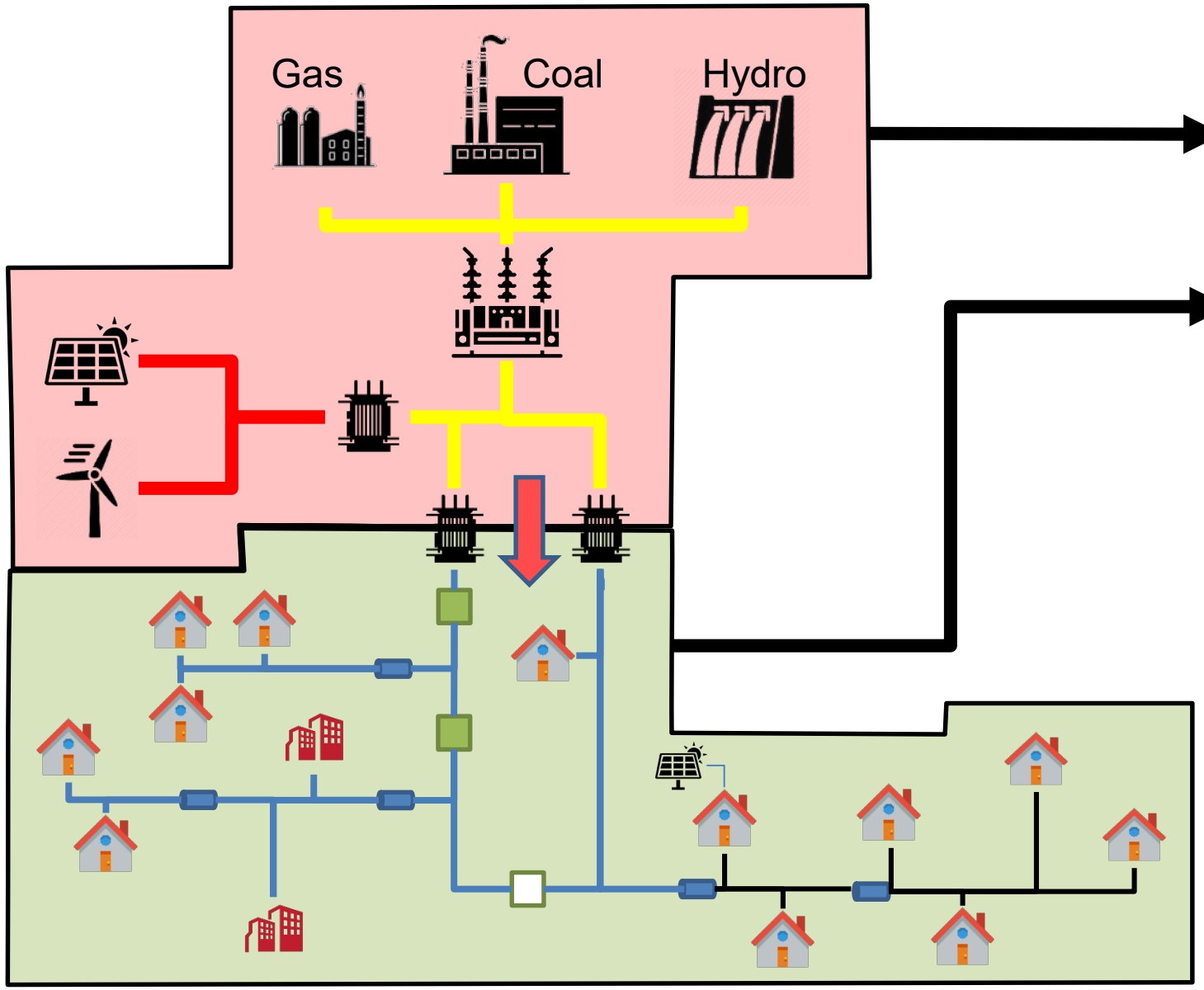
Today's New Foundation (EMS, ADMS, AMI)



Energy Management System

Control Supply to Meet Load

Advanced Distribution Management System

Enhanced Customer Experience

Provide Situational Awareness

- Communication to substations and distribution switches/devices.
- Real time power flow model.
- AMI Data Integration
  - Outage
  - Demand (KW)
  - Energy (kWh)
  - Voltage

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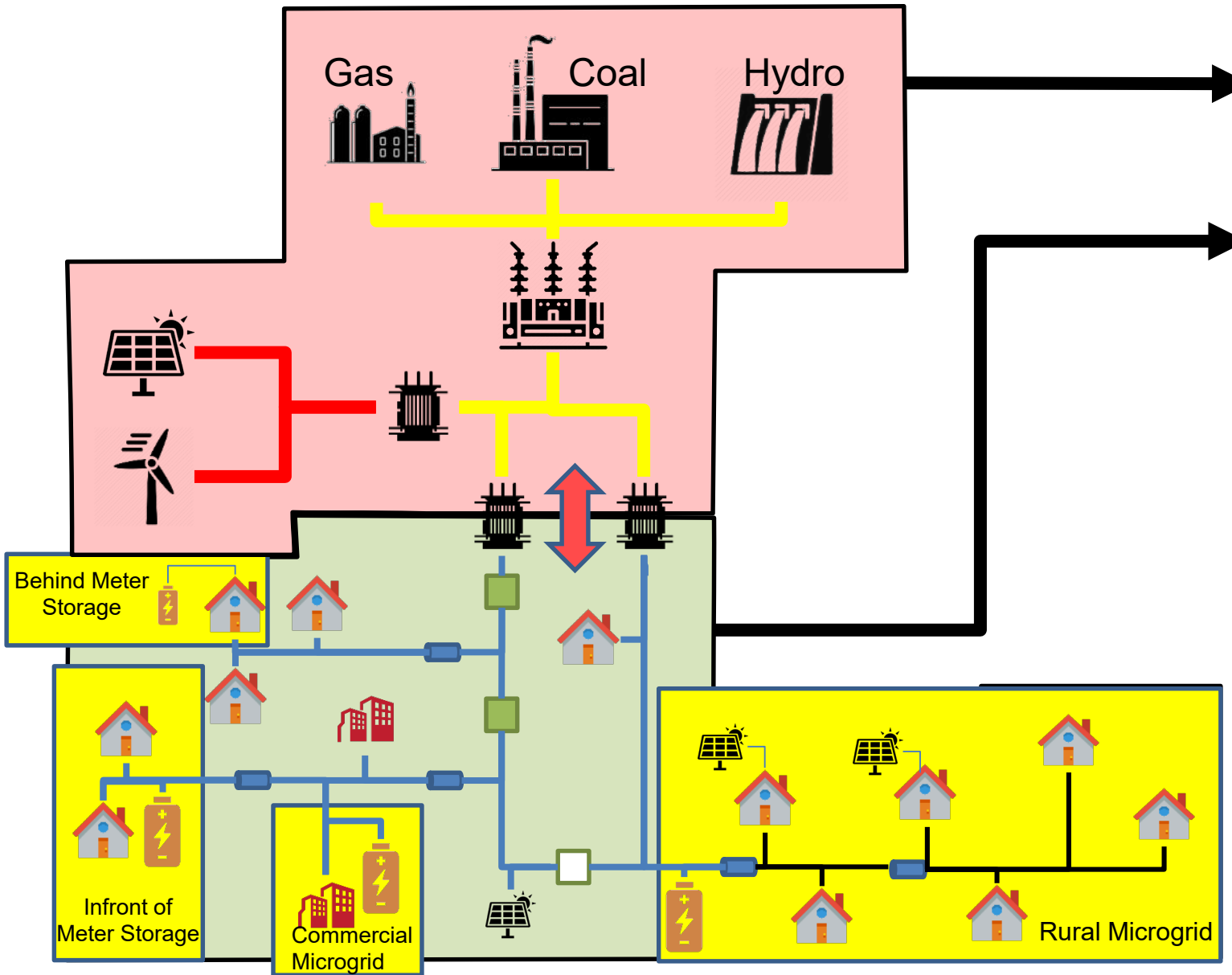
The Possibilities – Control Load to Match Supply



Energy Management System

Adjust supply and load to meet needs

Advanced Distribution Management System

Enhanced Customer Experience

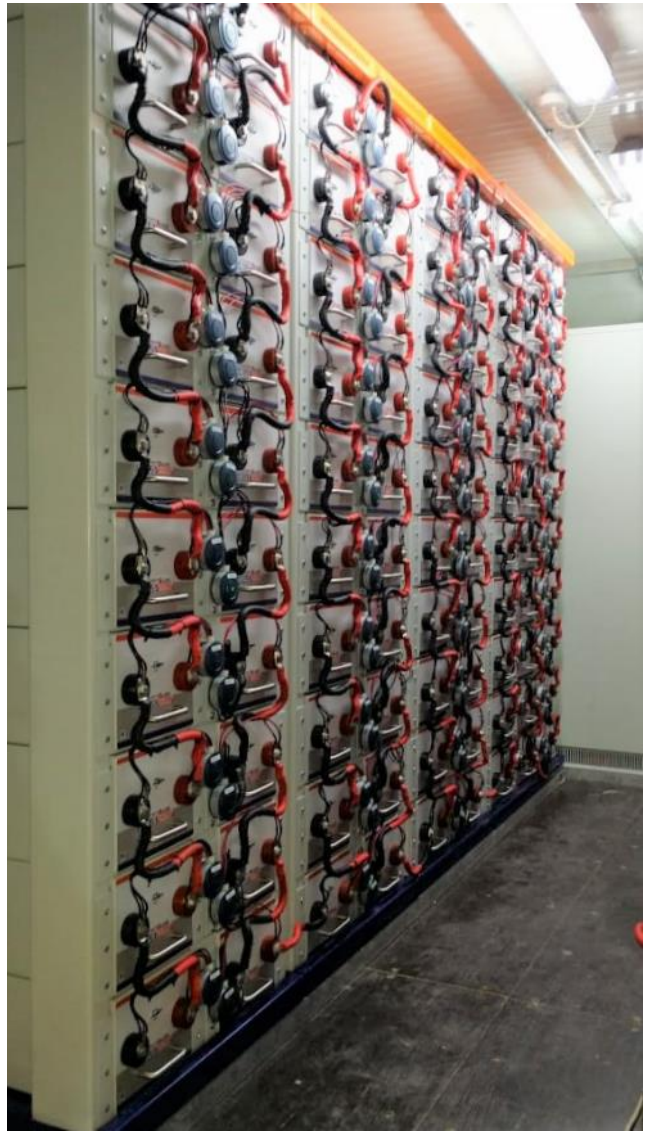
Provide Situational Awareness & Controls

- ***Energy Storage –***
  - ***Increase Reliability***
  - ***Localized Support***
  - ***System Support***
- ***FLISR – Increase Reliability***
- ***Demand Response – Adjust Loads***
- ***Volt Var Optimization – Adjust Loads***

AMI

- ***Align rates to system impacts***
- ***Provide Outage Informaton***
- ***Provide Voltage information***

Standalone Energy Storage



- Increase reliability
- Resolve localized issues
  - Local voltage support
  - Reduce local peak
  - Balance onsite renewable energy

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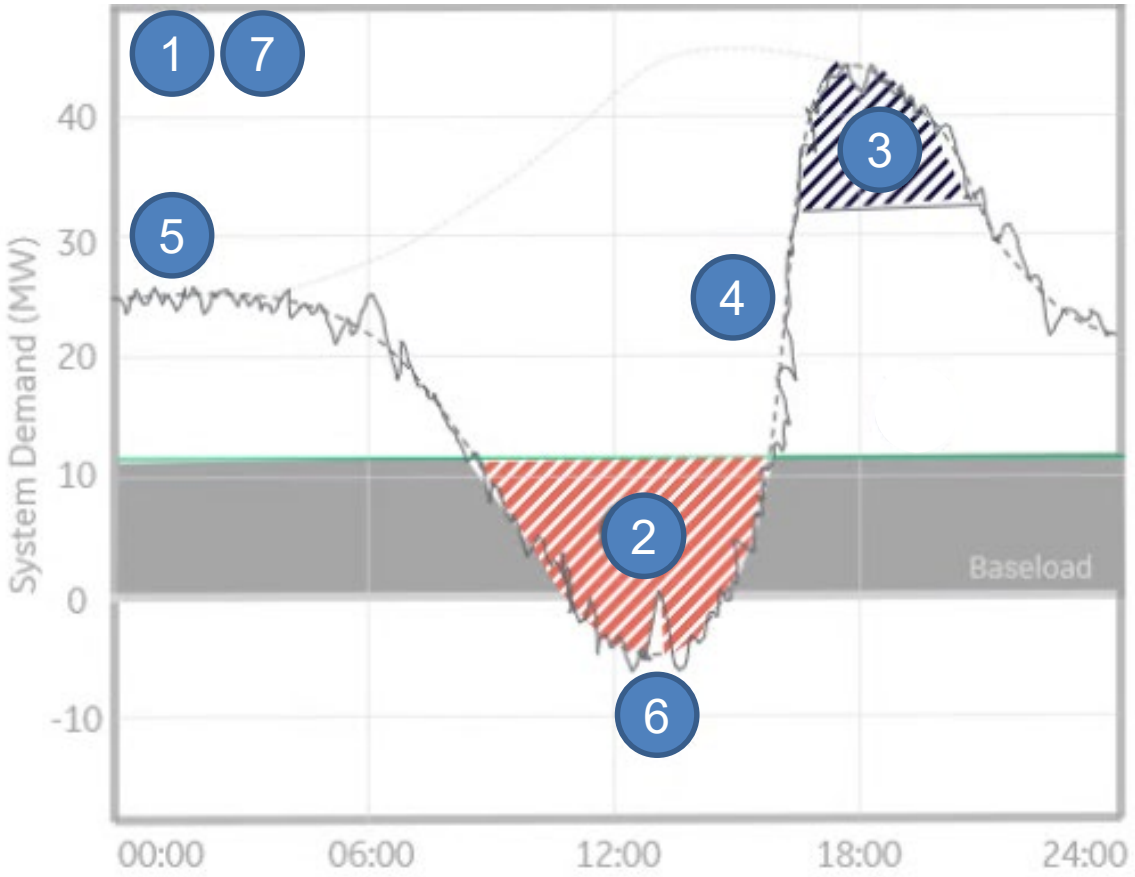
Aggregated Energy Storage (future)

Energy Storage is a unique asset that provides Reliability and Flexibility in the grid.



1. **Reliability**
   4 hours of backup power
2. **Absorb Renewable Energy**
   Manage constant baseload generation
3. **Manage Peak Loads**
   Shift daily peak loads
4. **Fast Ramping**
   Respond to intermittent generation dynamics
5. **Frequency Response**
   Real-time frequency control
6. **Spinning Reserves**
   Dynamic Response to events (wind/clouds)
7. **Reduce Emissions**
   Maximize efficiency of fossil fuel generation

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Putting Data to Use/ Rural Reliability

NorthWestern Energy Distribution System Journey

Stabilize

Proactive Programs to re-establish healthy asset profile

Identify system performance metrics

Modernize

Communication platform to enable technology implementation

Enhanced data collection process (InService, DOC, Smart Switches)

Analyze

Putting data to work utilizing dynamic dashboards

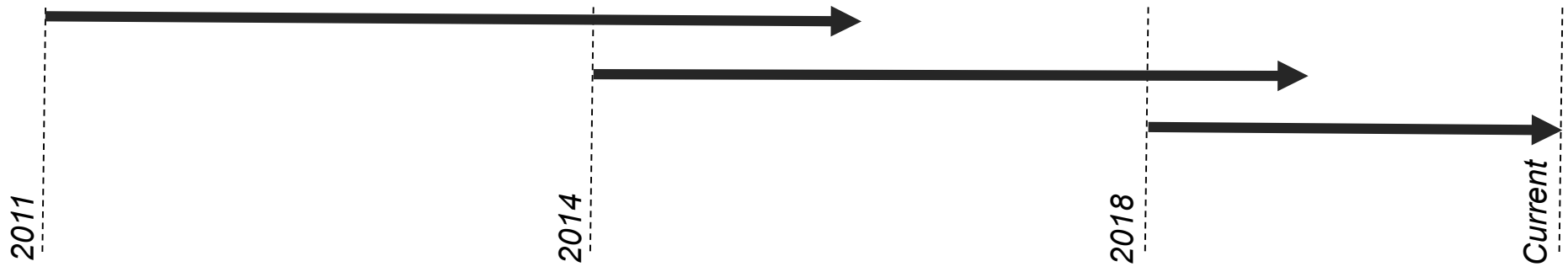
Re-evaluate system performance metrics

Optimize

Enhancing Customer Experience by setting up system to say "yes"

Achieve system performance metrics

Targeted technology solutions based on advanced data analytics



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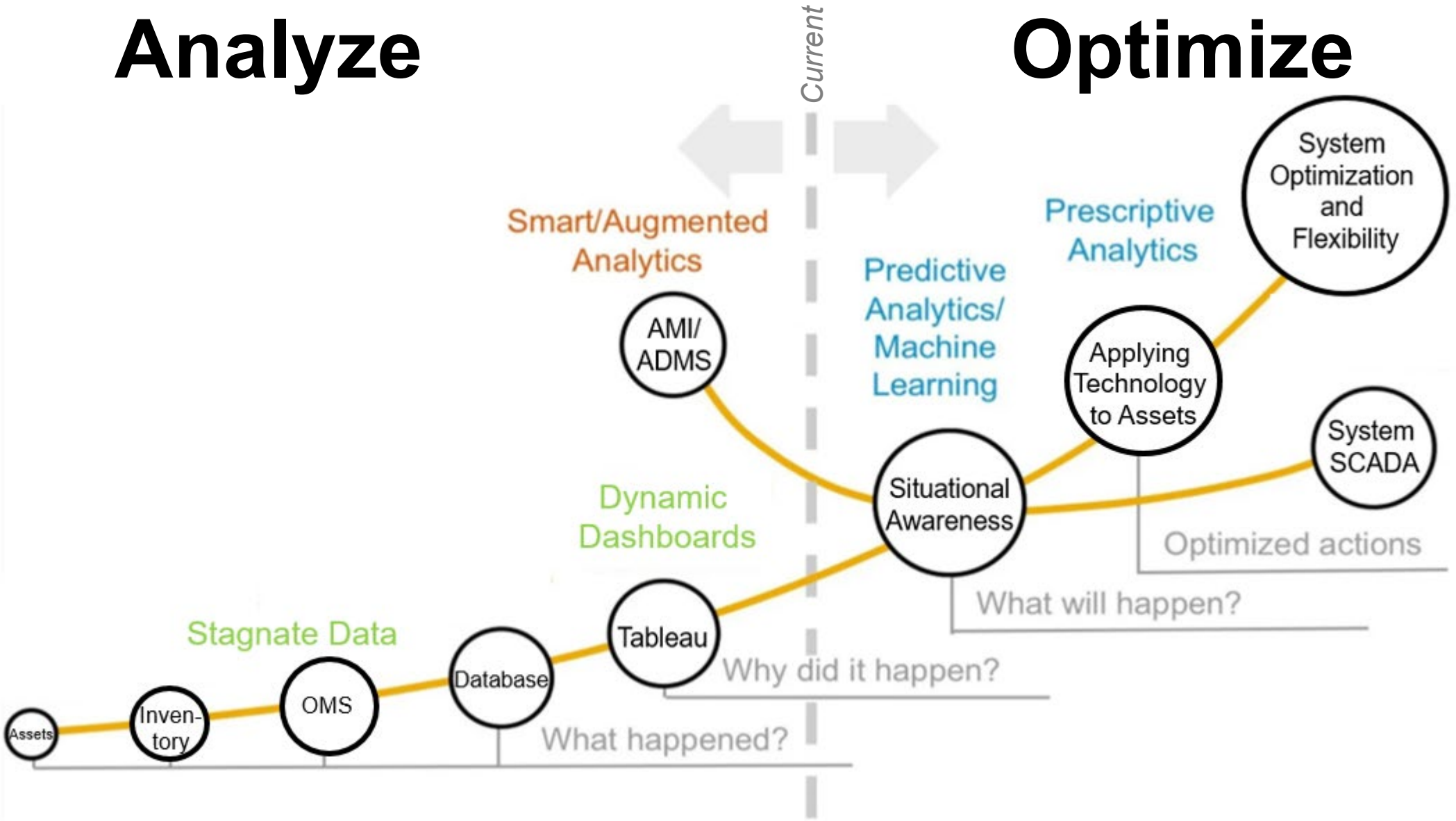
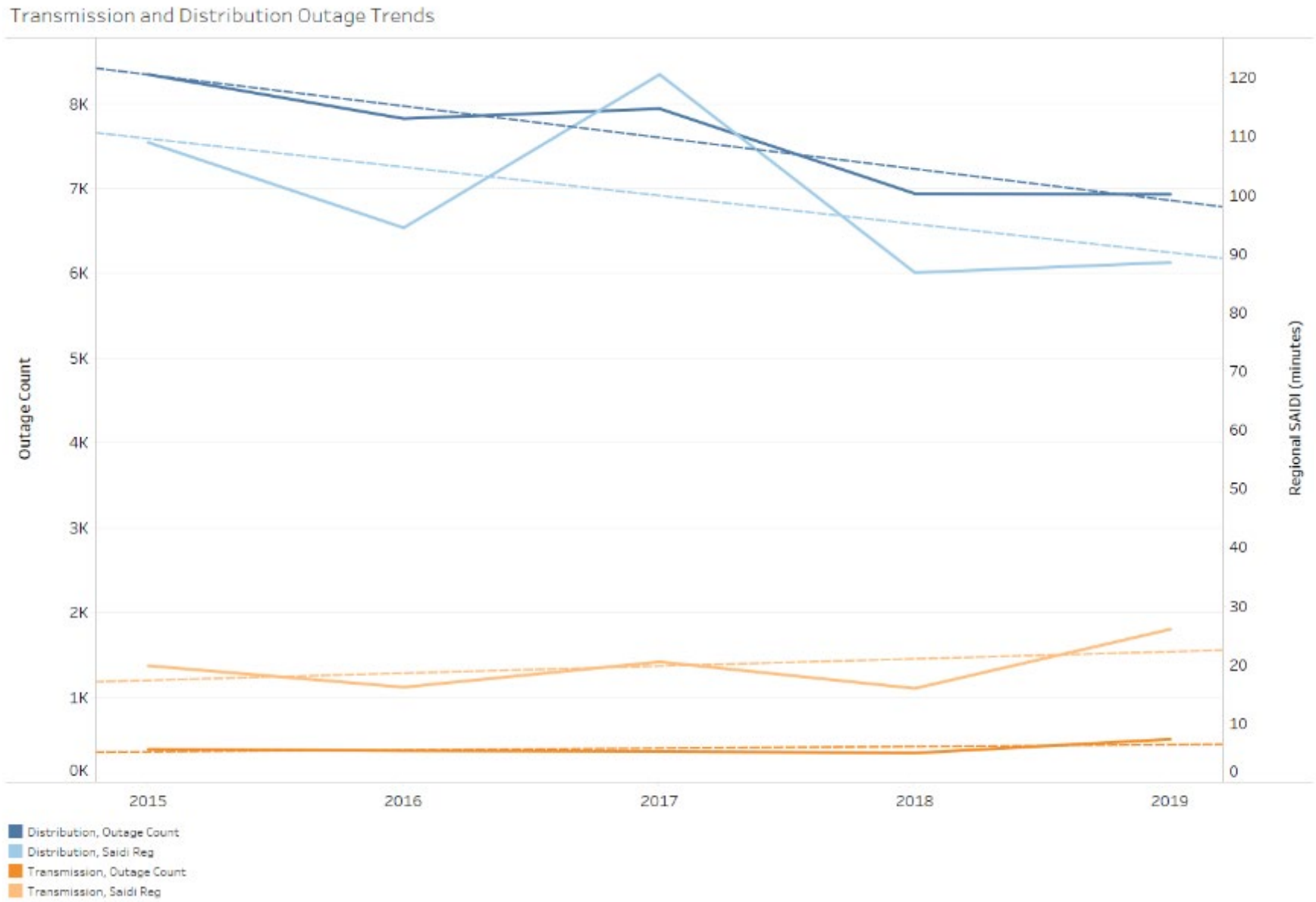
System Platform to Enable Advanced Analytics



Monitoring System Reliability: T&D



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Distributed Energy Resource Value Streams: Distribution Perspective

Improved Distribution Reliability

- Increased Customer Satisfaction
- Reduced Restoration Expense

Deferral of Traditional Capacity Solutions

- Peak Shaving
- Demand Response
- Managing Load Profiles

System Support

- Power Quality (Voltage Support, Network Losses, etc)
- Locational Value

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Determining DER Candidates: Putting Data to Work

Value Dashboard

NorthWestern Energy

Circuit: (All)

B/C: 0.90 – 5.03

Ckt SAIDI 3 Yr Avg: 200 – 6,335

Circuit Customer Count: 50 – 3,649

Estimated Feeder Load (MVA): 0.00 – 5.00

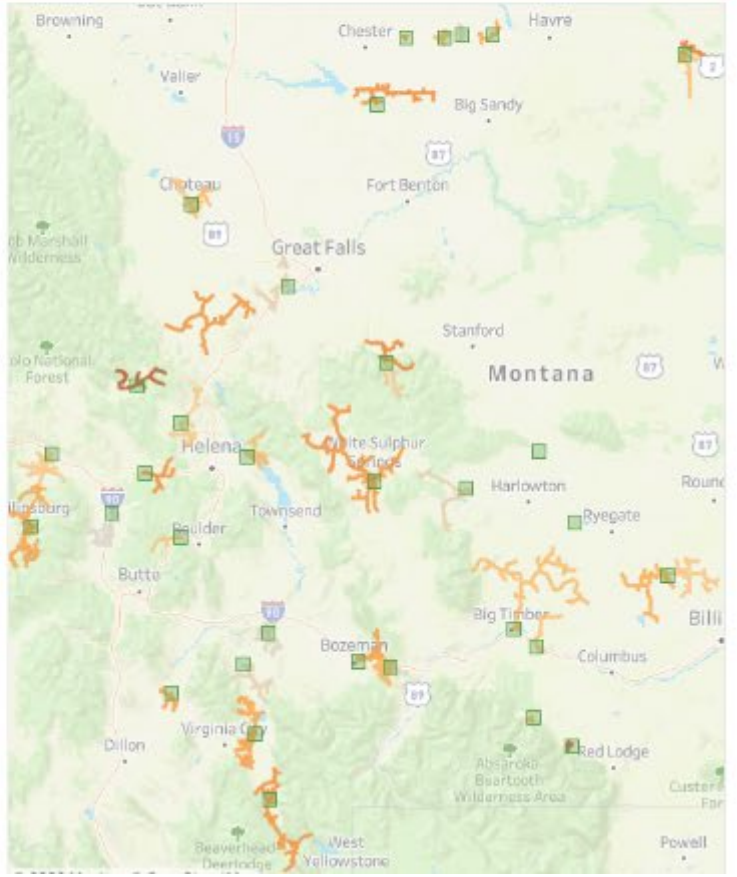
DER Life (Years): 20

DER Cost $/kW: $1,000

System Support $/kW: $200

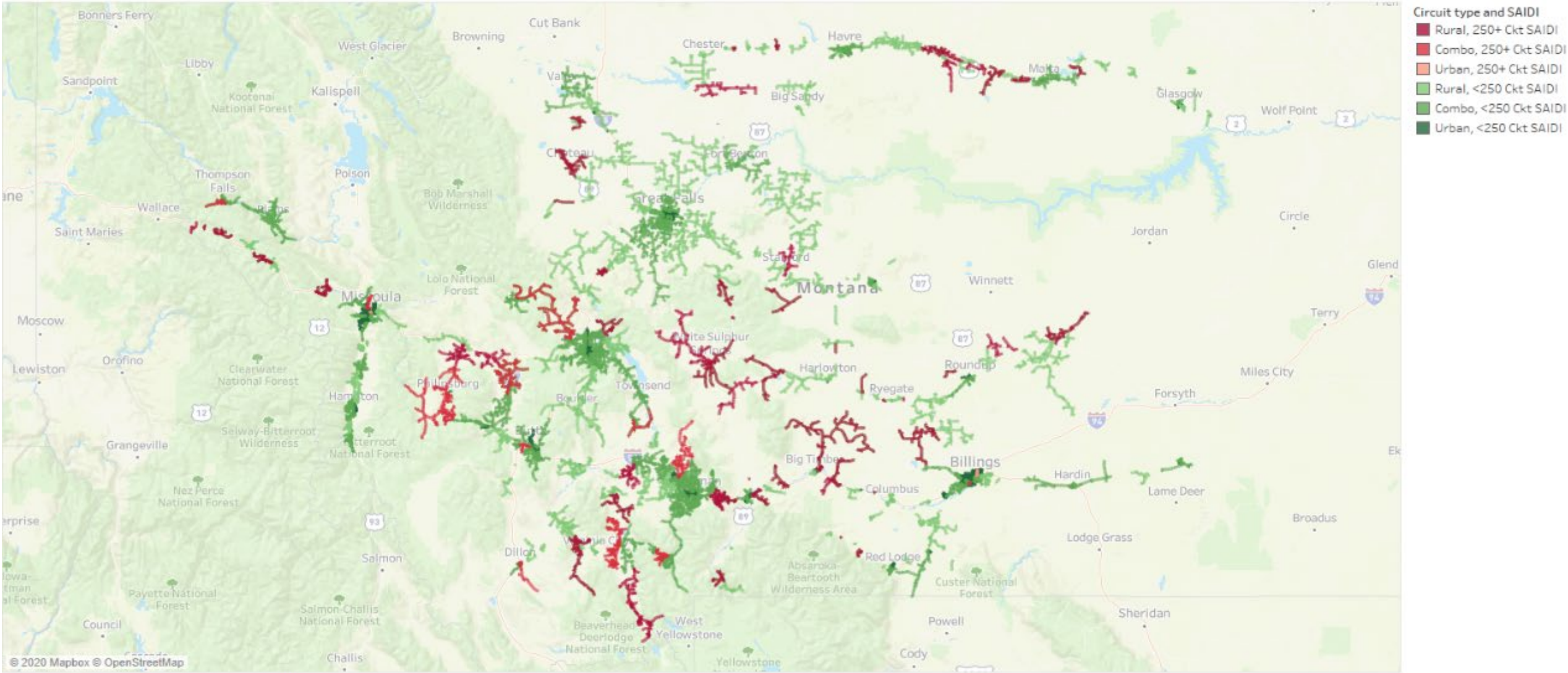
Percent Reduction in Restoration Cost: 0.5

			Ckt Customer Count	Ckt SAIDI (3 Yr Avg)	Sys SAIDI (3 Yr Avg)	Estimated Feeder Load (MVA)	DER Size (MVA)	Reliability T + D Value	Capacity Value	System Support Value	Cost	Benefit/..	Total Weighted Score (T)	Total Weighted Score (D)
MISSOULA INDUSTRIAL 46	MISSOULA INDUSTRIAL	Combo	537	313	0.404	2.94	3.000	1,521,362	9,387,000	600,000	$3,000,000	3.84	51	63
ELLISTON 1	ELLISTON	Rural	152	274	0.096	0.45	0.500	532,888	1,117,500	100,000	$500,000	3.50	57	66
LANDERS FORK 2	LANDERS FORK	Combo	101	685	0.167	0.20	0.250	772,663	0	50,000	$250,000	3.29	49	62
EAST ROSEBUD 1	EAST ROSEBUD	Rural	96	503	0.116	0.32	0.500	379,690	1,117,500	100,000	$500,000	3.19	68	40
HARLEM CITY 2	HARLEM CITY	Rural	57	423	0.058	0.23	0.250	502,532	0	50,000	$250,000	2.21	64	58
MONARCH 1	MONARCH	Rural	158	213	0.082	0.40	0.500	998,984	0	100,000	$500,000	2.20	58	51
ELLISTON 2	ELLISTON	Rural	274	247	0.164	0.81	1.000	729,255	1,117,500	200,000	$1,000,000	2.05	49	62
CIRCLE BRIDGE 1	CIRCLE BRIDGE	Rural	90	456	0.098	0.79	1.000	725,786	1,117,500	200,000	$1,000,000	2.04	67	62
MADISON VALLEY 1	MADISON VALLEY	Rural	84	373	0.076	0.35	0.500	397,877	495,142	100,000	$500,000	1.99	54	52
WHITE SULPHUR SPRING..	WHITE SULPHUR SPRINGS	Rural	497	477	0.570	2.18	3.000	2,996,339	2,235,000	600,000	$3,000,000	1.94	65	66
MISSION 2	MISSION	Rural	108	240	0.062	0.44	0.500	869,279	0	100,000	$500,000	1.94	55	58
MADISON VALLEY 2	MADISON VALLEY	Rural	450	580	0.620	1.89	2.000	2,338,381	1,117,500	400,000	$2,000,000	1.93	64	60
WHITE SULPHUR SPRING..	WHITE SULPHUR SPRINGS	Rural	674	349	0.565	2.96	3.000	2,703,794	2,235,000	600,000	$3,000,000	1.85	63	64
INVERNESS 1	INVERNESS	Rural	62	467	0.069	0.14	0.250	392,148	0	50,000	$250,000	1.77	79	50
ENNIS CITY 1	ENNIS CITY	Combo	838	423	0.856	3.17	4.000	2,640,823	3,559,581	800,000	$4,000,000	1.75	38	56
TWIN BRIDGES 12	TWIN BRIDGES	Rural	150	207	0.074	0.46	0.500	774,391	0	100,000	$500,000	1.75	58	67
CIRCLE BRIDGE 2	CIRCLE BRIDGE	Rural	59	402	0.057	0.52	1.000	415,379	1,117,500	200,000	$1,000,000	1.73	69	54
BOZEMAN EAST GALLATI..	BOZEMAN EAST GALLATIN	Combo	962	228	0.531	4.69	5.000	2,037,448	5,587,500	1,000,000	$5,000,000	1.72	45	61
FORT BELKNAP 1	FORT BELKNAP	Rural	218	234	0.123	0.92	1.000	401,224	1,117,500	200,000	$1,000,000	1.72	75	62
PHILIPSBURG 3	PHILIPSBURG	Combo	1,303	281	0.883	2.25	3.000	4,460,064	0	600,000	$3,000,000	1.69	25	43
ENNIS CITY 3	ENNIS CITY	Combo	539	370	0.481	2.04	3.000	1,711,643	2,669,686	600,000	$3,000,000	1.66	38	54
PHILIPSBURG 5	PHILIPSBURG	Combo	358	460	0.402	0.62	1.000	1,449,294	0	200,000	$1,000,000	1.65	21	39
KREMLIN 1	KREMLIN	Rural	106	207	0.053	0.23	0.250	340,742	0	50,000	$250,000	1.56	70	58
BROADVIEW CITY 2	BROADVIEW CITY	Rural	229	444	0.243	0.84	1.000	1,319,634	0	200,000	$1,000,000	1.52	52	59
BUFFALO JUMP 1	BUFFALO JUMP	Rural	53	243	0.031	0.10	0.125	163,547	0	25,000	$125,000	1.51	57	63
DODSON 3	DODSON	Rural	77	396	0.073	0.28	0.500	642,625	0	100,000	$500,000	1.49	65	44
HINGHAM 1	HINGHAM	Rural	175	246	0.104	0.72	1.000	468,459	758,179	200,000	$1,000,000	1.43	56	36
MUIR 1	MUIR	Rural	485	553	0.646	2.09	3.000	2,790,326	819,058	600,000	$3,000,000	1.40	62	65



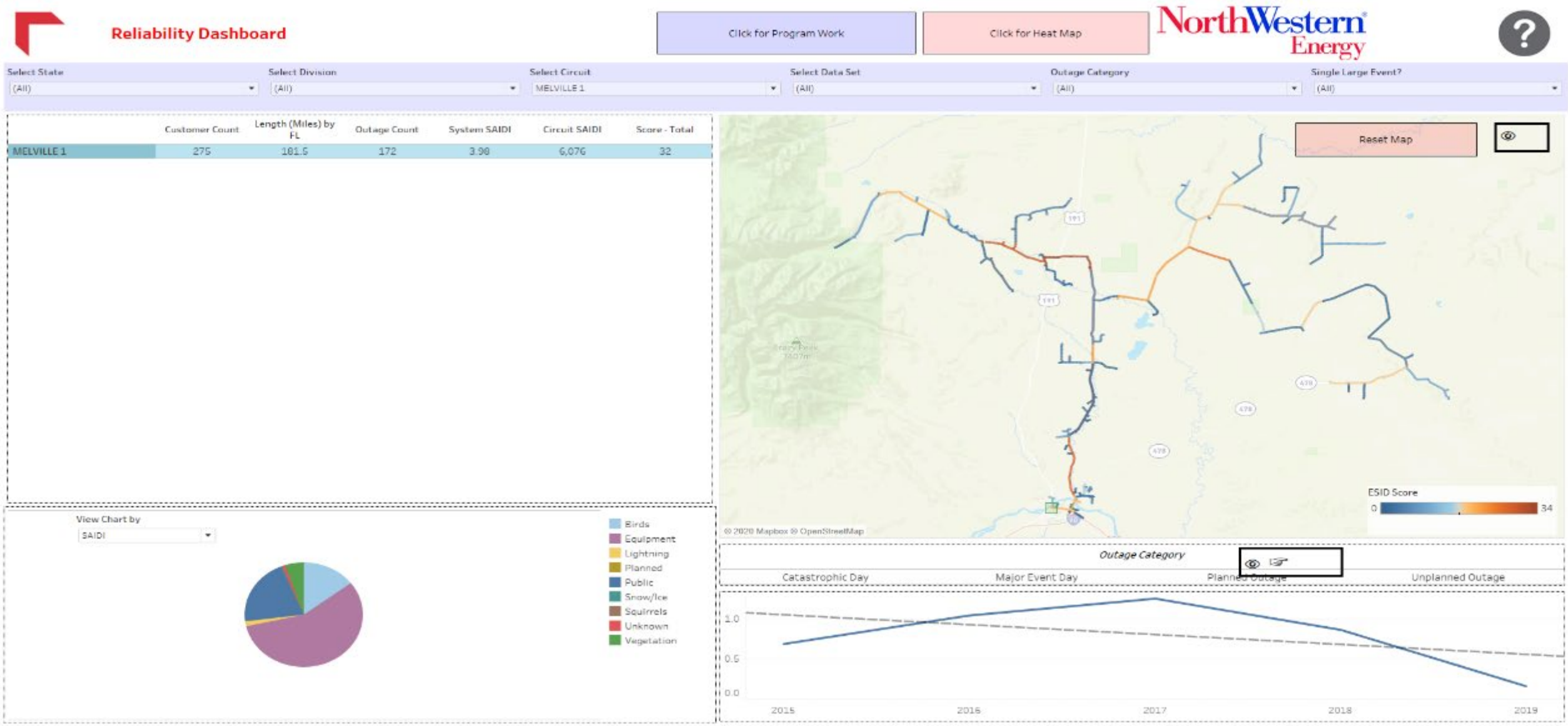
Rural Reliability Focused

MT Circuit Reliability Overview



Northwestern Energy Montana Distribution circuits colored by 3-year Average Circuit SAIDI (2017-2019) and Customer Type. Excludes Catastrophic Days, Major Event Days and Planned Outages. Includes all Transmission and Distribution Unplanned Outages.

Utilizing Data for Value Driven Placement

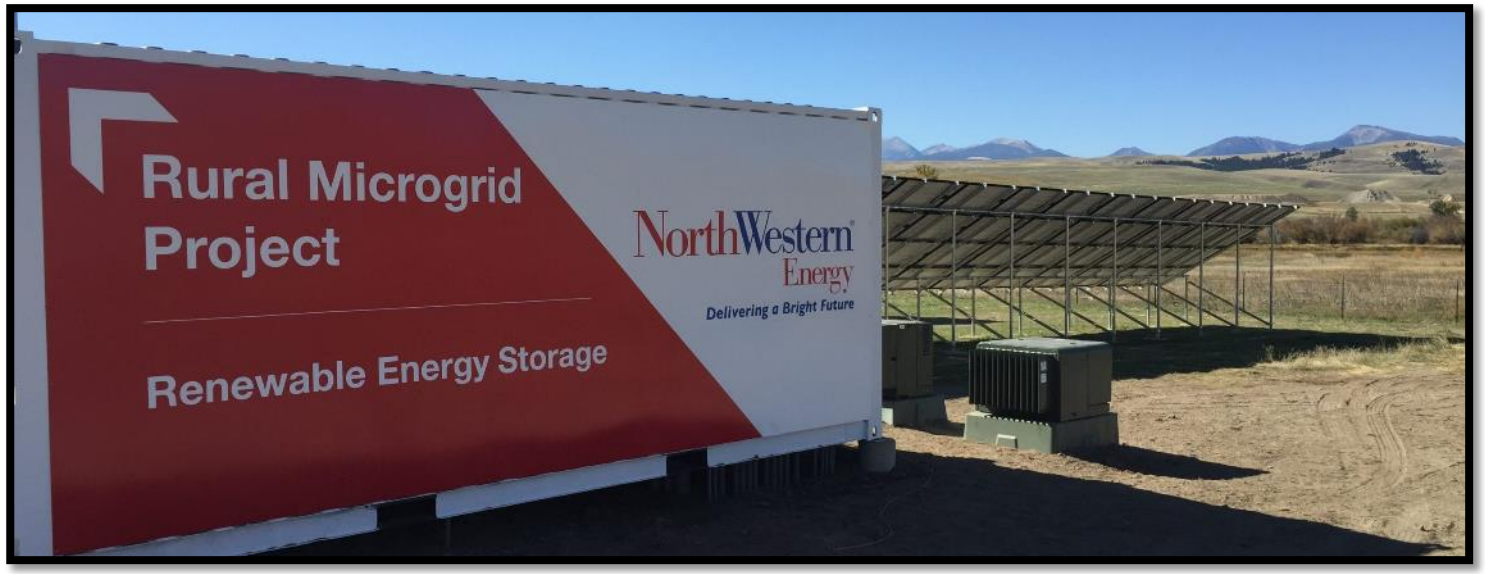


Projects

Existing Pilot – Beck Hill (Rural Reliability Application)

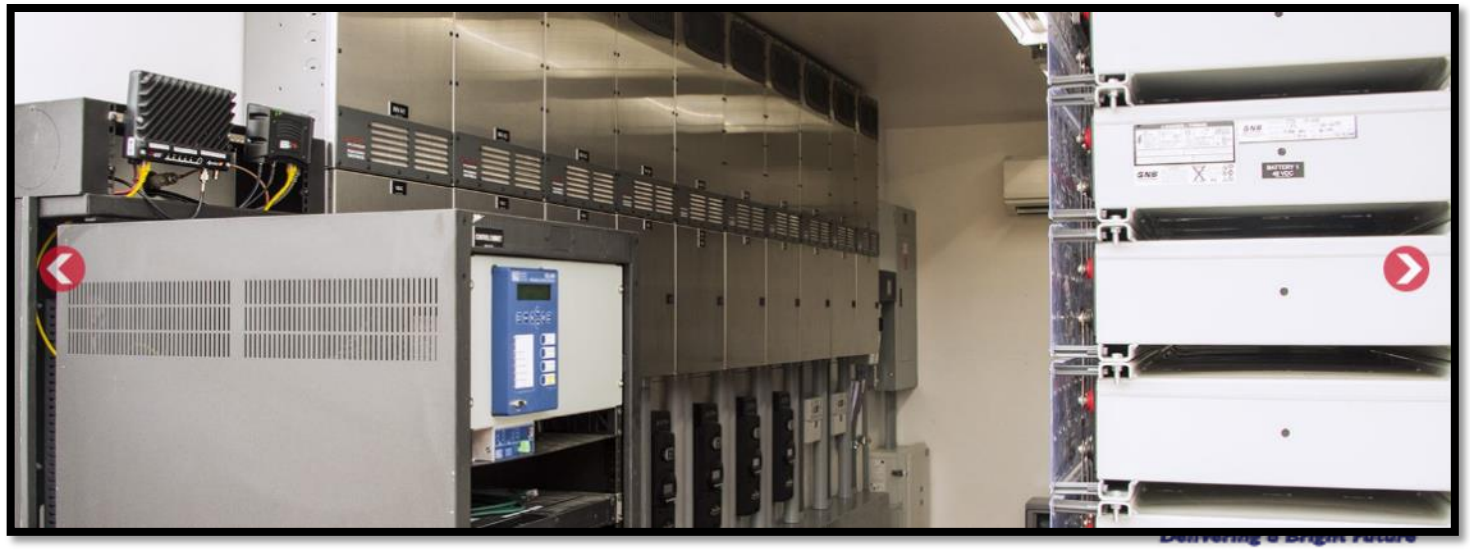
Beck Hill Microgrid small pilot:

- Installed 2015
- 80 KW / 200 kWh
- Serves 18 Customers
- Automatically operates during outages
- Operated 12 times
- Powered customers for over 4 hours during outages



Potential New Applications (up to 3MW):

- Twin Bridges, MT
- White Sulphur Springs, MT
- 320 Guest Ranch, MT
- Blunt, SD



Other Potential Storage Projects

- Bechler Ranger Station, WY
- Helena Pilot

Other Community Pilot Projects

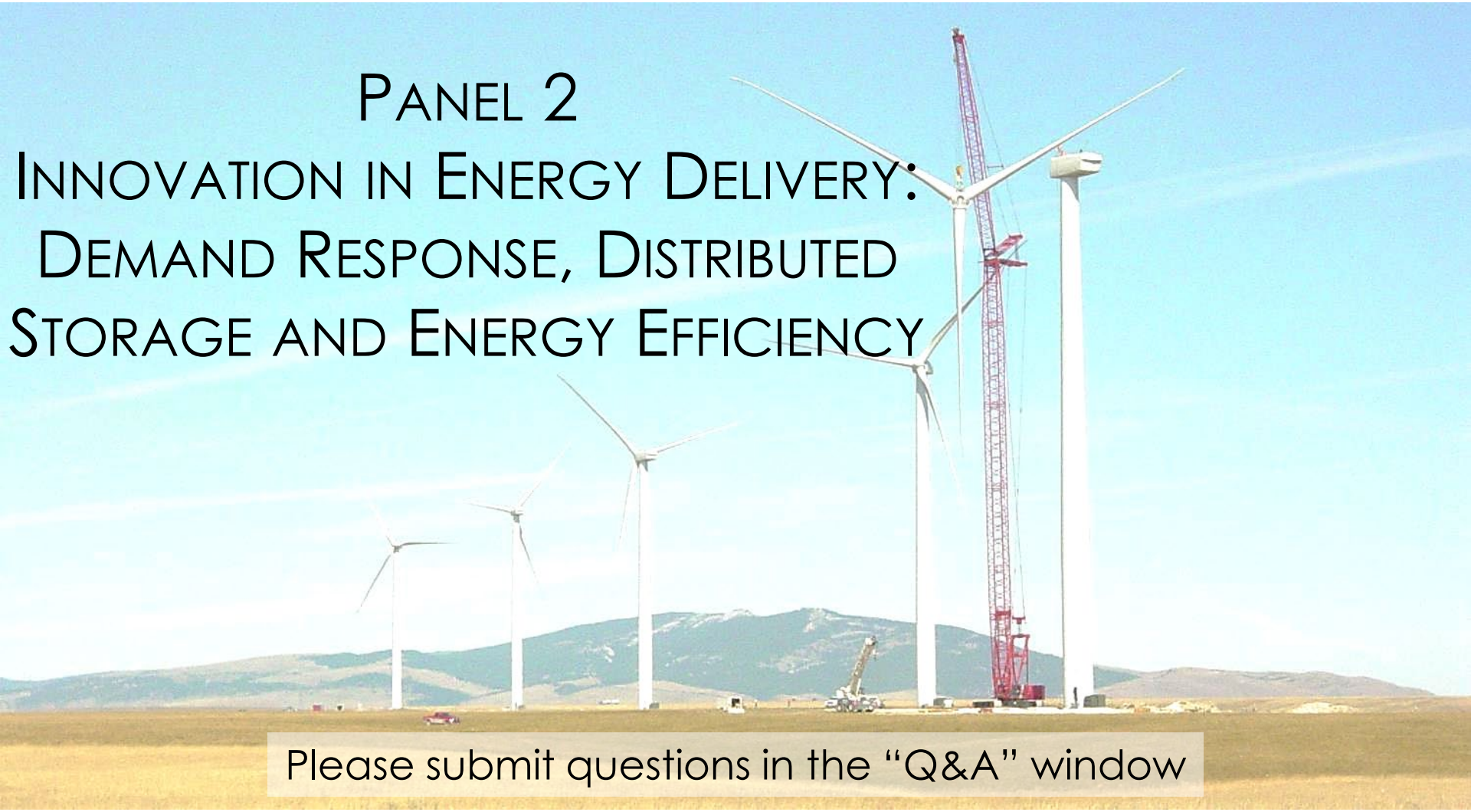
Bozeman Solar Project (2016):

- 330 KW
- Advanced Inverters
- Streams 5 minute interval data w/ 60 customers to understand solar production vs. residential, commercial, and industrial loads.

Missoula Solar Project – Themes:

- Hellgate – “Urban Integration”
- Sentinel - “Outdoor Classroom”
- Willard – “Building Integration”
- Big Sky – “Value w/ Storage”

West Thumb



Panel 2
Innovation in Energy Delivery: Demand Response, Distributed Storage and Energy Efficiency

Please submit questions in the "Q&A" window

DEQ
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ENERGY OFFICE

MISSOULA ELECTRIC COOPERATIVE

Innovation in Energy Delivery

DECEMBER 14, 2020

Energy Efficiency

A least-cost resource

MEC currently offers rebates for efficiency measures in the following areas:

- Residential
- Commercial
- Agricultural

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Energy Efficiency

A least-cost resource

Residential Sector

- Weatherization-

  Insulation, air sealing, doors and windows

- HVAC-

  Heat pumps

- Water Heating-

  Heat pump water heaters

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Energy Efficiency

A least-cost resource

Heat Pumps

Efficient-

- Ductless Heat Pumps
  - COP 2 @ -13°F / 3.5 @ 32°F
  - Est. savings 1,670 kWh/year
- Air Source Heat Pumps
  - COP 3.3 @ 10°F
  - Est. savings 6,277 kWh/year

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Energy Efficiency

A least-cost resource

Heat Pump Water Heaters

- Efficiency
  - Est. savings 1,300-1,500 kWh/year
- Regulatory
  - Post 2015 – we can only rebate electric water heaters over 100% efficient.
  - For tanks over 50 gallons – HPWH is only option.

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Energy Efficiency

A least-cost resource

Commercial Sector

- Lighting-
  LEDs
- HVAC-
  VRFs

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Energy Efficiency

A least-cost resource

Why Energy Efficiency?

- Cheaper to save a Watt than to generate a new Watt.
- Columbia River Federal Hydrosystem has fixed capacity.
- Efficiency helps serve more consumers with the same amount of generation.

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The Future

Where do we go from here?

Looking Forward

- Battery Energy Storage Systems
  - Utility-scale
  - Consumer-scale
- Electric Vehicles
  - Managed Charging
  - EVs as a resource

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The Future

Where do we go from here?

Battery Storage- is the time right?

- Technology has come a long way in the past decade. (Thanks Tesla)
- Cost of utility-scale battery storage has come down enough to make projects more cost effective.
- It is already happening – we can learn from those who went first.

MISSOULA ELECTRIC COOPERATIVE

The Future

Where do we go from here?

Battery Storage- is the time right?

- MEC is studying BESS for peak shaving.
- We have budgeted dollars in 2021 with a goal of installing a 100 to 200 kWh battery on our distribution system.
- We have calculated a 9 year payback.

MISSOULA ELECTRIC COOPERATIVE

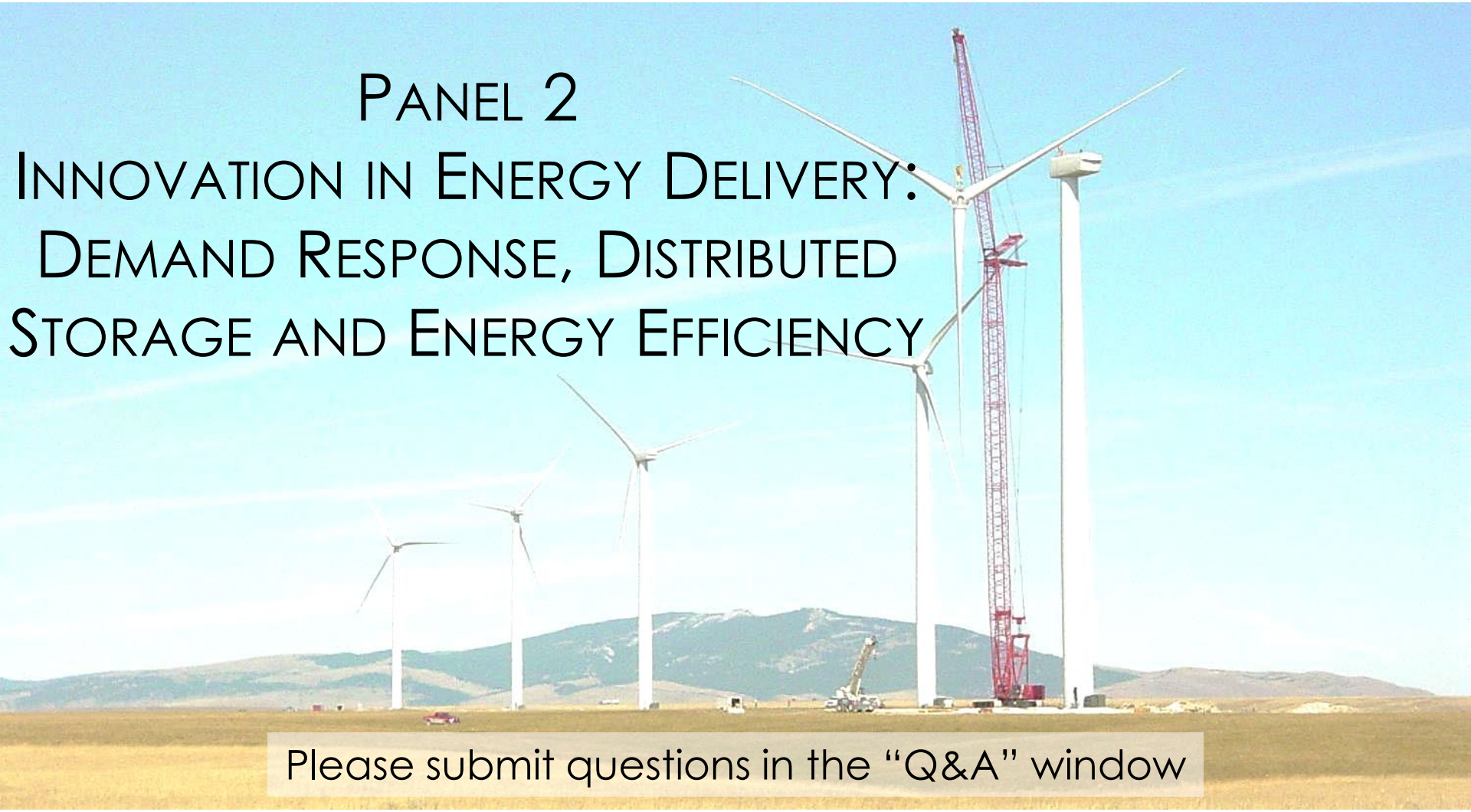
The Future

Where do we go from here?

Electric Vehicles

- EVs are coming – even to MT.
- 90% of charging will take place at home
- This new category of load will have a tremendous impact on our systems
- Managed charging will mean EVs could also be a great resource

MISSOULA ELECTRIC COOPERATIVE



Panel 2
Innovation in Energy Delivery: Demand Response, Distributed Storage and Energy Efficiency

Please submit questions in the "Q&A" window

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Project Spotlight
Cabin Creek Solar Project

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BASIN ELECTRIC POWER COOPERATIVE

A Touchstone Energy® Cooperative

Montana Generation & Transmission Working Group Webinar

Andy Buntrock

Basin Electric Director of Strategic Planning & Communications

Joan Dietz

Basin Electric Communications Manager

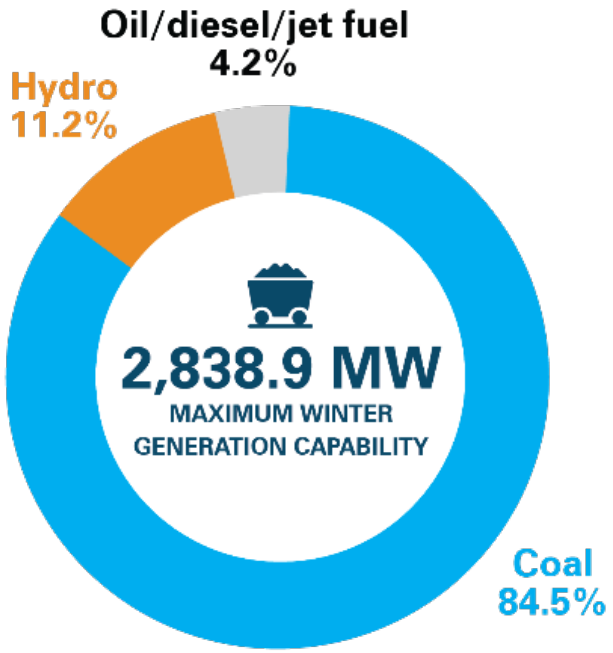
Basin Electric

- Generation and Transmission Cooperative since 1961
- 140 cooperatives - 18 in Montana
- Serve 9 state area stretching from Canada to Mexico
- Serve 3 million customers
- 2,500-plus miles of transmission to deliver electricity to members

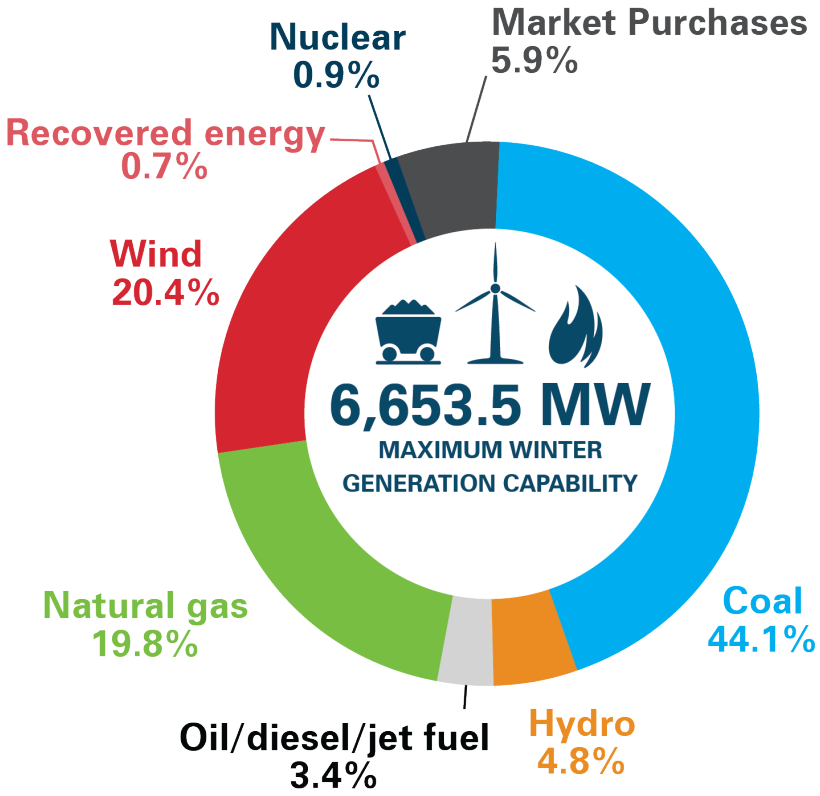
BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Basin Electric's Evolving Capability Portfolio

2000



2019



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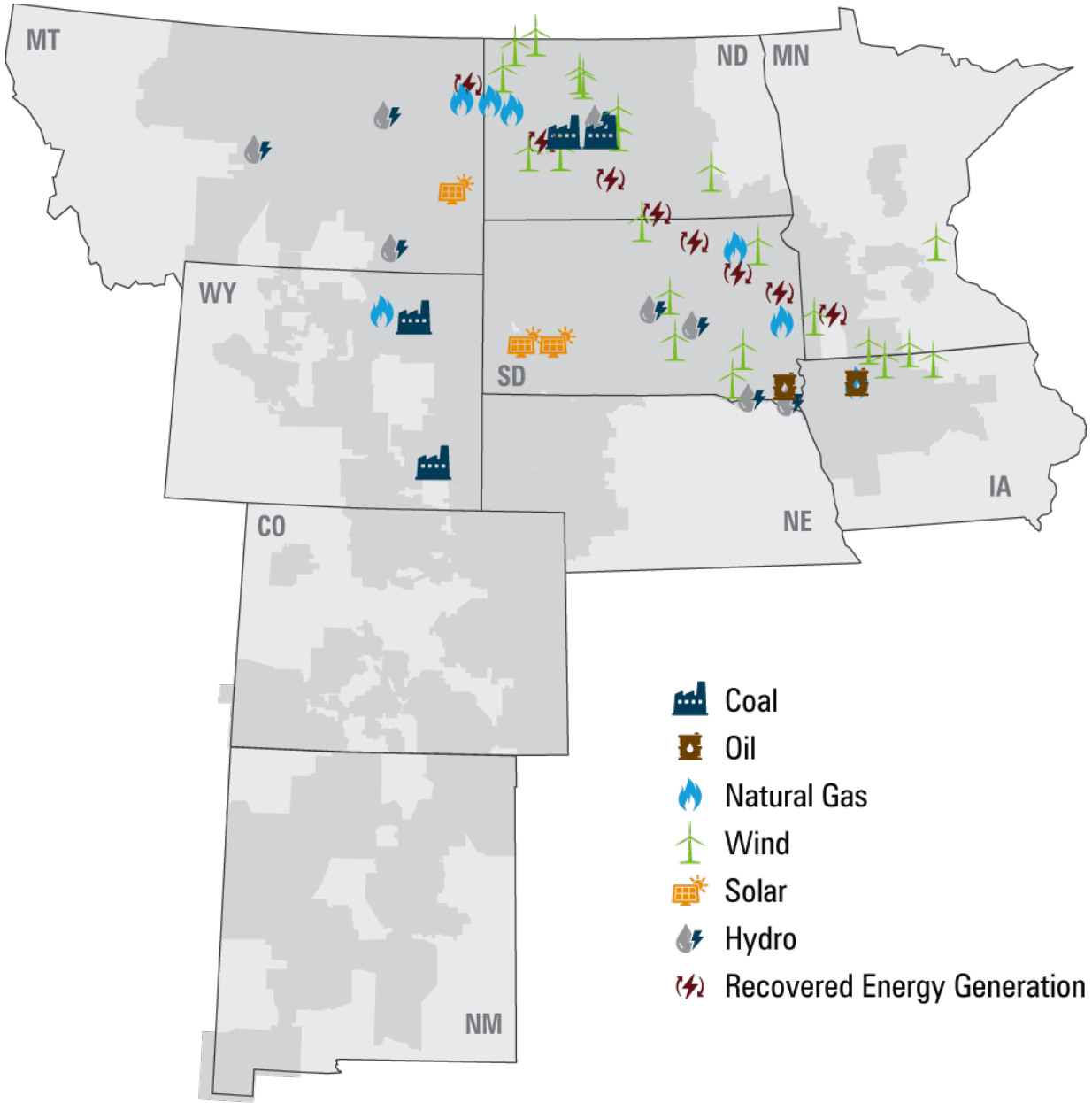
Updated 11/2020

Basin Electric - Generation Resources



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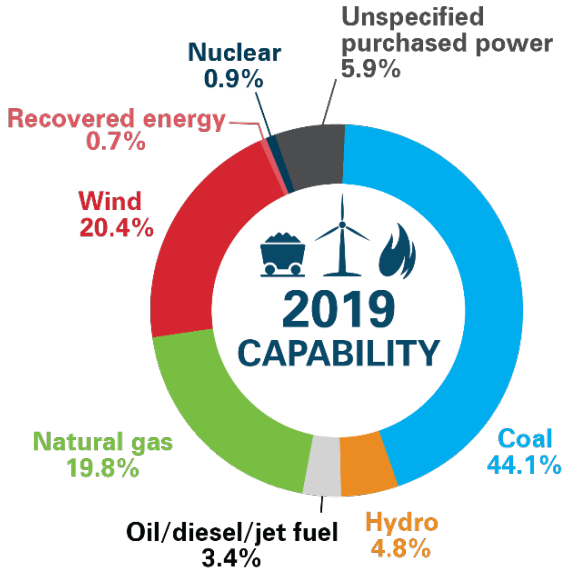
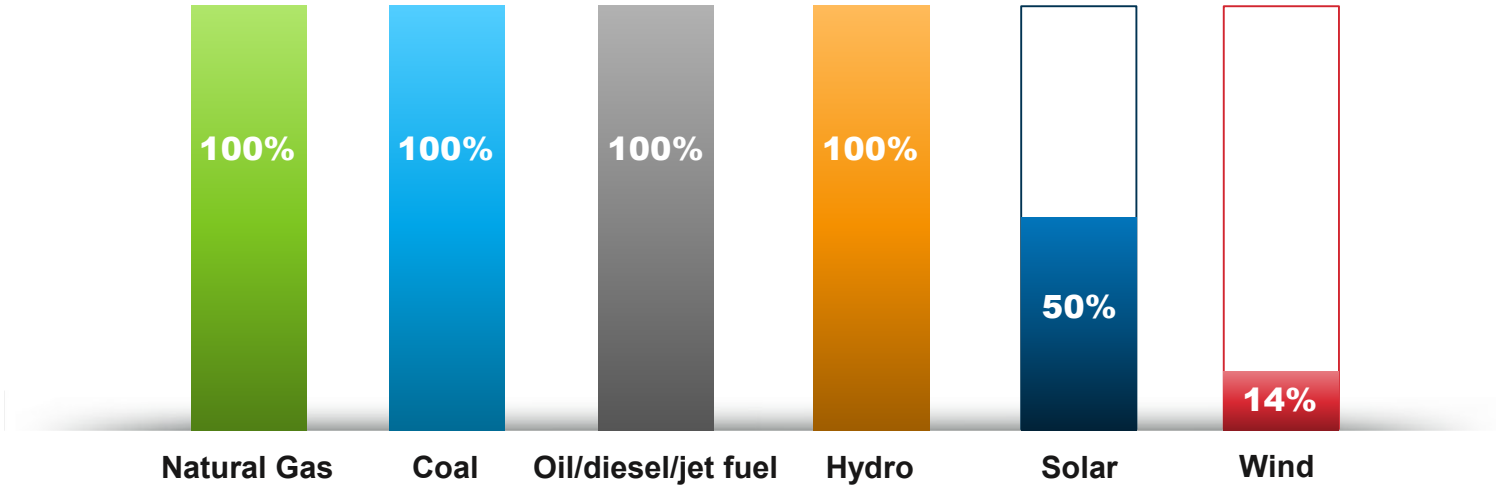
Basin Electric's Capability



*capability represents name-plate generation
* hydro is winter name-plate generation

Current Summer Accreditation Value (Capacity)



*solar winter value approximately 10%
*wind winter value approximately 25%

Currently, power markets require accredited capacity equal to 100% of summer peak load, losses, and 12% reserves.

*As renewable penetration levels increase, renewable accreditations values will decline

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Basin Electric's **Renewable** Portfolio

11.2%

2000

25.9%

2019

Includes capability for hydro, wind and recovered energy generation.

Project Spotlight
Cabin Creek Solar Project

Please submit questions in the "Q&A" window

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THANK YOU!

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