Integrating a Battery Energy Storage System into the Grid

2024 Navajo Nation Energy Summit

RedStreak

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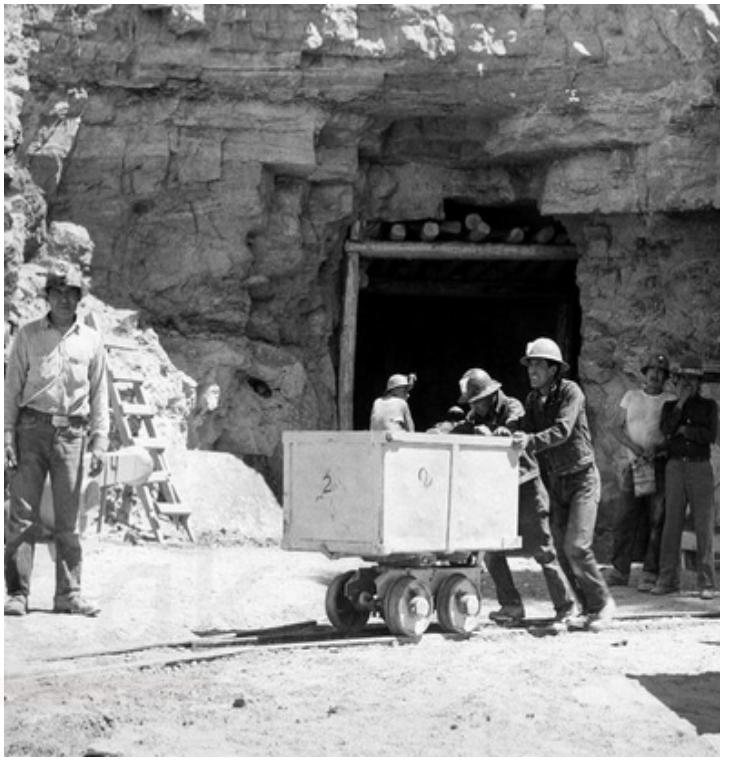
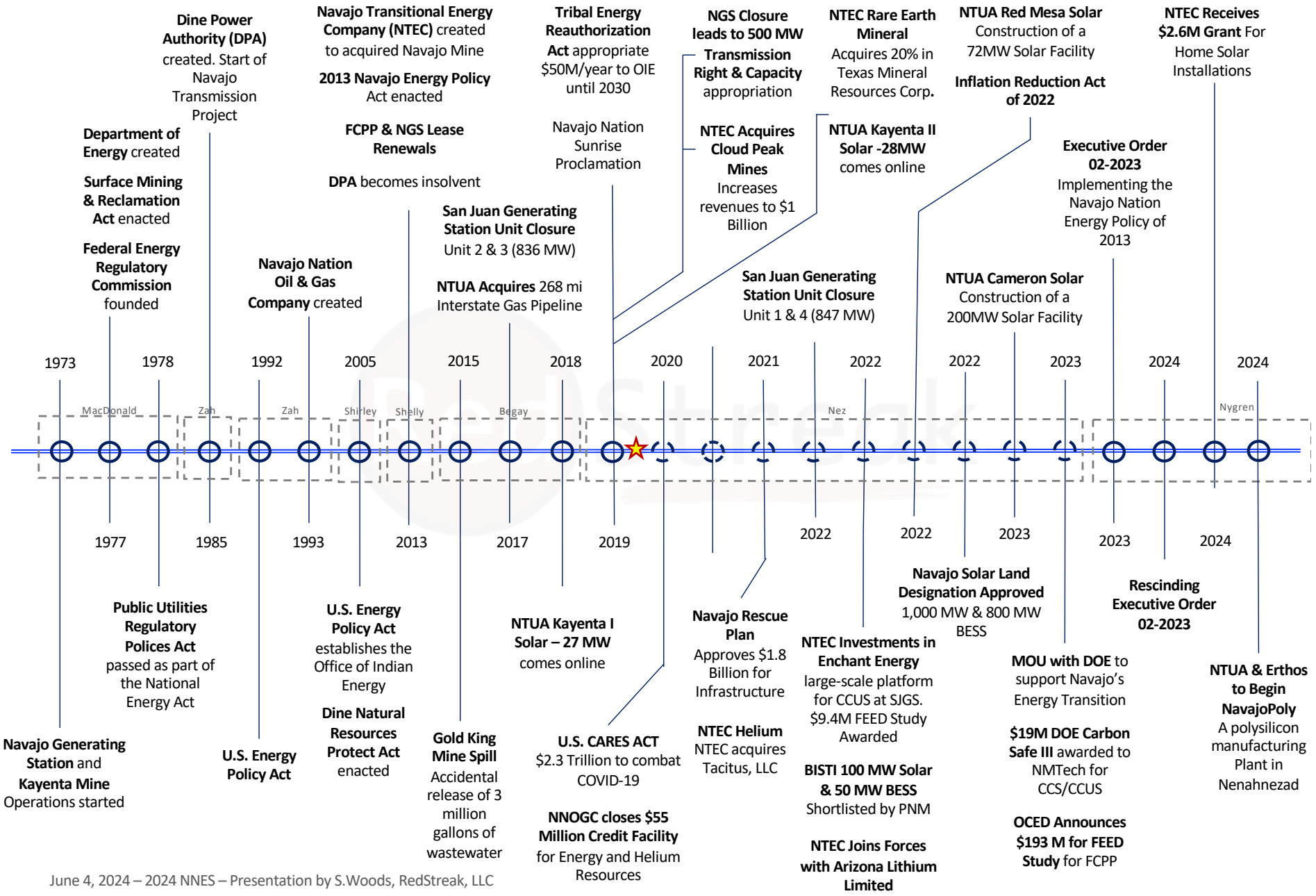
Navajo Nation
Trends & Impacts

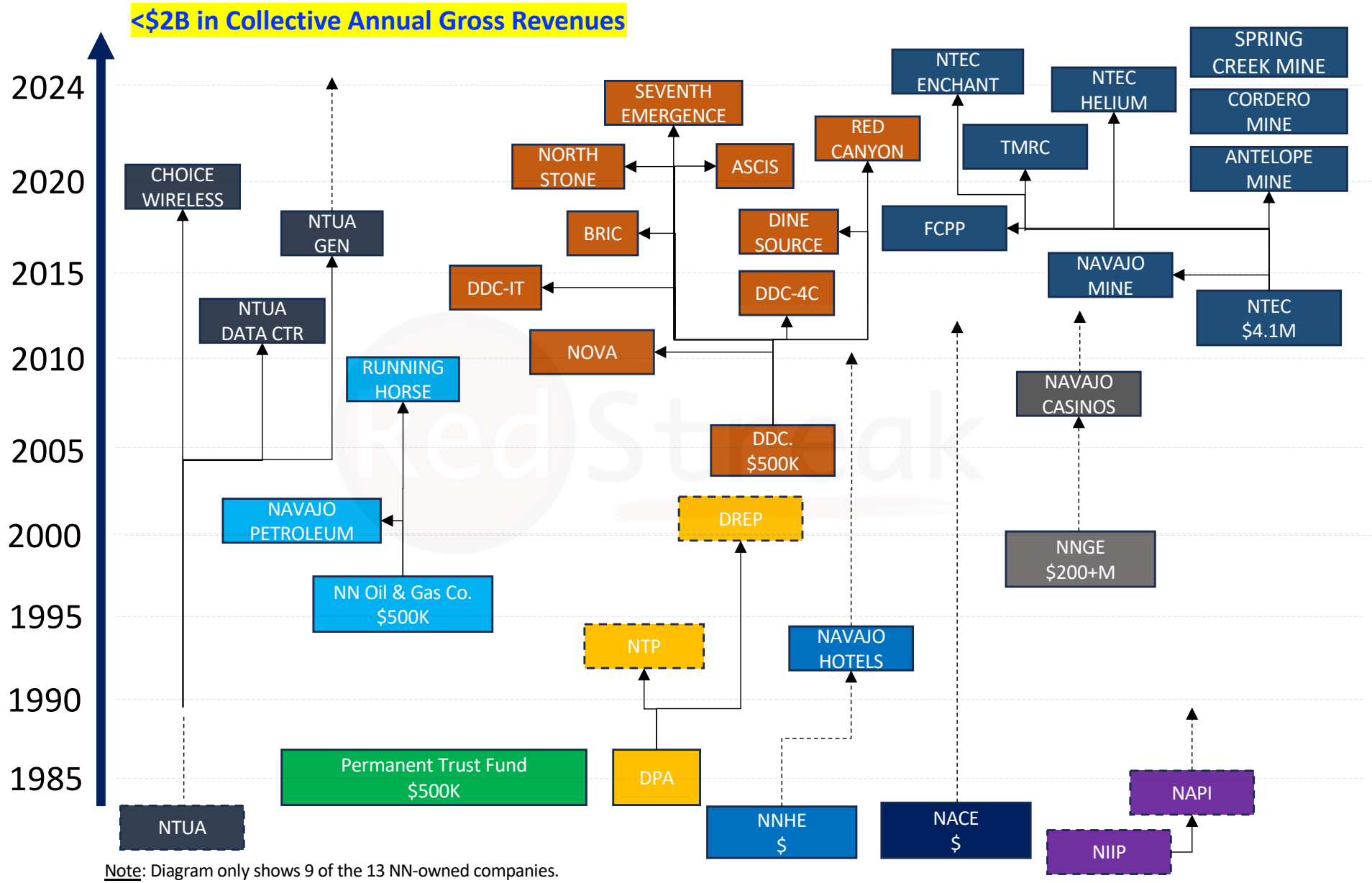
Educating & Empowering. Respect, Honor & Protect



Historical Energy/Resources Impacts *(P. MacDonald to B. Nygren)*



Revenue Investments. Navajo Nation Companies



Note: Diagram only shows 9 of the 13 NN-owned companies.

Navajo Nation. Disparities and Deficiencies

- **Food and Agriculture**
  - The USDA has deemed the Navajo Nation to be a "**Food Desert**".
    - Only **10 grocery stores** serving 170,000+ people across the Navajo Nation.
  - Rising costs for alfalfa & water scarcity for livestock.
- **Health & Wellness**
  - High **rise in health disparities** (Heart disease, diabetes, cancer, liver disease, etc.).
  - Poor health and physical inactivity leads to most health and mental disparities.
- **Water Security**
  - Approximately 30% of the Navajo Nation population **do not have access to clean reliable drinking water.**
  - Seasonal and long-term droughts and floods leads to **deficiencies in health, economy, and welfare**.
- **Energy Security**
  - More than **15,000+ homes still without electricity** on the Navajo Nation. Long-term power outages causes reliability and resiliency issues.
  - Navajo Nation **buys its electric power** from outside the Navajo Nation.
- **Fuel Security**
  - Nearly **80,000,000 million gallons of gasoline** are consumed annually on the Navajo Nation.
  - CO_2 equivalents: a) 1.5 M barrels of Oil, b) 744 M lbs. of annual coal burns, c) 28M trash bags of waste, etc.
- **Community Benefits**
  - Businesses engagement is **top-down with communities**. The planned workforce does not advance diversity, equity, inclusion, or justice into their business plans.
  - Huge **disparity between STEM education and the workforce**.

U.S. vs. Navajo. Today & Tomorrow

- A recent article found that 59% of Americans are looking forward to technological and scientific changes. While 30% think the new future will lead to being worse off than they are today.
- The next 100 years of Science, Technology, Medicine, and Engineering
  - Physical Internet, Mars Settlements, Uncovering Earth's Depths, STEM, Artificial Intelligence, Robotics, Smart Electric Power, Energy Storage Advances, 3D Printed Bones, 3D Printed Foods, Advanced Flights, Direct Air Capture, Self-Healing Technology, Artificial Neurons, Clean Fuels, etc.

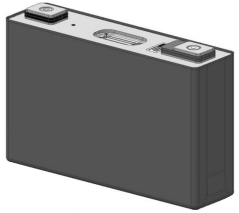
Vs.

- What do Navajo's think of the future? Catching up with current times.
- Most political Navajo campaigns today are about:
  - Infrastructure
    - Water
    - Electric
  - Jobs
  - Roads
  - Creating Economy
  - Education, Language, and Culture
  - Housing
  - Public Safety

Battery Storage Basics

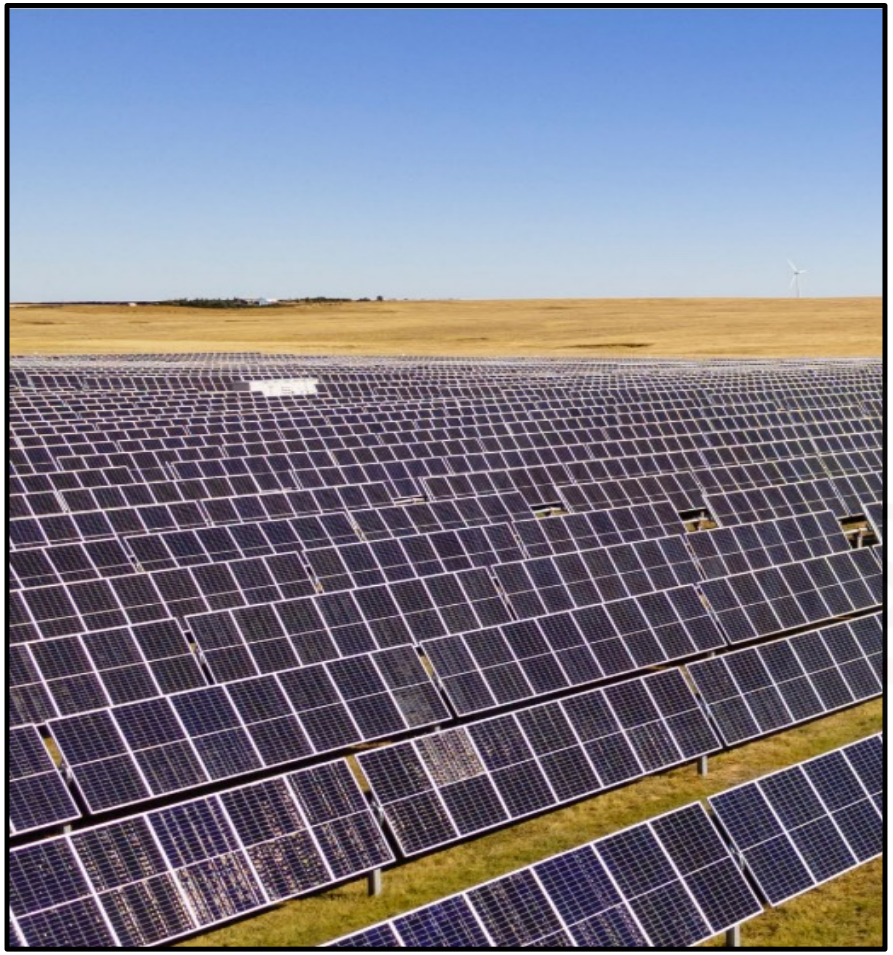
Batteries. Different Types & Storage Capacity

- Lithium
- Alkaline
- Carbon- Zinc
- Silver-Oxide
- Zinc-Air
- Nickel-Cadmium
- Nickel-Metal



Battery Storage Facilities

Solar-Plus-Storage. State-of-the-Art System

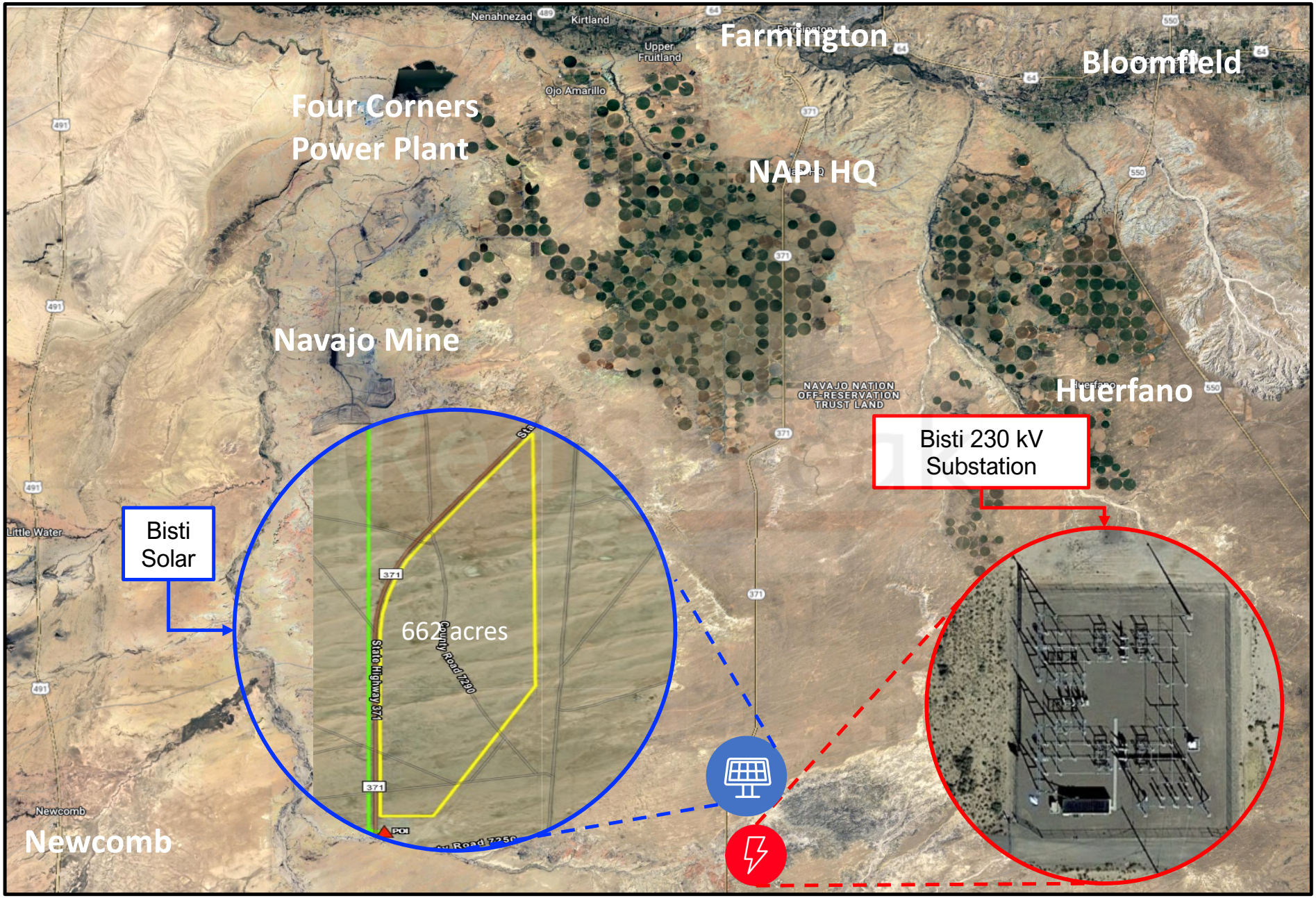


Solar PV Facility

Battery Energy Storage System (BESS)

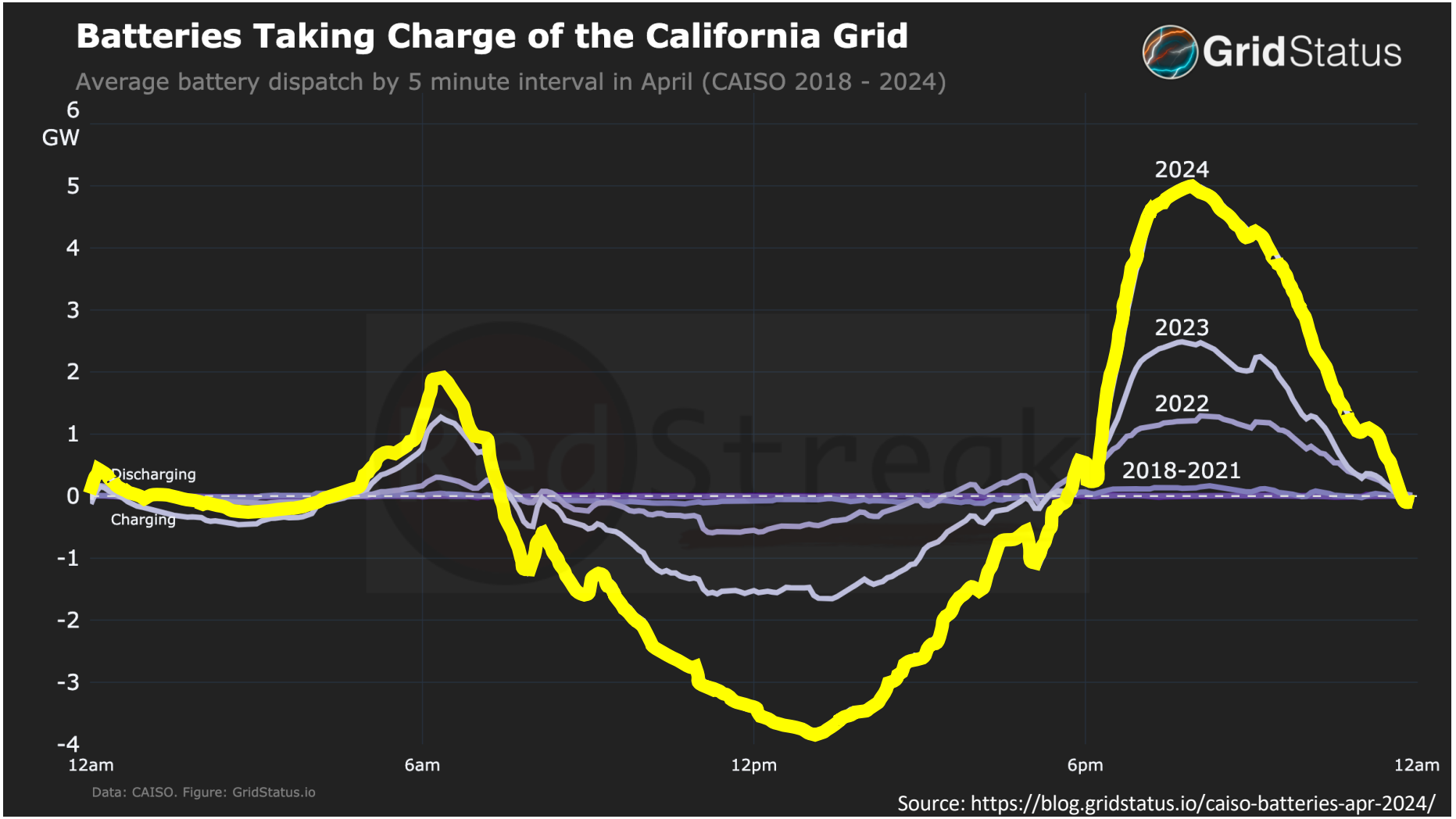
State-of-the-art Solar plus BESS integrated into the Transmission grid to power thousands of homes using Lithium-ion batteries.

NextEra - Bisti Solar. 100 MW & 50 MW BESS



Battery Energy Storage Systems

Trends. Battery Storage Taking Charge in CAISO Grid

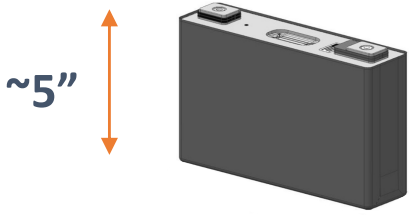


- Batteries discharged over 5GW at peak times.
- This battery discharged is eroding natural gas generation each evening.
- The shifting of batteries charged by solar is phasing out gas in the peak morning/evening times.

Utility-Scale. Typical Battery Storage System

Battery Container
~10 Racks/ Container

Battery Racks
~8 Modules/ Rack

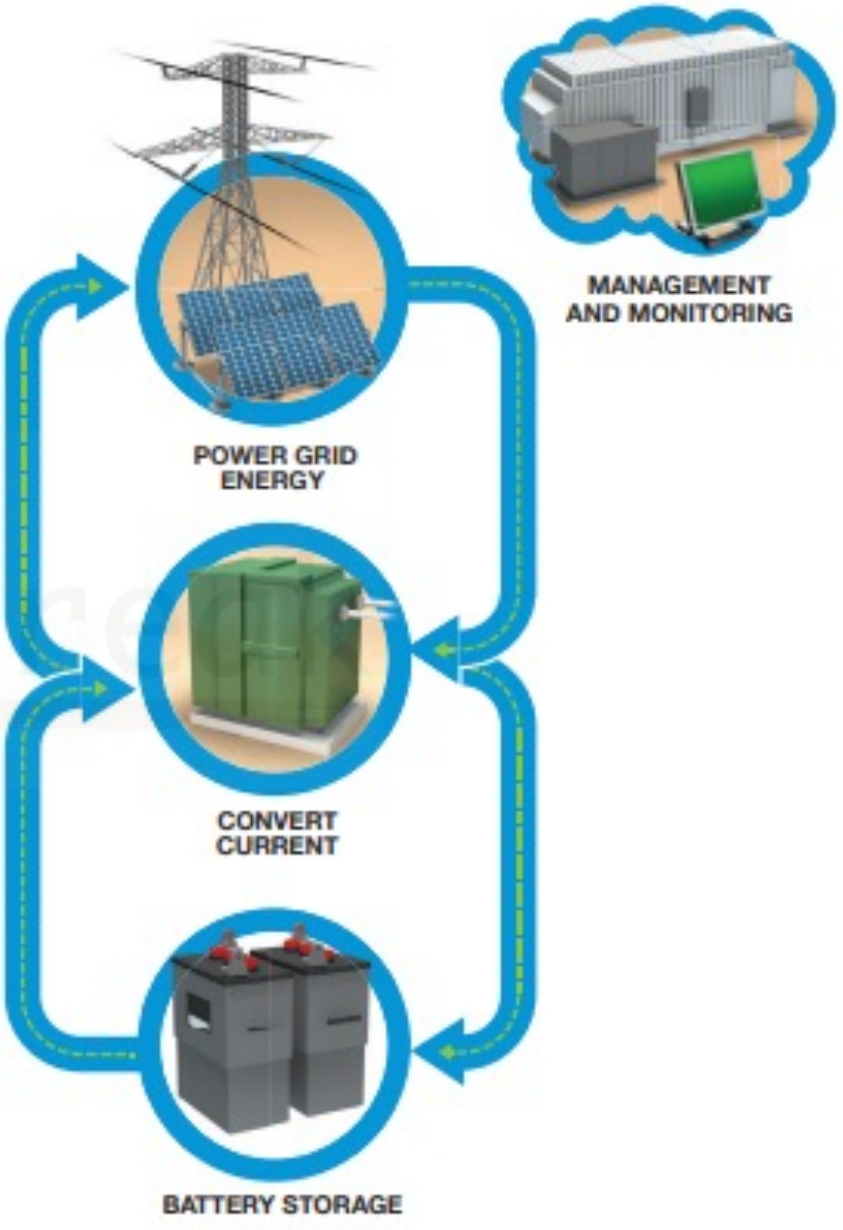


Battery Cell
Prismatic

Battery Module
~56 Cells / Module

How it Works?

- **Facilities have large containers filled with racks of smaller battery cells.**
  - Relatively small footprint and scalable.
  - Most containers can provide energy for 770 homes for 4 hours daily.
  - Large-scale facilities could have more than 200 containers, providing power to small cities.
- **Provides power when it's needed.**
  - Stores energy during low-demand periods and discharges when demand is high.
  - Provides additional services to maintain reliability.
- **Battery energy storage facilities are long-term investments.**
  - Most commonly use lithium-ion batteries
  - Lifespan can be over 25 years.



State-of-the-Art Fire Safety Program

- **Battery energy storage projects are engineered to meet the highest standards of safety and fire protection to minimize risk.**
  - They are continuously monitored by on-site system and off-site 24-hr control room.
  - They undergo rigorous industry testing and certification related to fire safety.
  - They Equipped with cooling system to operate within ideal temperatures.

- **Battery storage system are often coordinate with first responders and fire officials to develop appropriate emergency response plans.**
  - Emergency action plans submitted with applications.
  - Training local responders includes multiple briefings: prior to construction, prior to start-up and upon request.

Remote Operating Centers

Performance Diagnostic Center

- Detects small changes in voltage, current or temperature.
- Evaluates hundreds of million data points per second
- Uses AI to enable early-stage repairs
- Avoids potential maintenance/year

Renewable Operations Control Center

- Staffed with energy experts 24/7/365
- Can shut down the system remotely and alert local support.
- Remotely operates Generation, Transmission, etc.

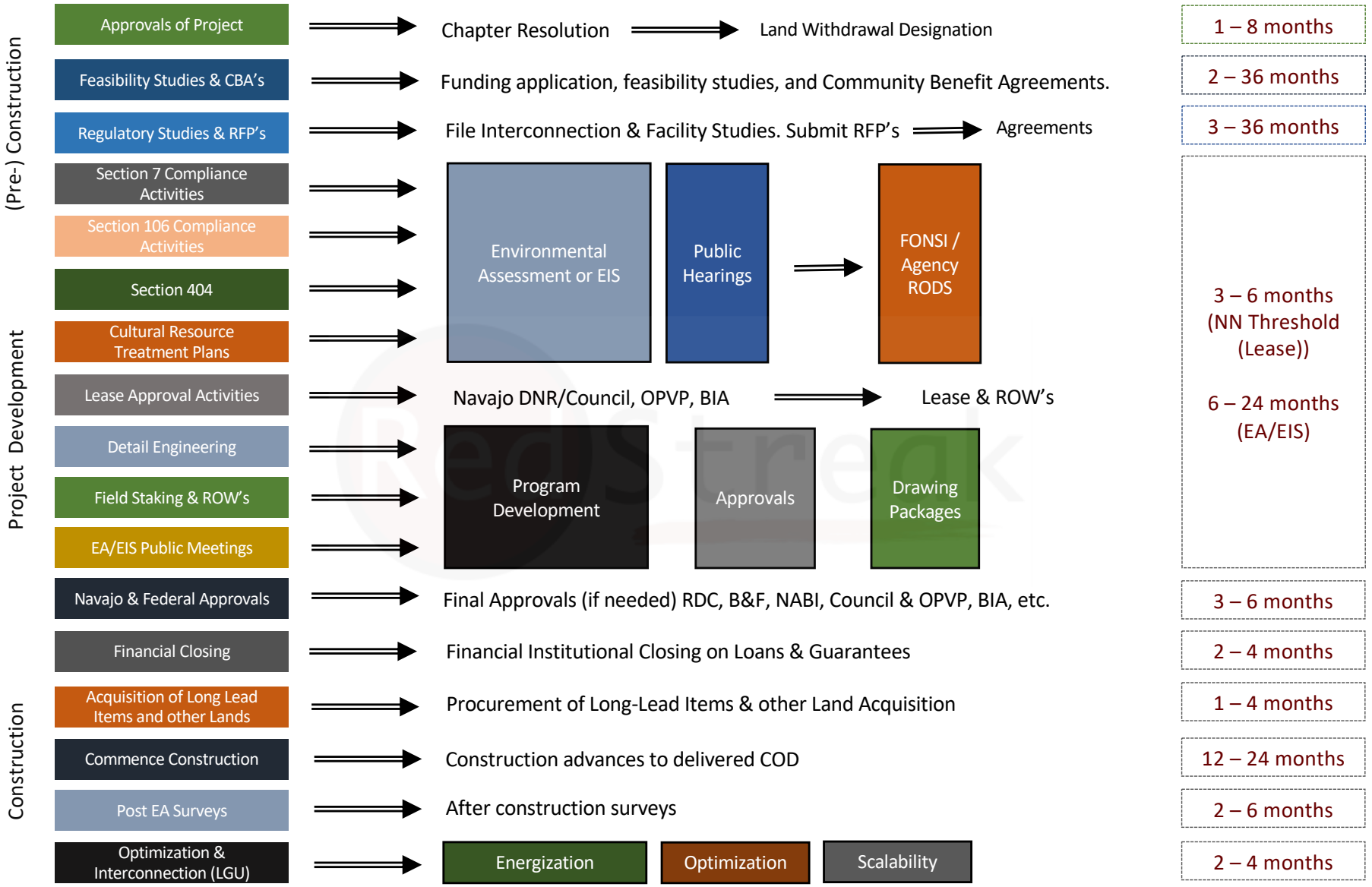
Integrating Battery Storage into the Grid

Why Integrate Battery Energy Storage?

- **Battery Energy Storage System (BESS) helps optimize the way the power grid delivers electricity to customers.**
  - Smooths out fluctuations in frequency and voltage.
  - Reduces energy losses and waste.
  - Avoids the need for some system upgrades, including big transmission projects.
  - Extends the hours a renewable energy project can operate. i.e., even after the sun goes down or the wind stops blowing.
  - Allows customers to enjoy renewable energy more hours of the day.

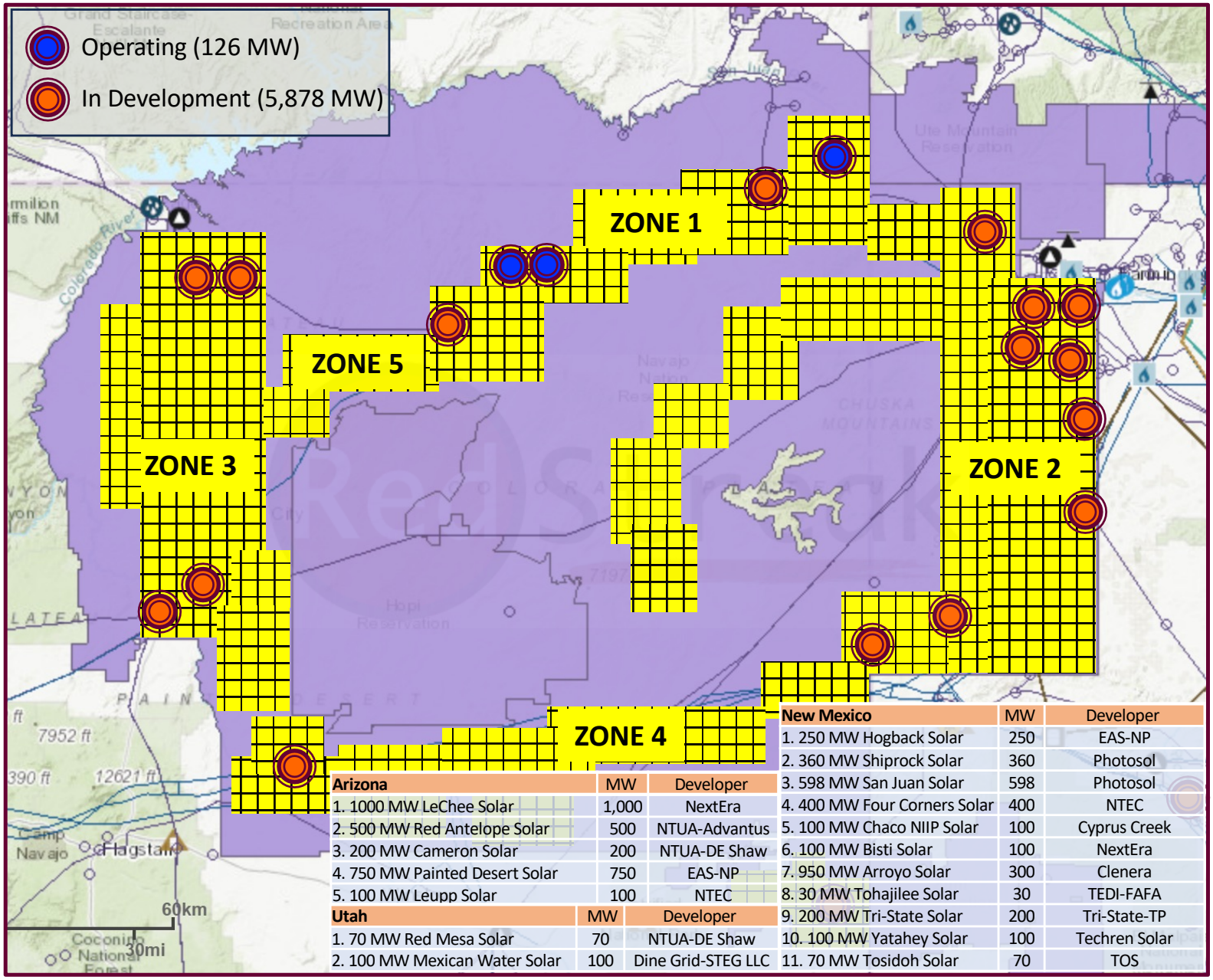
Project Approval Processes

Processes. Tribal & Regulatory Requirements



Navajo Nation Clean Energy Potential

Navajo Nation. Potential Energy Zones & Projects.



Arizona	MW	Developer
1. 1000 MW LeChee Solar	1,000	NextEra
2. 500 MW Red Antelope Solar	500	NTUA-Advantus
3. 200 MW Cameron Solar	200	NTUA-DE Shaw
4. 750 MW Painted Desert Solar	750	EAS-NP
5. 100 MW Leupp Solar	100	NTEC

Utah	MW	Developer
1. 70 MW Red Mesa Solar	70	NTUA-DE Shaw
2. 100 MW Mexican Water Solar	100	Dine Grid-STEG LLC

New Mexico	MW	Developer
1. 250 MW Hogback Solar	250	EAS-NP
2. 360 MW Shiprock Solar	360	Photosol
3. 598 MW San Juan Solar	598	Photosol
4. 400 MW Four Corners Solar	400	NTEC
5. 100 MW Chaco NIIP Solar	100	Cyprus Creek
6. 100 MW Bisti Solar	100	NextEra
7. 950 MW Arroyo Solar	300	Clenera
8. 30 MW Tohajilee Solar	30	TEDI-FAFA
9. 200 MW Tri-State Solar	200	Tri-State-TP
10. 100 MW Yatahey Solar	100	Techren Solar
11. 70 MW Tosidoh Solar	70	TOS

Estimate Potential. Renewables & Battery Storage

Renewable Energy Potential

- Solar PV – Utility: 6,000+ MW (measured), hypothetical (energy zones): 40,000+ MW.
- Solar CSP: 830,414 MW.
- Wind: 4,562 MW.
- Geothermal & Hydro: 160,372 MW & 84 MW
- Estimated Economic Potential: $2B+ in Solar Modules (solar PV measured), $3B+ in estimated annual revenues

Battery Energy Storage

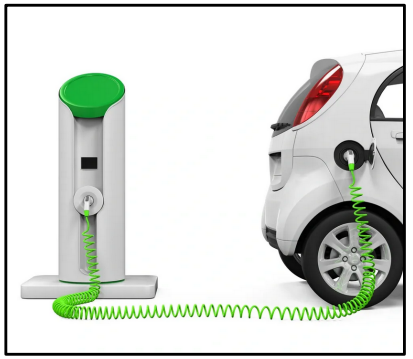
- Storage size would typically match energy capacity size.
- $4B+ for EPC (estimated, solar PV measured only)

Source: Geospatial Analysis of Renewable Energy Technical Potential on Tribal Lands – E. Doris, A. Lopez and D. Beckley (NREL), Developing Clean Energy Projects on Tribal Lands – Office of Indian Energy (DOE)

Final Thoughts. Educating & Empowering

❖ Navajo Nation Deficiencies & Disparities

- Create jobs, energy security, commit to a clean energy program, added community benefits, Introduce more electric vehicles, support STEM related initiatives, potential horizontal/vertical growth (manufacturing, training, etc.)



❖ Interconnecting to the Grid

- Grid stability, increase energy efficiencies, low-costs system impacts, supports zero-neutral programs, enjoy more renewable energy, etc.

❖ Other Related Impacts

- Add strategic plans for the Navajo energy policy, Become a technology leader, develop a deeper technical workforce, create a thriving & regenerative economy, etc.

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