

This presentation was prepared by staff at the Utah School & Institutional Trust Lands Administration as part of an internal lunch & learn series for staff education and program updates in the Fall of 2021.

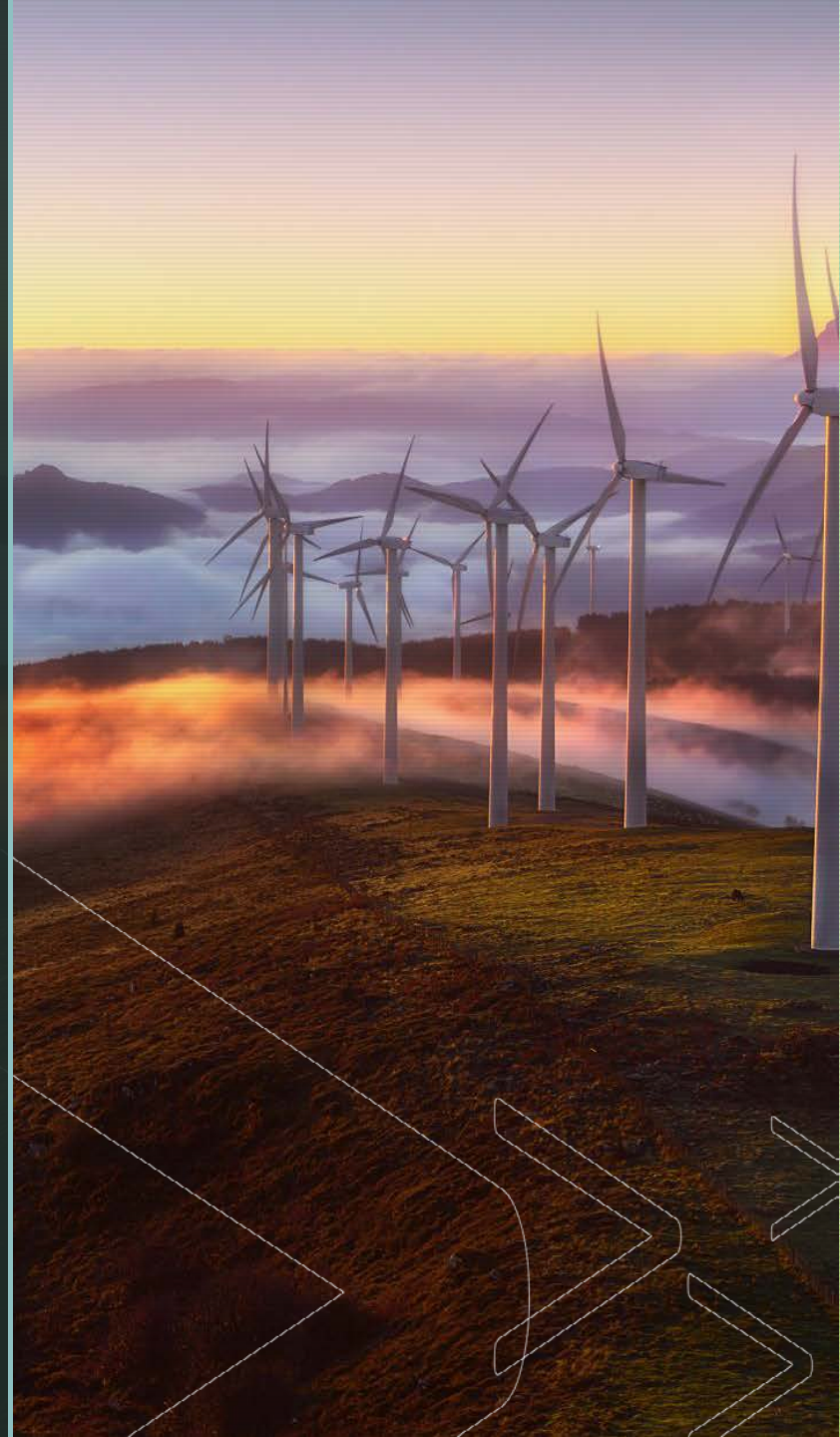
Information in this presentation may not be up to date and should be verified.

Renewable Energy

Nuts & Bolts

- Solar
- Wind
- BESS
- Geothermal
- Hydrogen

Renewables Future?



Types of Solar

- Concentrated Solar Power
- Concentrated Thermal Power
- Photovoltaic
 - Albert Einstein in 1905



Concentrated Solar Power (CSP)

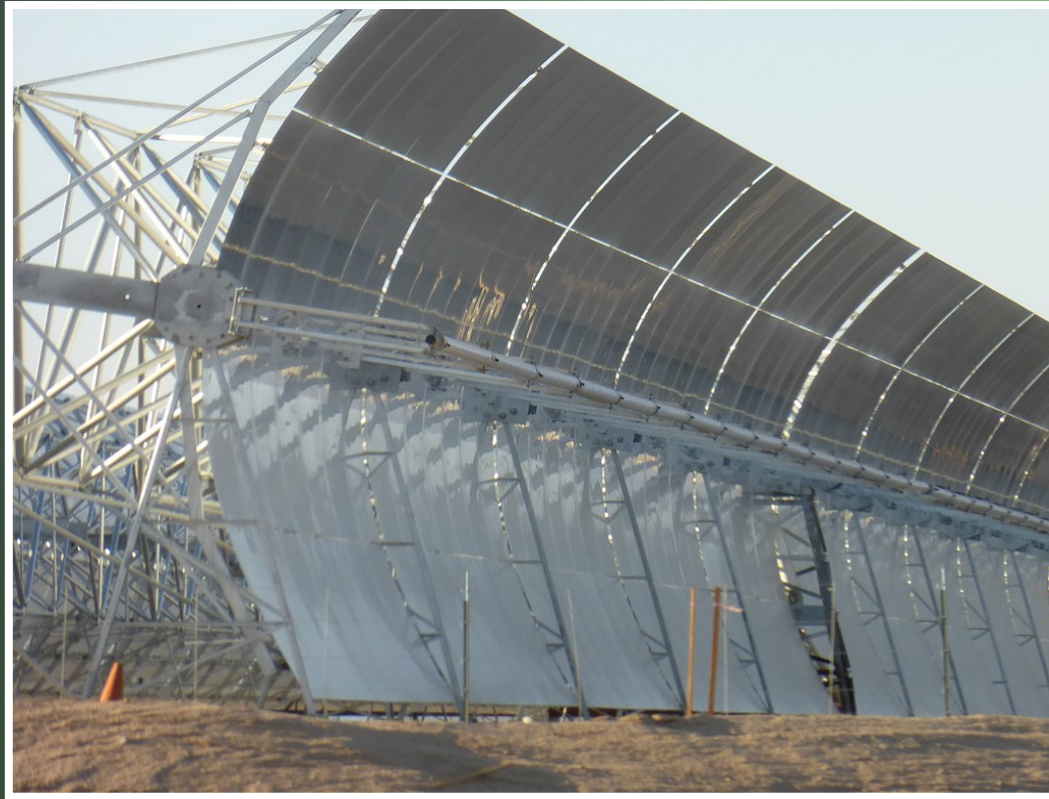
(No SITLA Leases currently)



- CSP – Uses Mirrors to concentrate sunlight onto a small area
- Heat is created that drives a steam turbine that creates electricity
- Example is the Ivanpah Solar Electric Generating System in Southern California near Las Vegas.

Concentrated Solar Thermal (CST)

(No SITLA Leases currently)



- Convex reflective panel
- Heat pipe of water or molten salts, Hot liquid stored in cement tank
- Liquid goes through heat pump and turbine to generate electricity
- Can generate electricity for three days without sun because of stored heat

Photovoltaic (PV's)

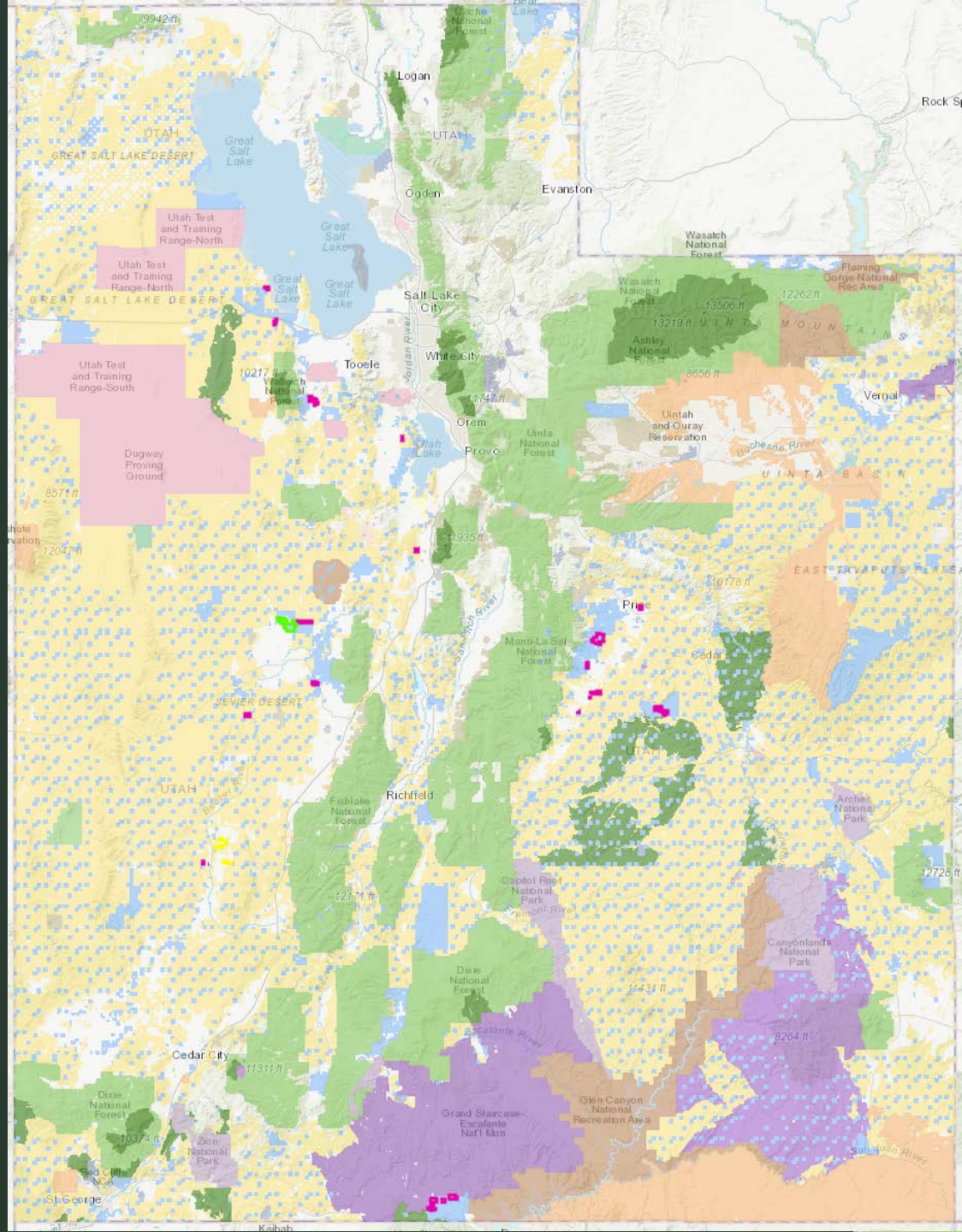
Most Popular

- 6-7 Acres per MW – 165 homes
- Single axis – vs- Double Axis
- Generally last 30+ years
 - Only lose approximately 6% production efficiency over 25 years
- Can be “repowered” easily



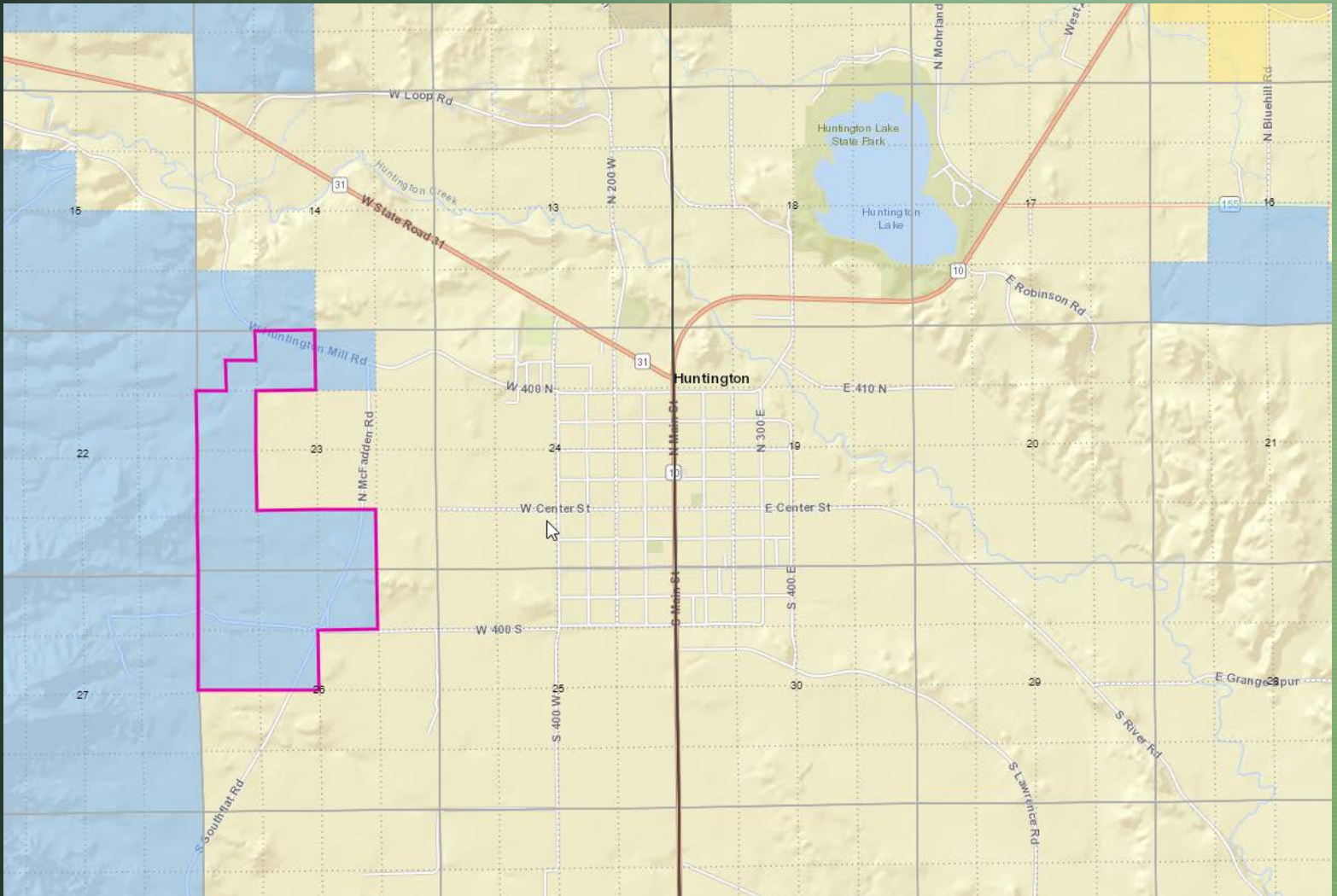
SITLA Photovoltaic Lease's

- 24,000 Acres Leased
- 3 Operational (51 MW's)
 - Milford Solar 1
 - Escalante Solar
 - Hunter Solar
- 3 Under Construction (200 MW's)
 - Elektron Solar (80 MW)
 - Horseshoe Solar (80 MW)
 - Castle Solar (40 MW)
- 15 Projects in pre-development (2,250 MW's)
- 7 Applications in review and negotiation (1,000 MW's on 7,600 Acres)
- IPP Block (1,000+ MW's)
- Potential 4,500 MW's (4.5GW's) on 45,000 acres



Castle Solar

450 Acres - 40 MW



Castle Solar

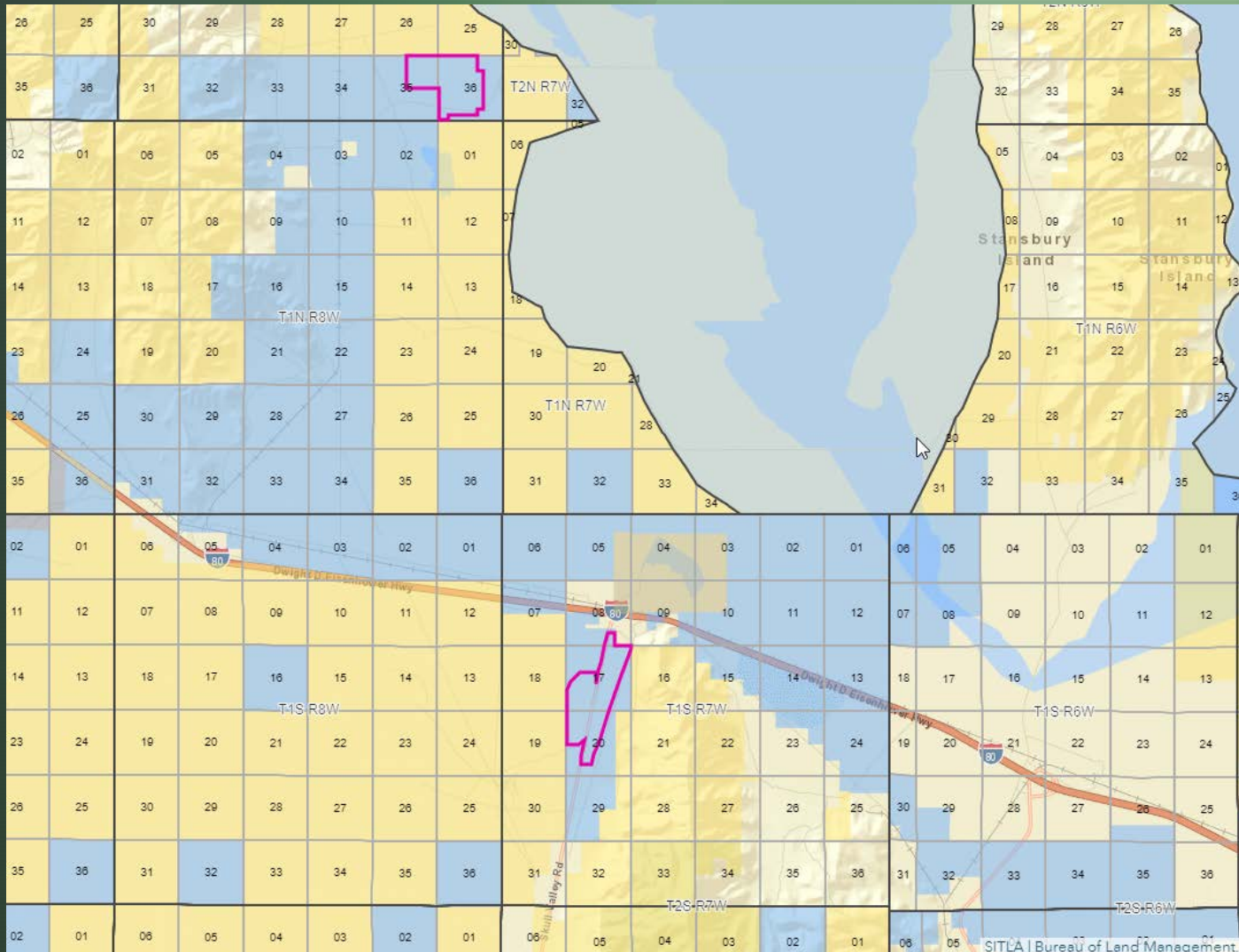
40 MW - Currently under Construction



Horseshoe & Elektron

Horseshoe – 620 Acres, 80 MW

Elektron – 550 Acres, 80 MW



Horseshoe

Construction Status 11/22/21



Elektron

Construction Status 11/22/21



Wind

2 Current Leases – 1 being discussed

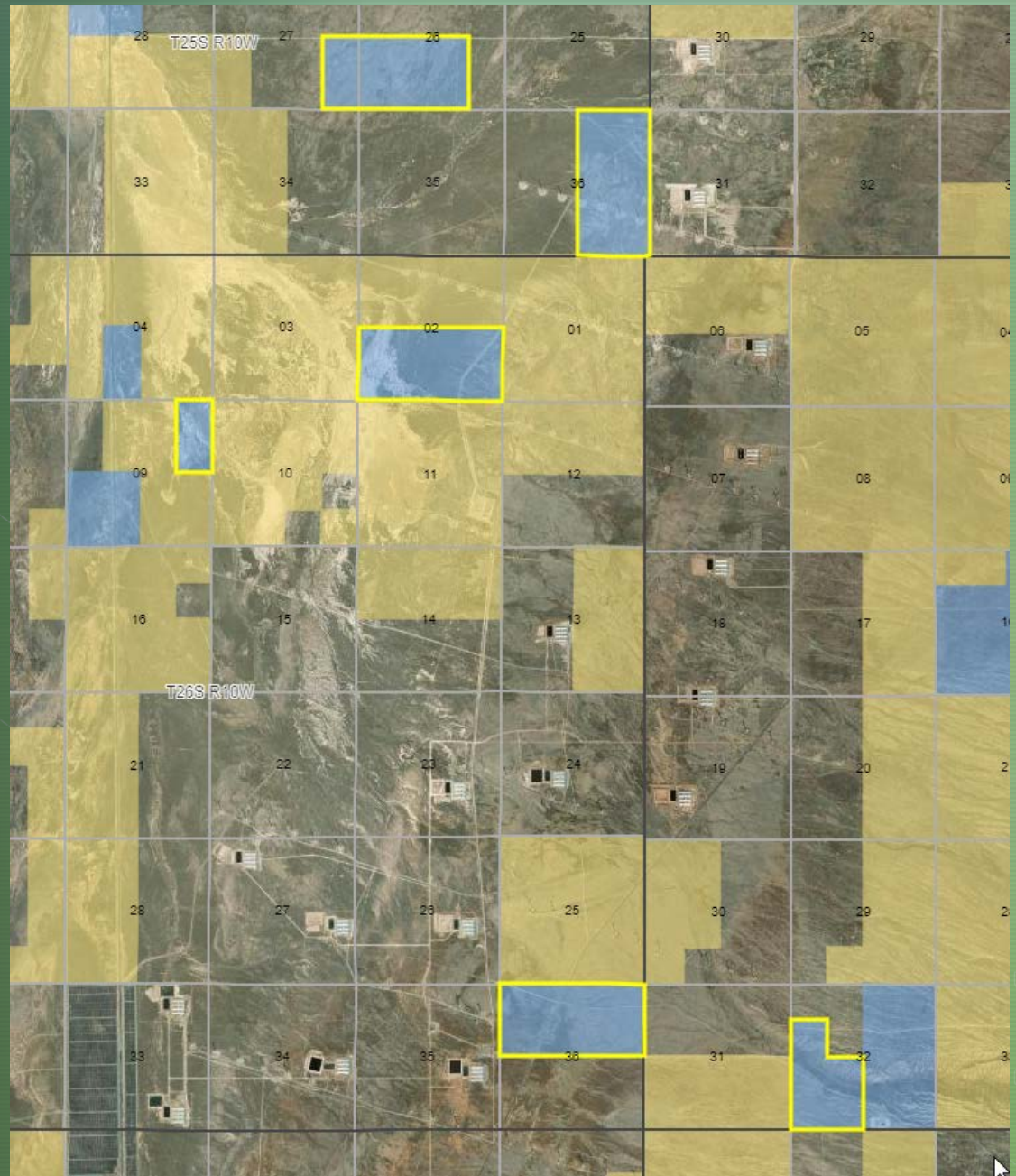


Video #1 - Storm
Video #2 - Fire

- Need Consistent Wind
- Space Requirements and Decommissioning Issues

SITLA Wind Lease's

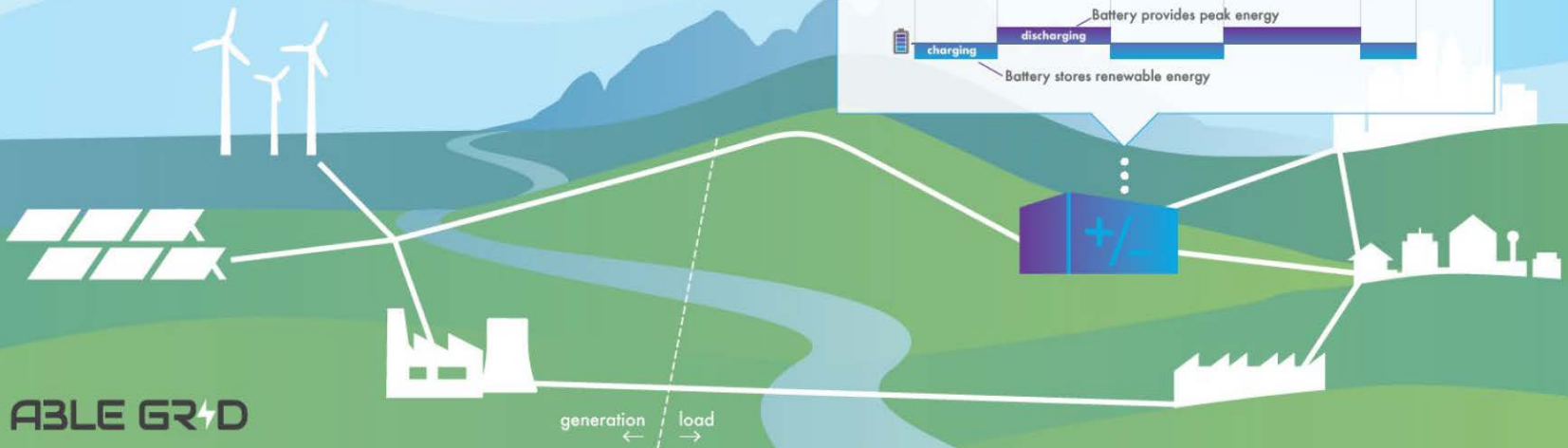
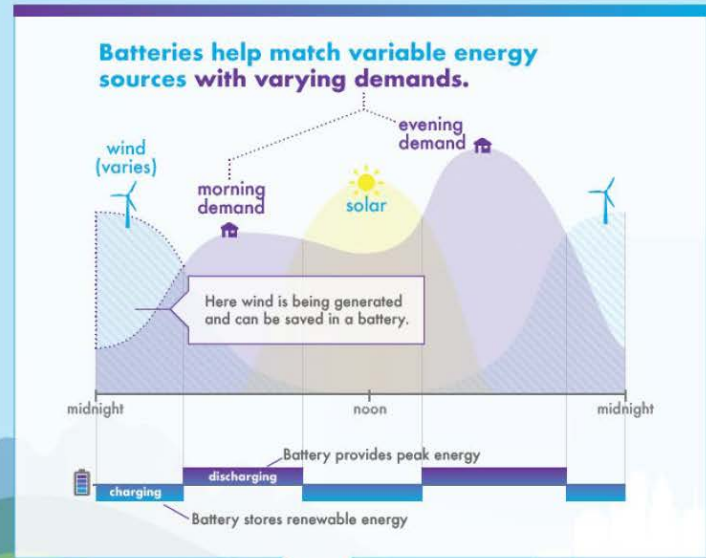
- 1,560 Acres Leased north of Milford, UT (Milford Flats)
- Utah Wind - 12 MW's



Battery Energy Storage System (BESS)

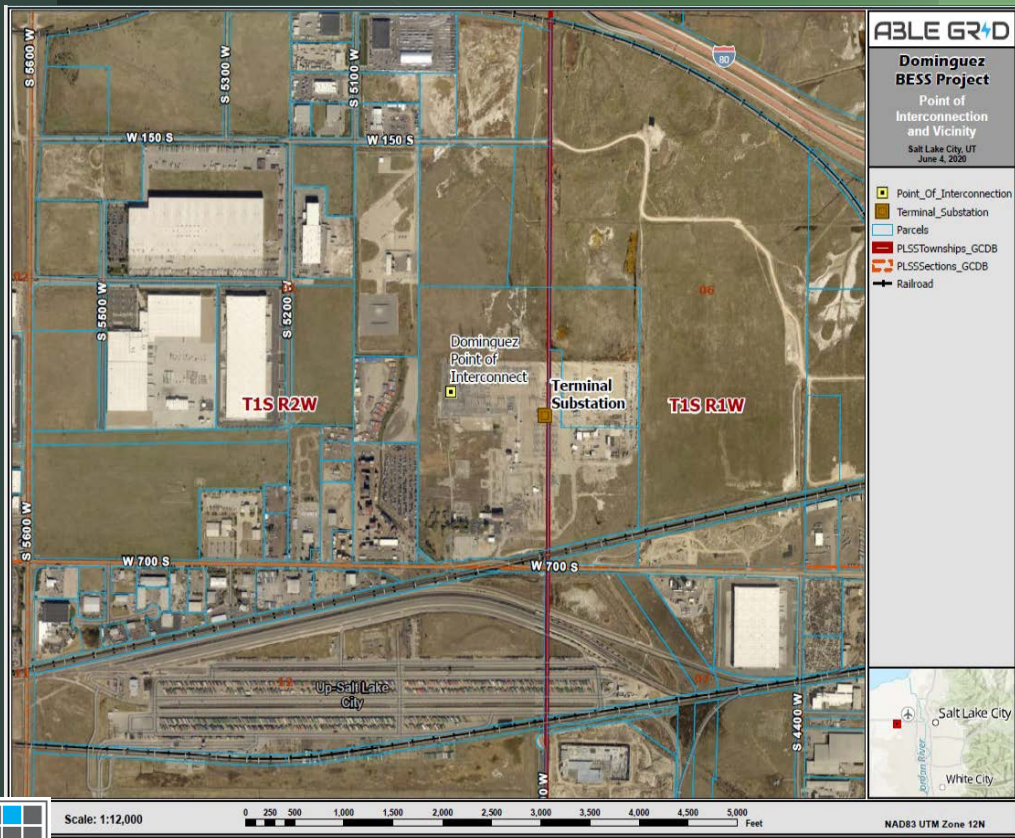
Batteries enable a cleaner energy grid.

Stand-alone batteries strategically located on the grid balance the combined generation of all energy sources and the demand from cities and factories. These batteries reduce the need for gas-fired peaker plants and their pollution.



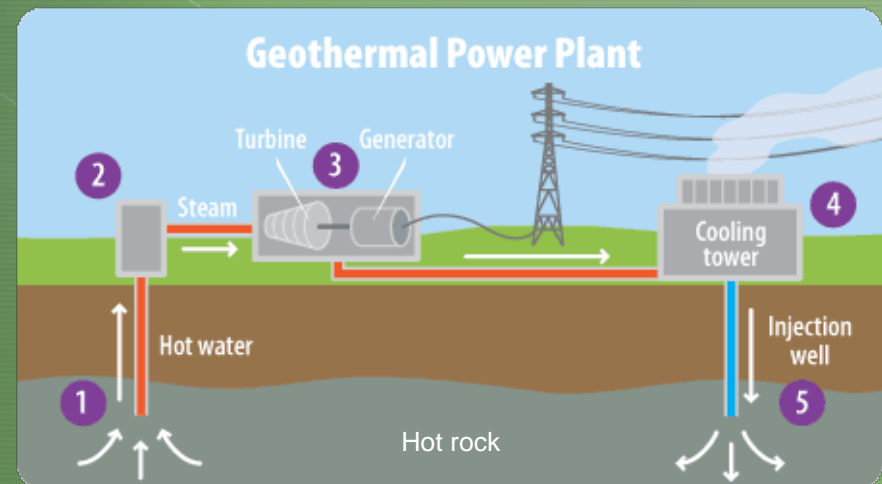
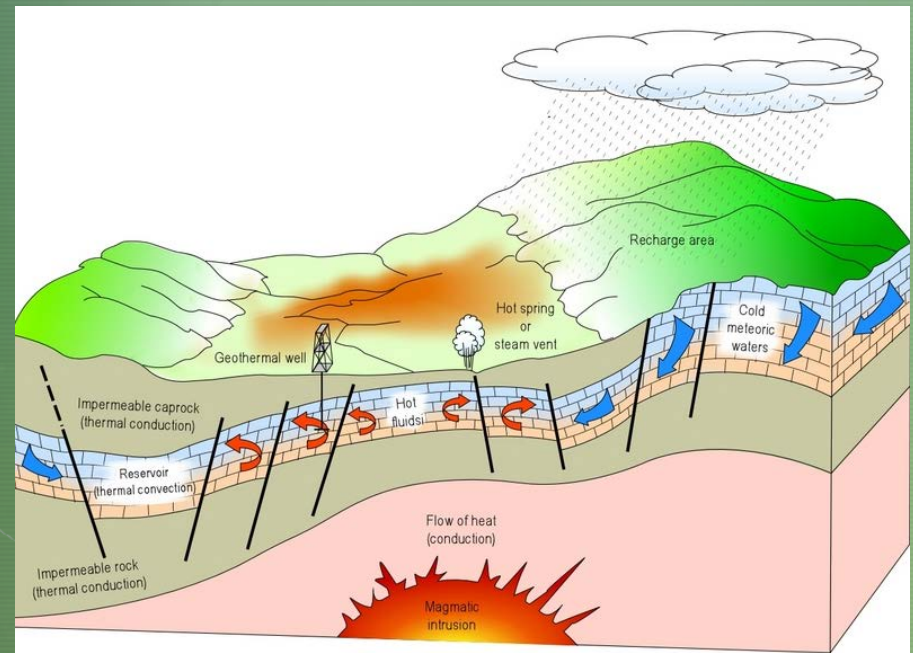
Dominguez BESS Project (SLC)

- 200 MW Stand Alone Battery Energy Storage System
- To be located at Terminal Substation in SLC



Geothermal

- A geothermal system is composed of three main elements:
 - 1) a heat source (e.g. magmatic intrusion),
 - 2) a reservoir (e.g. fractured/ weathered basement or basal sandstone ["granite wash"] formation),
 - 3) a fluid, which is the carrier that transfers the heat.
- There are three types of utilization
 - 1. Dry steam which use steam directly from the resource
 - 2. Flash steam uses steam from very hot water >360 degrees that in the reservoir is under pressure and when it is brought up through the production well the pressure is released and the fluid flashes to steam.
 - 3. Binary Cycle which uses hot water from 225 to 360 degrees to heat a "working fluid" usually isopentane that has a lower flash point than water; the hot water warms the "working fluid" to its flash point and that vapor is used to turn the turbine just as the steam in the dry steam and flash steam methods uses steam to turn the turbine.



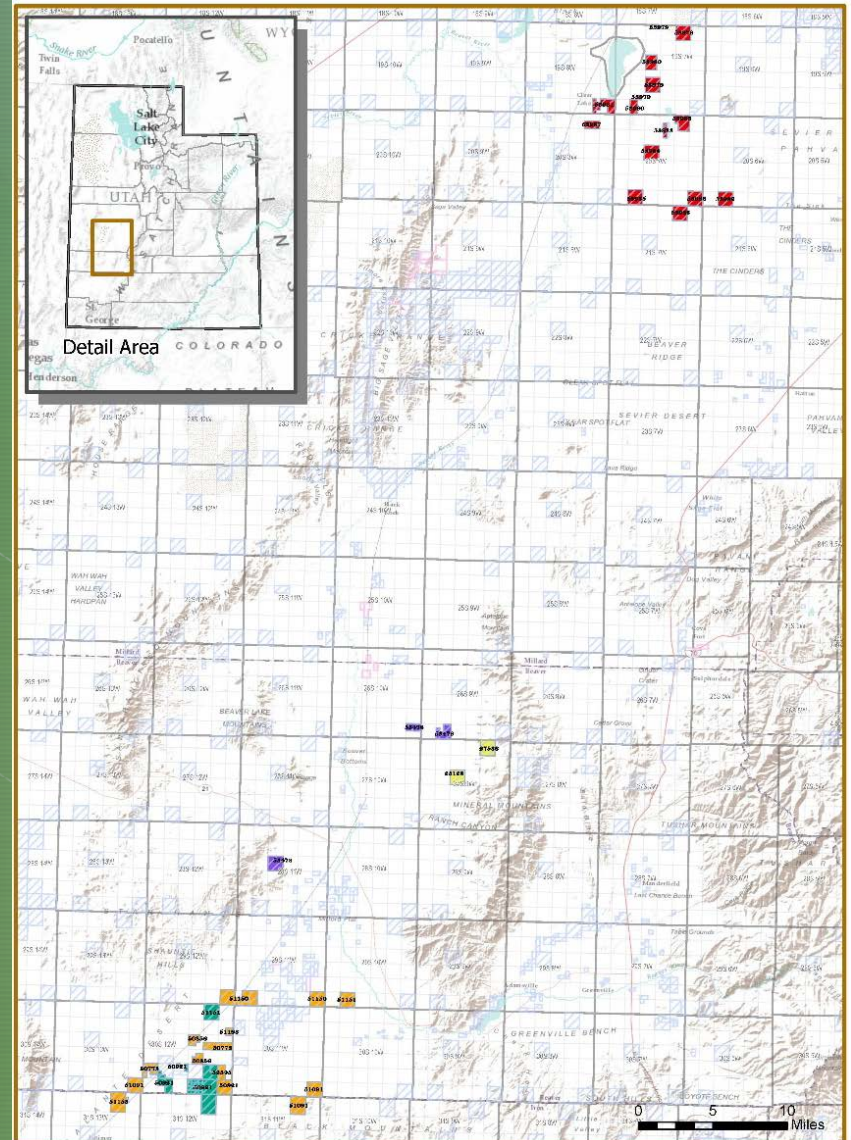
Geothermal

- Current Leases which were originally established through mineral offerings at auction
- 4 companies hold 17 of the leases
- 2 are currently producing commercial power plant
 - Thermo No. 1 (10.3 megawatt capacity)
 - Blundell Plant (34 megawatt capacity)



- 1 experimental project to enhance geothermal power technology
 - FORGE (Frontier Observatory for Research in Geothermal Energy)

Active Geothermal Leases



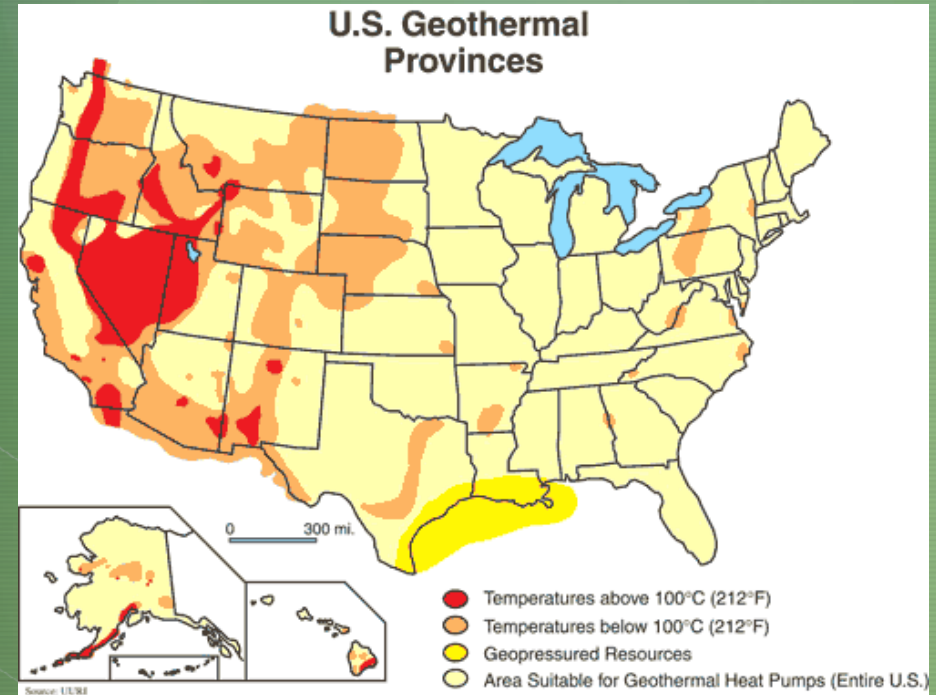
Utah Forge

- FORGE is a dedicated underground field laboratory sponsored by DOE for developing, testing, and accelerating breakthroughs in Enhanced Geothermal System technologies. Project is also sponsored by the University of Utah Geoscience Institute
- Most geothermal potential in Utah is “dry” (ie: hot rocks and pore space)
- Forge is looking at ways to inject a liquid solution through a horizontal fracked injection well; then pull the heated solution back up and out at the end of the horizontal line.



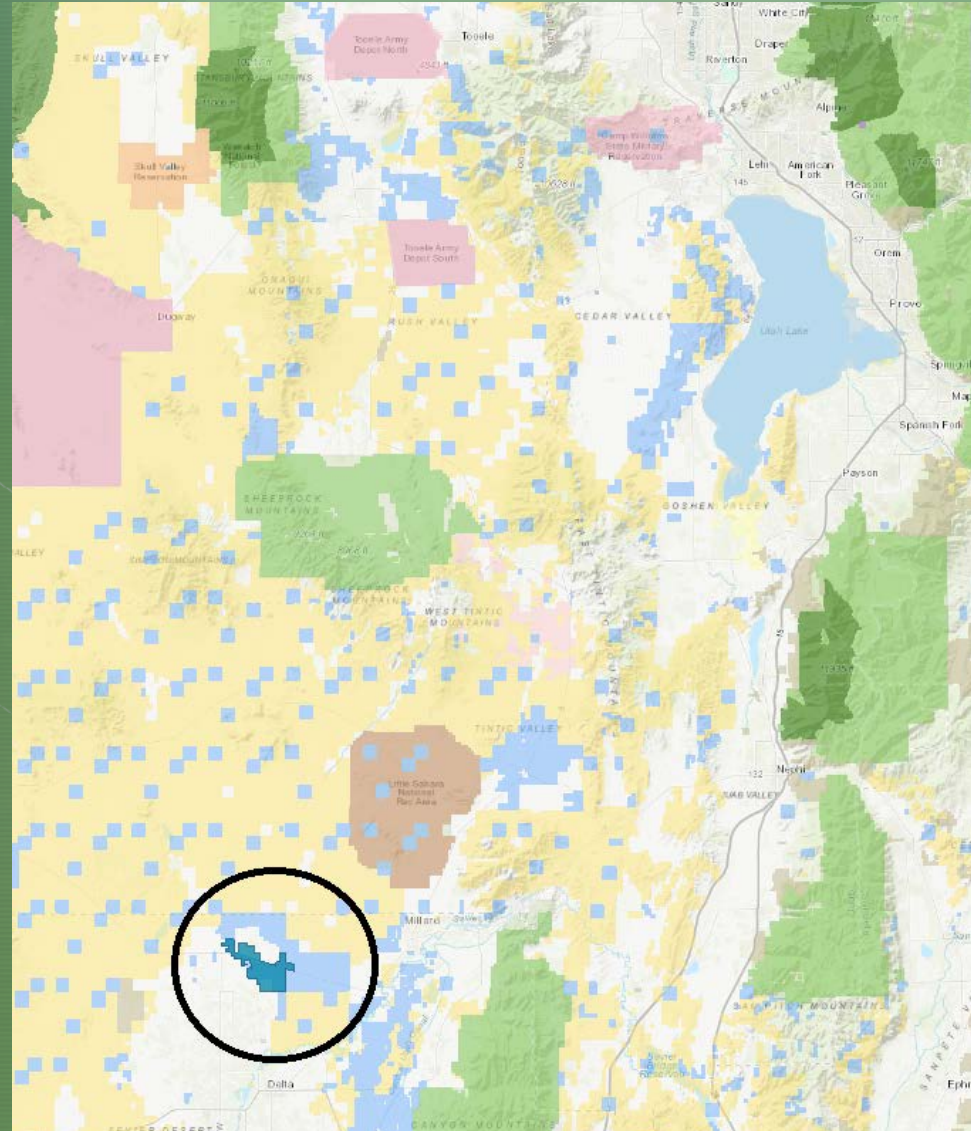
Geothermal in the Future

- Renewed interest in Geothermal has resulted in SITLA pausing any new leasing and removing geothermal properties from mineral offerings.
- New projects will be processed as OBA's under an Exploration and Option Agreement.
 - Demonstrate financial capability
 - Submit an Exploration Plan for review and proceed with yearly exploration including; drilling at least 1 well, spending at least \$100k per year in exploration, and submitting yearly reports describing activities completed.
 - Exploration is limited to 5yrs.
- If Option is exercised, then project moves to a lease (OBA) with additional requirements to submit Operations Plans and Engineering as well as commence commercial operations within 10 years.

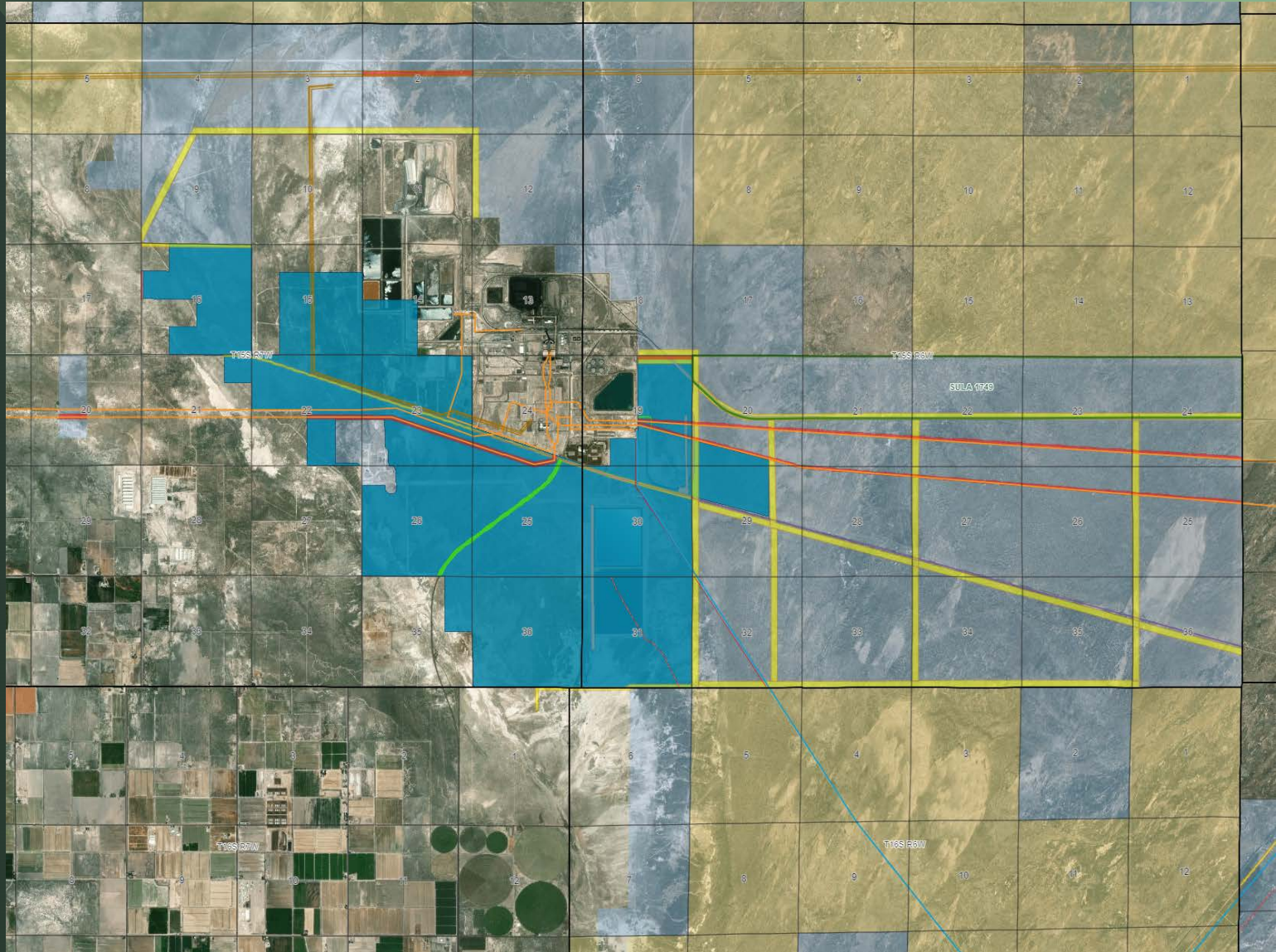


Hydrogen IPP Block – ACES Delta

- 20,000+ Acre Block
- Trust owned surface & mineral estate
- Intermountain Power Project north of Delta, is located central to the block
- Magnum Holdings, LLC is “anchor tenant” lessee on block
- Property sits on large geologic salt dome (1 mile thick, 2 miles across)



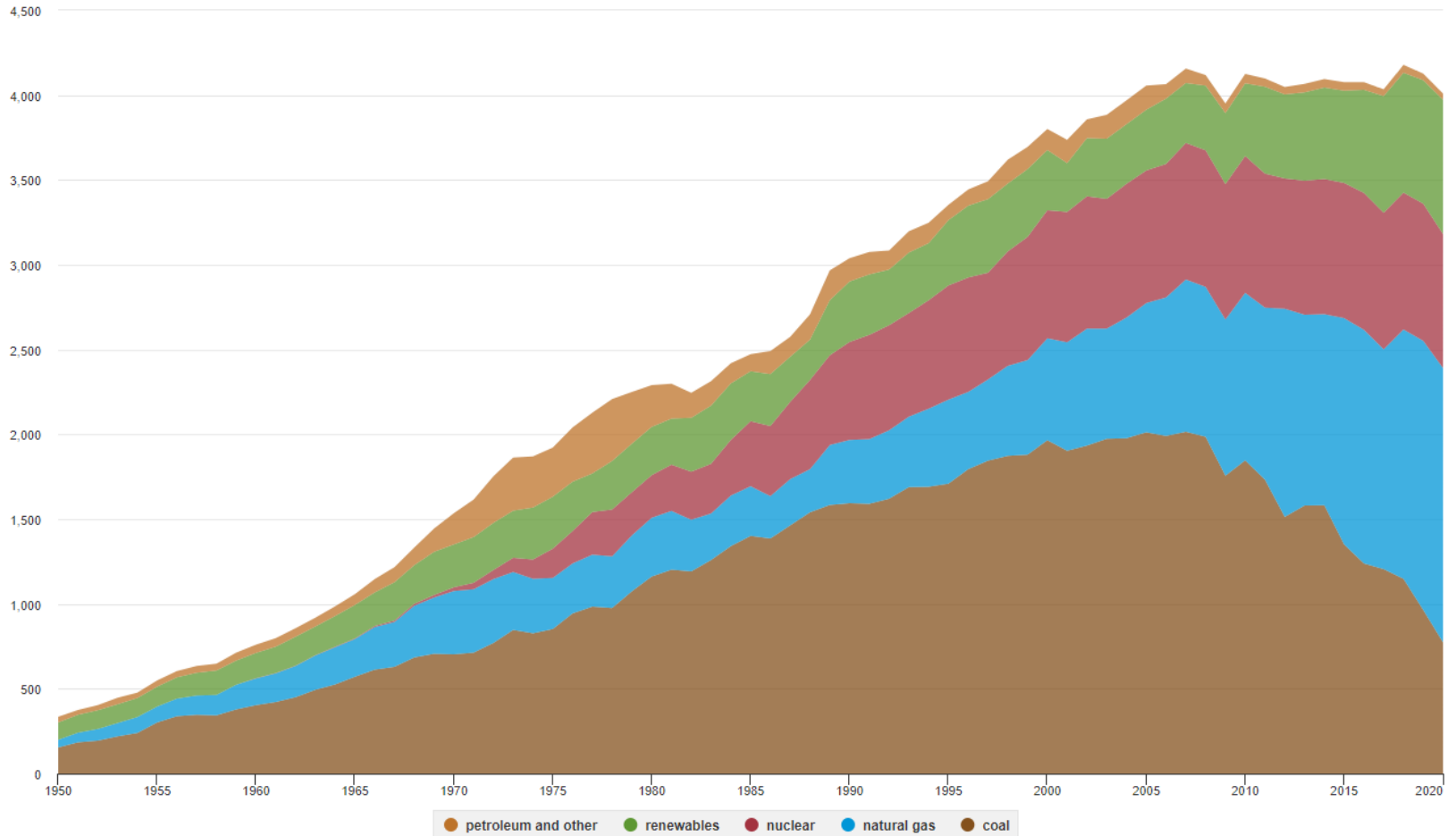
- Magnum, Mitsubishi, & Chevron New Energy - Partnership (ACES 1) to generate, store, and develop distribution systems for commercial hydrogen
- Solar Interest (excess of 10,000 acres) and over 1,000MW
- Traditional Industrial Development in support of IPP and ACES 1



Future of Renewables?

U.S. electricity generation by major energy source, 1950-2020

billion kilowatt-hours



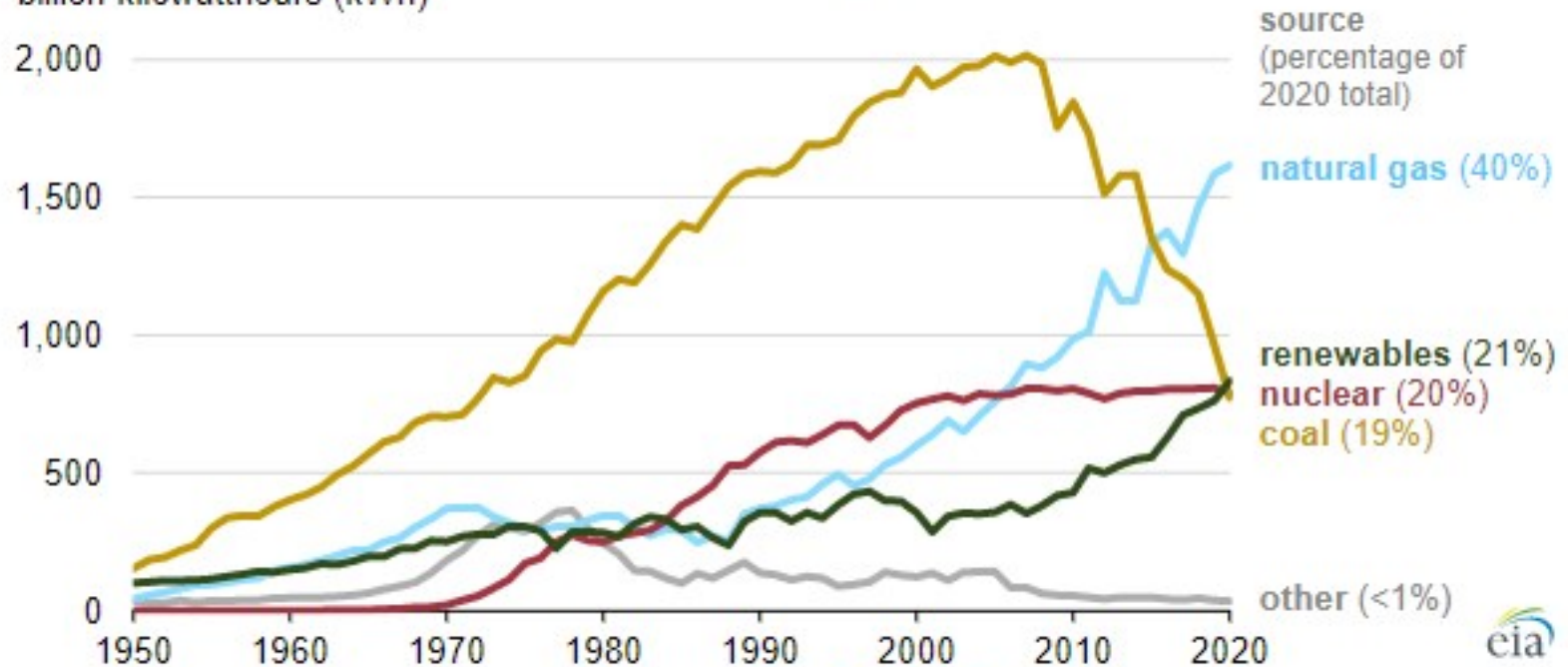
Note: Electricity generation from utility-scale facilities.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, January 2021 and *Electric Power Monthly*, February 2021, preliminary data for 2020

Future of Renewables?

JULY 28, 2021

Renewables became the second-most prevalent U.S. electricity source in 2020

Annual U.S. electricity generation from all sectors (1950–2020)
billion kilowatthours (kWh)



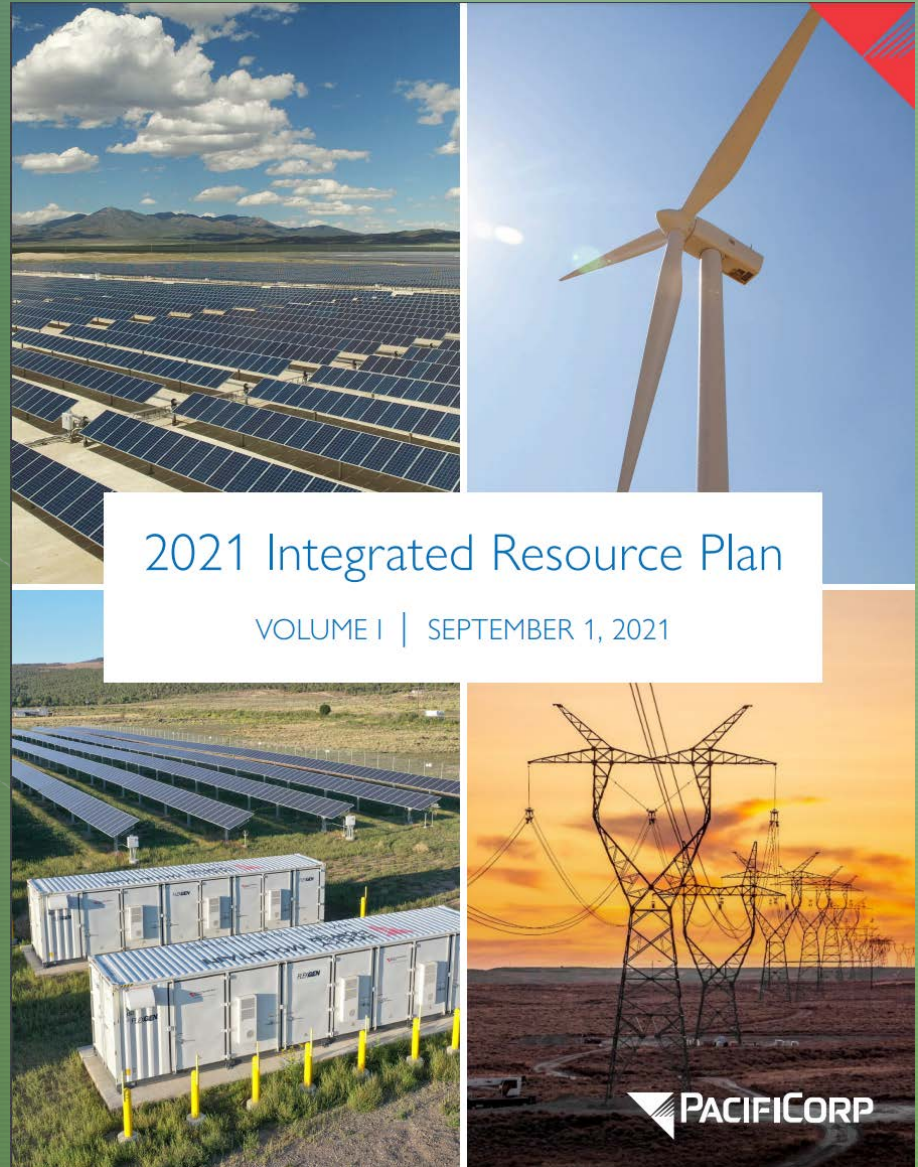
Source: U.S. Energy Information Administration (EIA), *Monthly Energy Review*

Note: This graph shows electricity net generation in all sectors (electric power, industrial, commercial, and residential) and includes both utility-scale and small-scale (customer-sited, less than 1 megawatt) solar.



PacifiCorp - Integrated Resource Plan

- PacifiCorp's 2021 Integrated Resource Plan (IRP) was developed through comprehensive analysis and an extensive public-input process spanning over a year and a half resulting in the selection of a least-cost, least-risk preferred portfolio. **With accelerated coal retirements, no new fossil-fueled resources, continued growth in energy efficiency programs, and incremental renewable resources,** the 2021 IRP preferred portfolio results in a greater reduction in greenhouse gas emissions relative to the 2019 IRP. Reliable service will be maintained with investment in transmission infrastructure, **the conversion of two coal units to natural gas peaking units,** growth in demand response programs, the addition of advanced nuclear resources, the addition of energy storage resources, and over the long term, the addition of non-emitting peaking resources.



2021 Integrated Resource Plan

VOLUME I | SEPTEMBER 1, 2021

Smart Grid

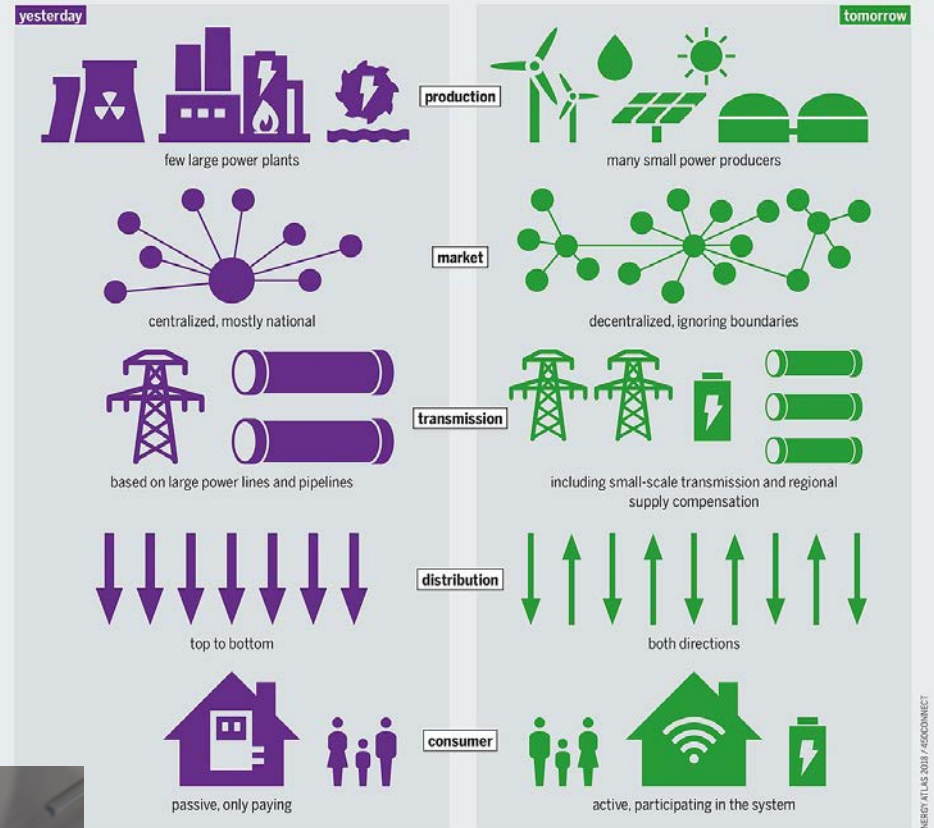
- A smart grid is an electrical grid which includes a variety of operation and energy measures including:

- Advanced metering infrastructure
- Smart distribution boards and circuit breakers integrated with home control and demand response (behind the meter from utility perspective)
- Load control switches and smart appliances,
- Renewable energy resources, including capacity to charge parked (electric vehicle) batteries or larger arrays of batteries



STAYING BIG OR GETTING SMALLER

Expected structural changes in the energy system made possible by the increased use of digital tools



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Rocky Mtn Power
Smart Meter

PacifiCorps – Unit Retirements

by lowering operating minimums and optimizing dispatch through the EIM) that has enabled the company to reduce fuel consumption and associated costs and emissions, and instead buy increasingly low-cost, zero-emissions renewable energy from market participants across the West, which is accessed by our expansive transmission grid. PacifiCorp's coal resources will continue to play a pivotal role in following fluctuations in renewable energy as the remaining coal units approach retirement dates. Driven in part by ongoing cost pressures on existing coal-fired facilities and dropping costs for new resource alternatives, of the 22 coal units currently serving PacifiCorp customers, the preferred portfolio includes retirement of 14 of the units by 2030 and 19 of the units by the end of the planning period in 2040. As shown in Figure 1.12, coal unit retirements/gas peaker conversions in the 2021 IRP preferred portfolio will reduce coal-fueled generation capacity by 1,300 MW by the end of 2025, over 2,200 MW by 2030, and over 4,000 MW by 2040.

PacifiCorps – Unit Retirements

Coal unit retirements scheduled under the preferred portfolio include:

- 2023 = Jim Bridger Units 1-2, converted to natural gas peakers in 2024 (same retirement year for Jim Bridger 1 in 2019 IRP and instead of 2028 for Jim Bridger 2 in the 2019 IRP).
- 2025 = Naughton Units 1-2 (same as 2019 IRP)
- 2025 = Craig Unit 1 (same as 2019 IRP)
- 2025 = Colstrip Units 3-4 (instead of 2027 in the 2019 IRP)
- 2027 = Dave Johnston Units 1-4 (same as 2019 IRP)
- 2027 = Hayden Unit 2 (instead of 2030 in the 2019 IRP)
- 2028 = Craig Unit 2 (instead of 2026 in the 2019 IRP)
- 2028 = Hayden Unit 1 (instead of 2030 in the 2019 IRP)
- 2036 = Huntington Units 1-2 (same as 2019 IRP)
- 2037 = Jim Bridger Units 3-4 (same as 2019 IRP)
- 2039 = Wyodak (same as 2019 IRP but outside of 2019 IRP planning horizon)

Figure 1.12 – 2021 IRP Preferred Portfolio Coal Retirements/Gas Conversions*

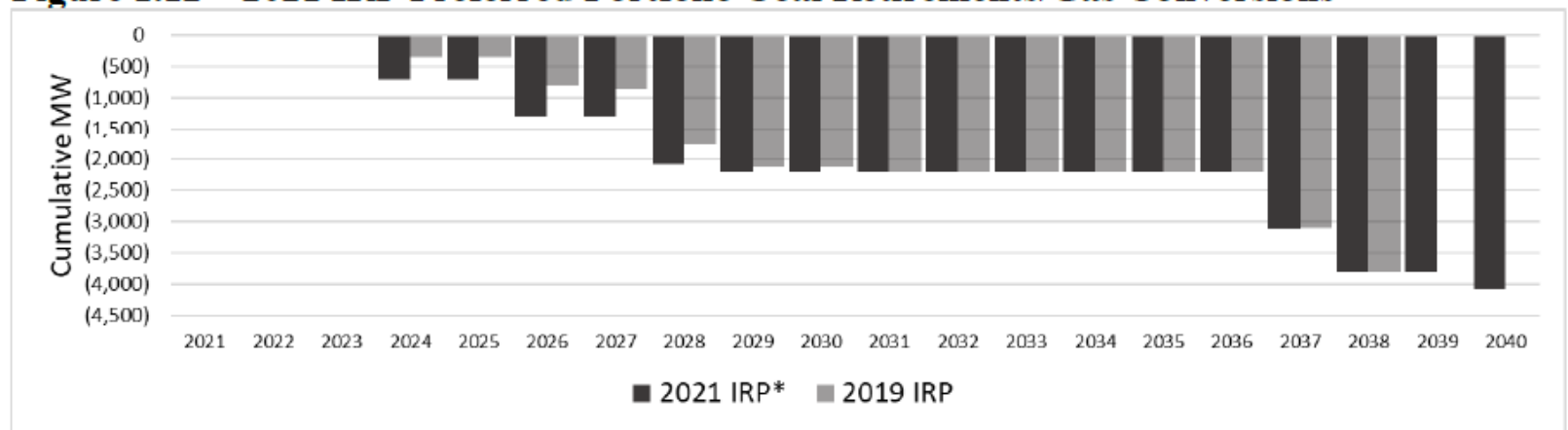
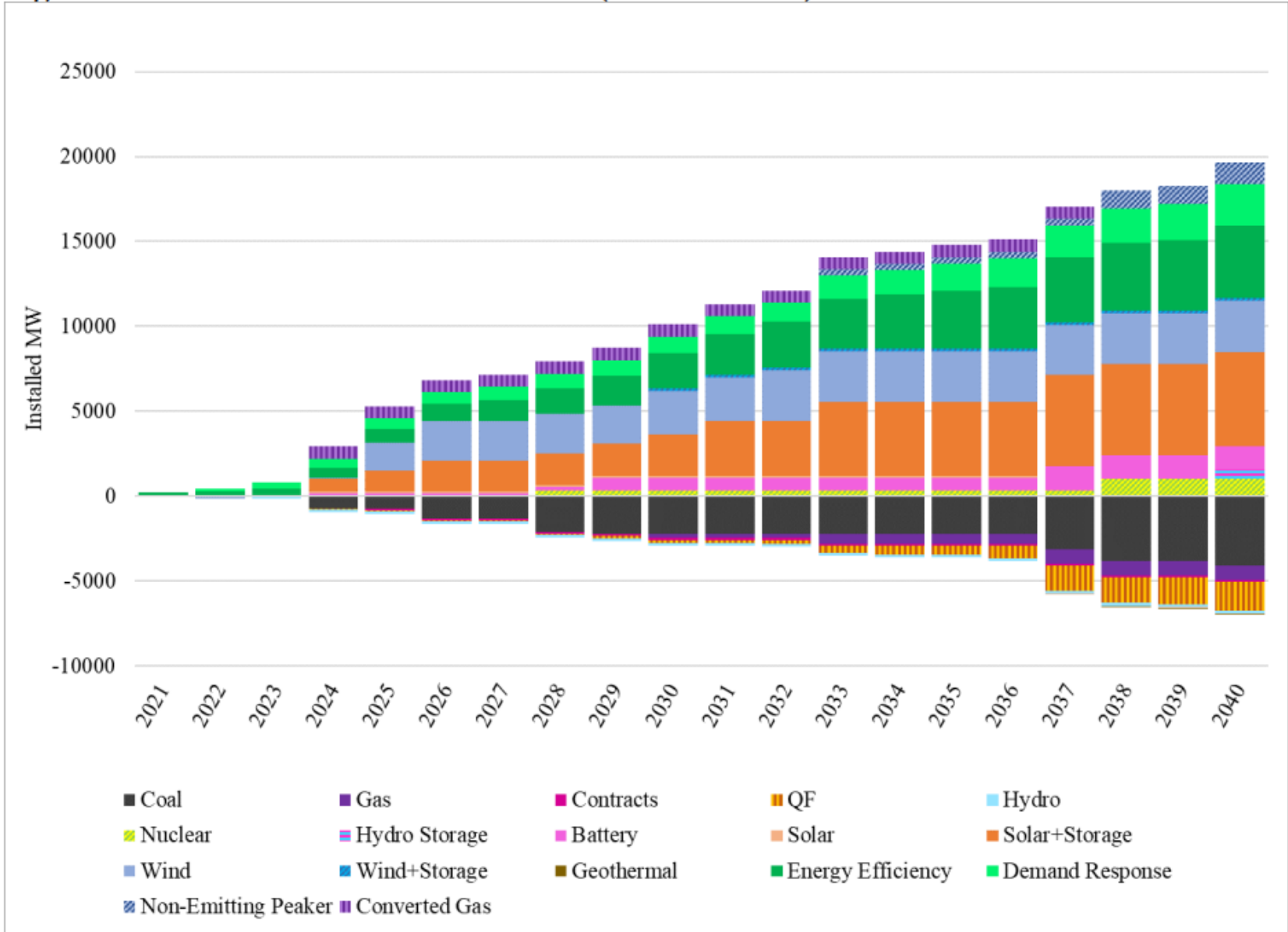


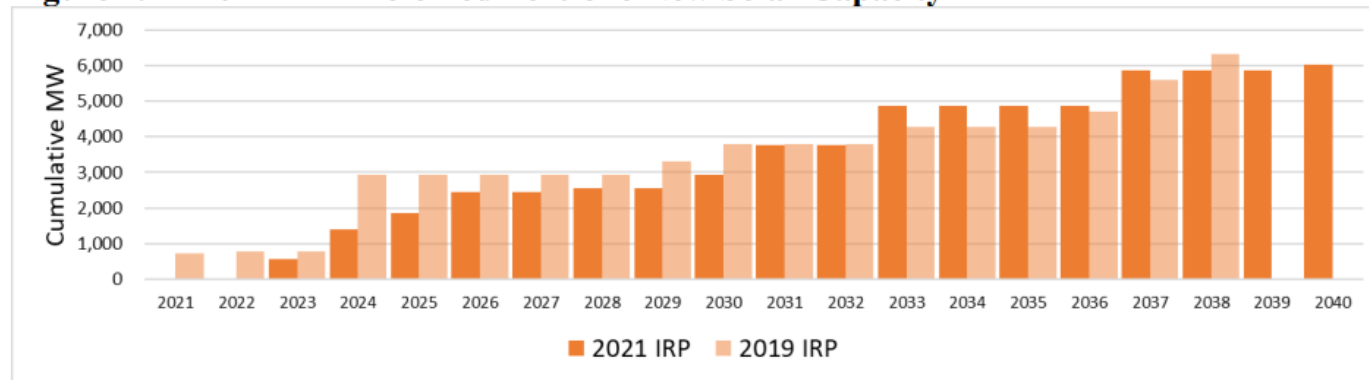
Figure 1.3 – 2021 IRP Preferred Portfolio (All Resources)



New Solar Resources

The 2021 IRP preferred portfolio includes 1,302 MW of new solar by the end of 2024 and 1,902 MW by the end of 2026. Through 2040, more than 5,600 MW of new solar is online as shown in Figure 1.4.

Figure 1.4 – 2021 IRP Preferred Portfolio New Solar Capacity*



* 2021 IRP solar capacity shown in the figure includes solar resources coming via the 2020 All-Source Request for Proposals by the end of 2024. Resources are shown in the first full year of operation (the year after the year-online dates). The reported capacity for the 2020 All-Source Request for Proposals solar resources reflects their expected maximum output after degradation in their first full year of operation. The maximum solar capacity prior to degradation is 1,306 MW.

2022 All-Source Request for Proposals:

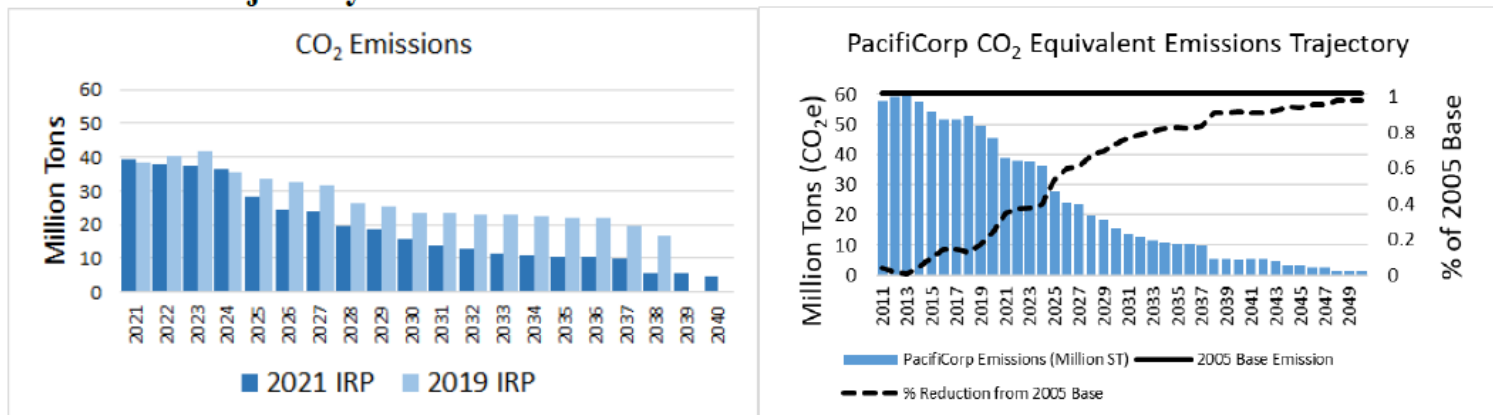
- PacifiCorp will issue an all-source Request for Proposals (RFP) to procure resources that can achieve commercial operations by the end of December 2026.

PacifiCorps – CO₂ Emissions

The chart on the left in Figure 1.13 compares projected annual CO₂ emissions between the 2021 IRP and 2019 IRP preferred portfolios. In this graph, emissions are not assigned to market purchases or sales, and in 2026, annual CO₂ emissions are down 26 percent relative to the 2019 IRP preferred portfolio. By 2030, average annual CO₂ emissions are down 34 percent relative to the 2019 IRP preferred portfolio, and down 52 percent in 2035. **By the end of the planning horizon, system CO₂ emissions are projected to fall from 39.1 million tons in 2021 to 4.8 million tons in 2040—a reduction of 88 percent.**

The chart on the right in Figure 1.13 includes historical data, assigns emissions at a rate of 0.4708 tons CO₂ equivalent per MWh to market purchases (with no credit to market sales), includes emissions associated with specified purchases, and extrapolates projections out through 2050. This graph demonstrates that **relative to a 2005 baseline, system CO₂ equivalent emissions are down 53 percent in 2025, 74 percent in 2030, 83 percent in 2035, 92 percent in 2040, 94 percent in 2045, and 98 percent in 2050.**

Figure 1.13 – 2021 IRP Preferred Portfolio CO₂ Emissions and PacifiCorp CO₂ Equivalent Emissions Trajectory*



Economic Impact to the State

- \$5.3 billion of total economic benefit through 2023
- \$4.1 billion in construction and investment in renewable energy facilities in Utah
- An estimated 4,368 full-time equivalent construction workers will be directly employed in the construction of the facilities from 2007 to 2023.
- \$154.4 million in annual economic activity and \$87.8 million in annual direct economic and fiscal benefits
- \$6.3 million in annual lease payments.
- \$24.6 million in annual property tax revenue throughout Utah by 2023

