Tohatchi Energy Project

A Clean Energy Feasibility & Deployment Plan

Tohatchi Chapter – Public Worksession

7/29/23

Tohatchi Chapter

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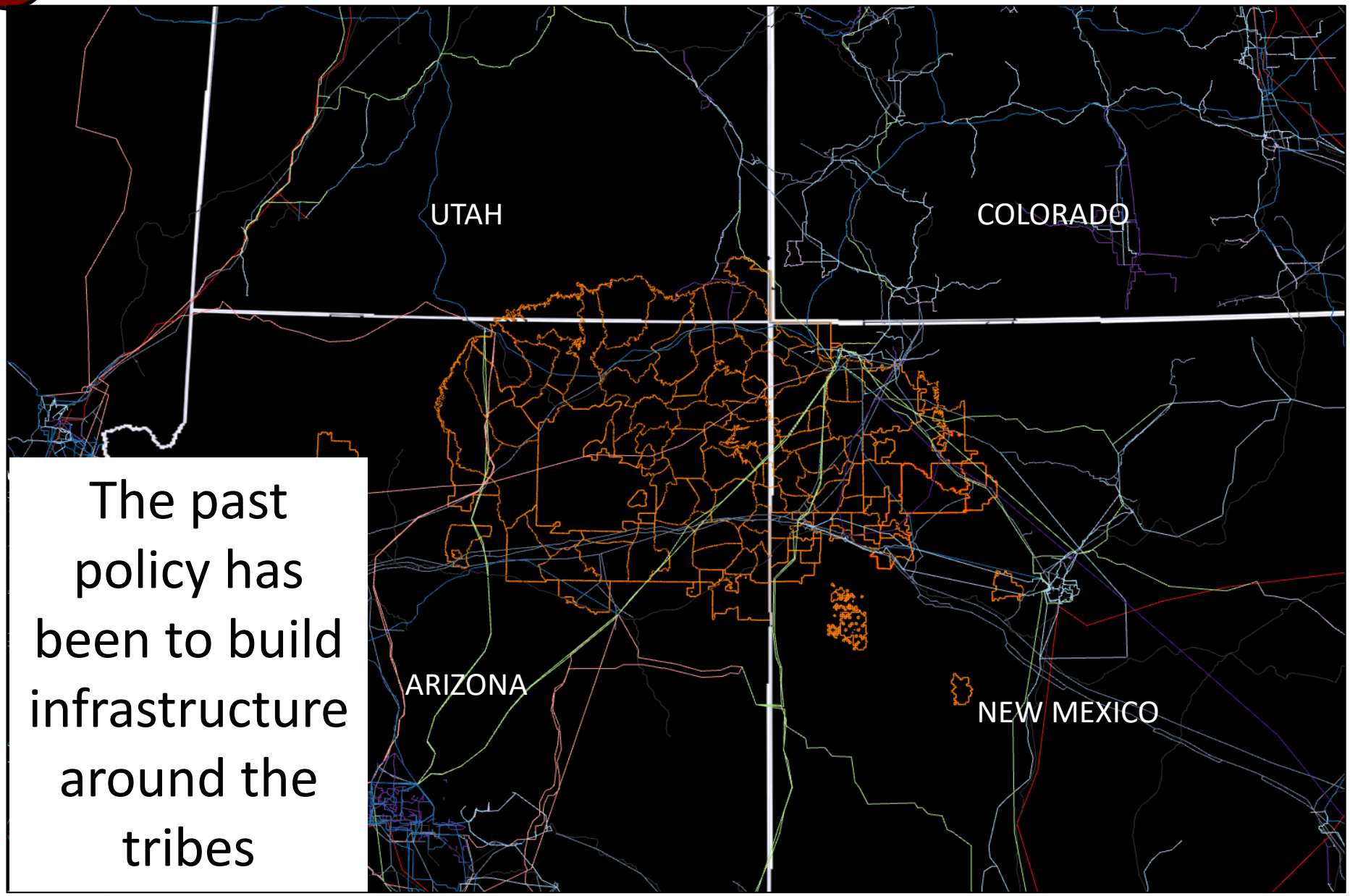
Navajo Nation Disparities and Deficiencies

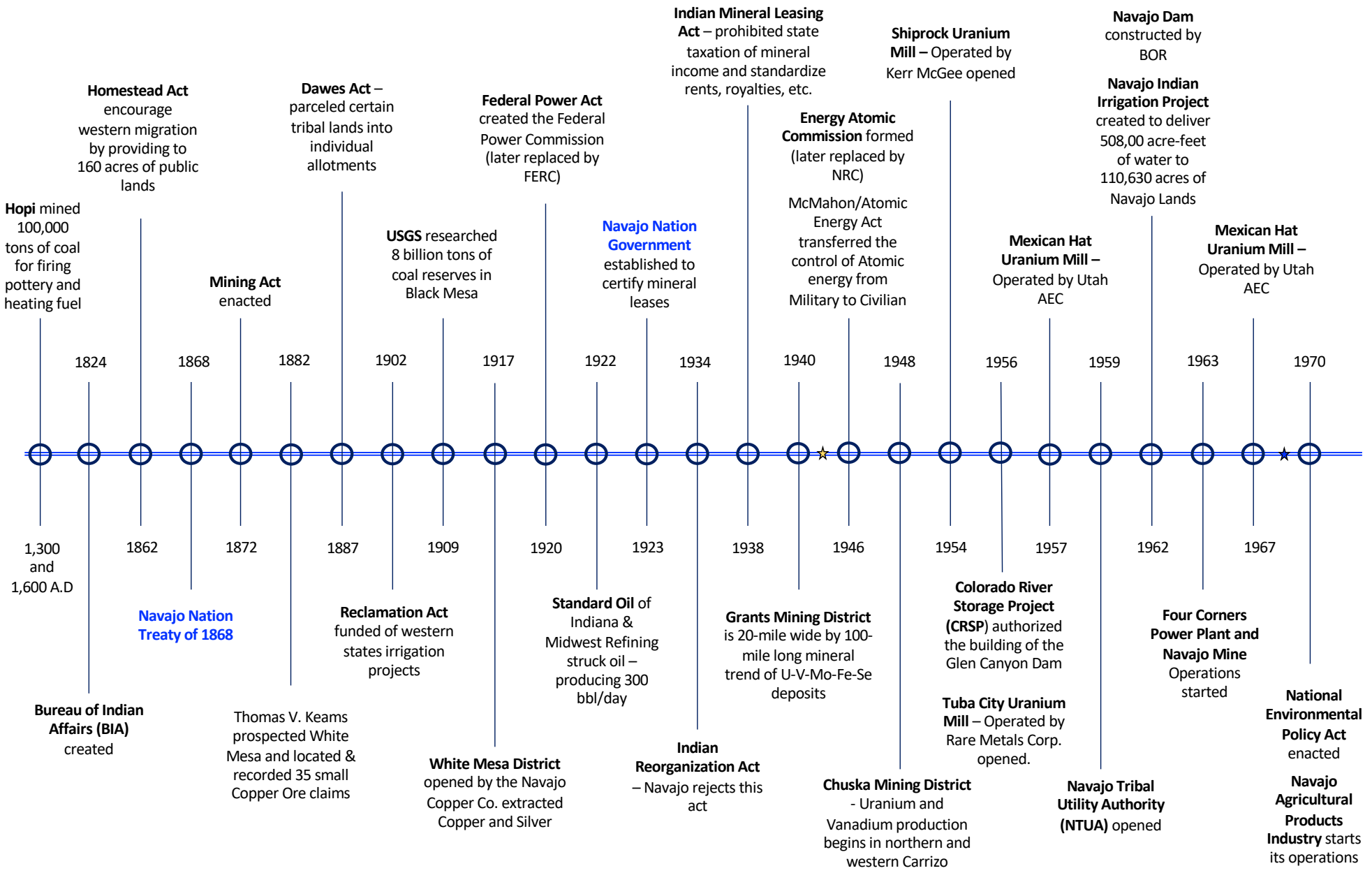
- Food and Agriculture
  1. The USDA has deemed the Navajo Nation to be a "**Food Desert**".
     - Only **10 grocery stores** serving 170,000+ people across the Navajo Nation.
  2. Rising costs for alfalfa & water scarcity for livestock.
- Health & Wellness
  1. High **rise in health disparities** (Heart disease, diabetes, cancer, liver disease, etc.).
  2. Poor health and physical inactivity leads to most health and mental disparities.
- Water Security
  1. Approximately 30% of the Navajo Nation population **do not have access to clean reliable drinking water.**
  2. 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
  1. Businesses engagement is **top-down with communities**. The planned workforce does not advance diversity, equity, inclusion, or justice into their business plans.
  2. Huge **disparity between STEM education and the workforce**.

Navajo Nation

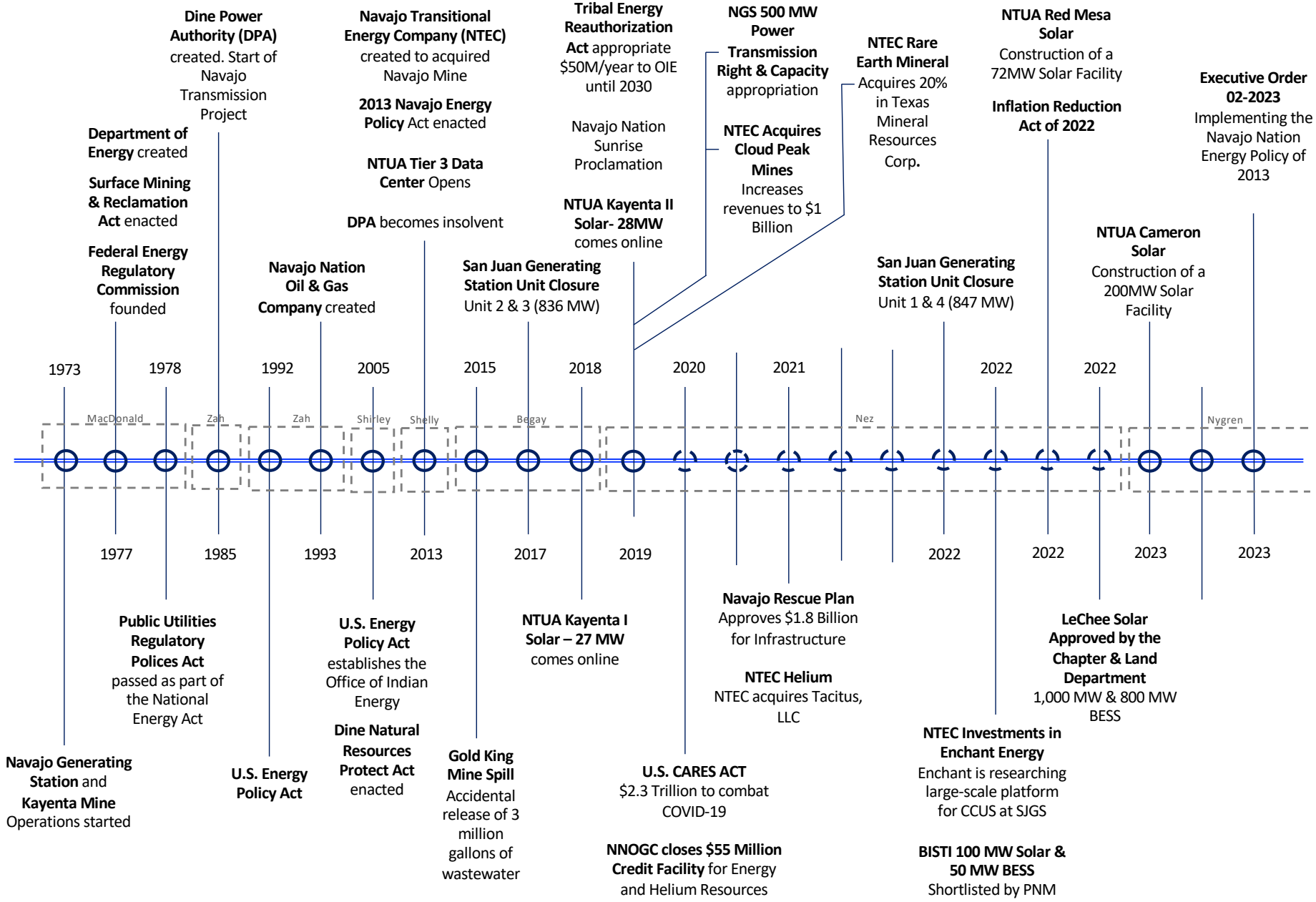


The past policy has been to build infrastructure around the tribes

Historical Impacts *(Narbona/Manuelito to R. Nakai)*



Historical Impacts *(P. MacDonald to B. Nygren)*



What Does History Tell Us?

“Those who do not learn history are doomed to repeat it.”

“Those who fail to learn from history are doomed to repeat it.”

Opportunities and Megatrends

Opportunity

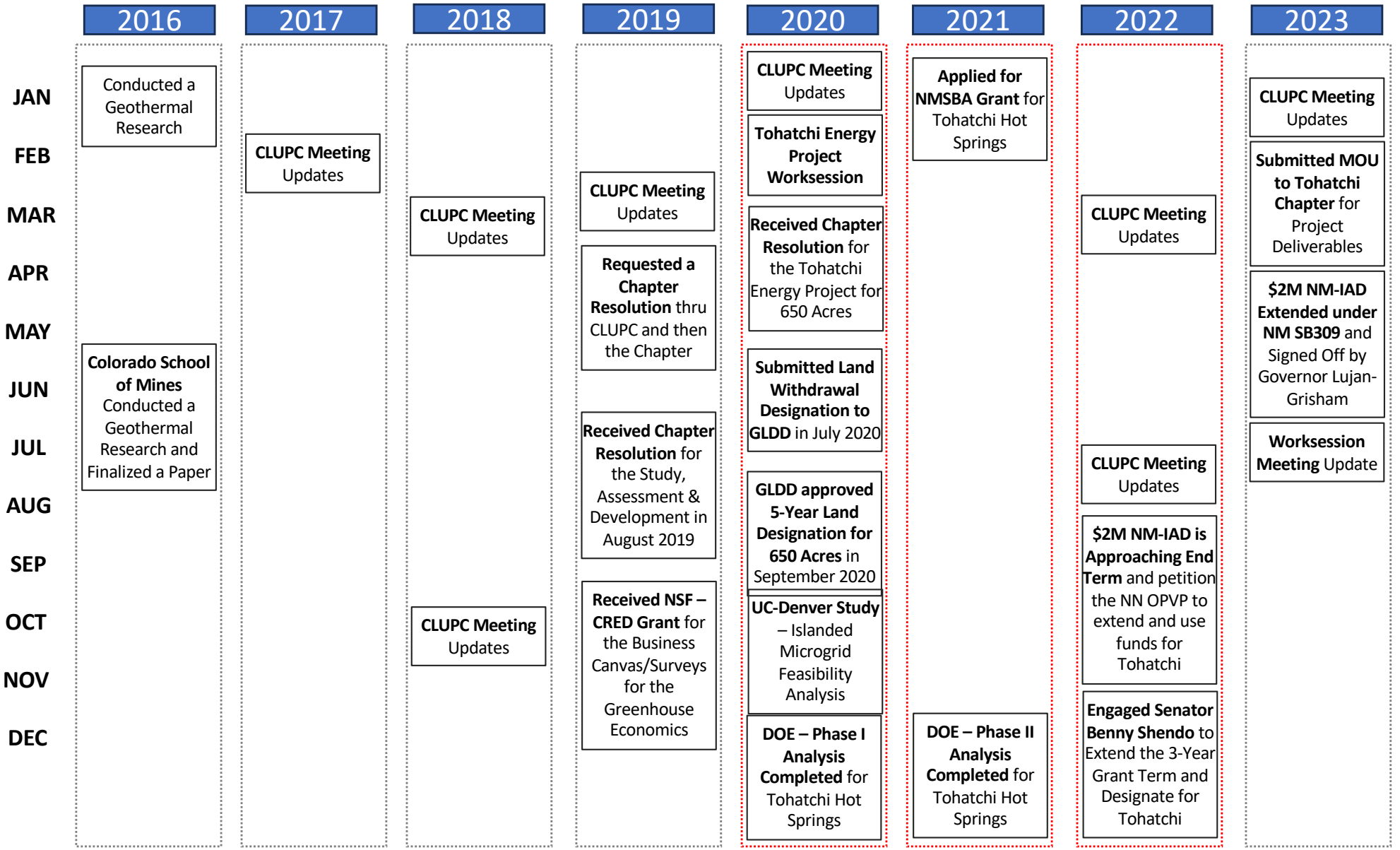
- **Geothermal Greenhouse**
  - New Ponderosa Seedlings Market for the Chuska Mountain, or other nearby forests.
  - Participating in the 3% annual growth with U.S. revenues estimating around $5 B.
- **Green Hydrogen**
  - Supports the U.S. zero-carbon initiatives by 2050.
  - Navajo Road Map potentially could transition into a scalable market-base product by 2030.
  - Supports the NM ETA and Wester Interstate's Hydrogen Hub initiative.
  - Take advantage of the IRA subsidies for H_2.
- **Utility-scale solar favorable for ESG investors**
  - Participate in the Solar PV Module industry. Module industry is expecting a 4.3% growth rate. Take advantage of the IRA ITC/PTC and Direct Pay incentives.
  - RFP's for suitable lands should be developed.
  - Additional workforce development opportunities.
- **Implement Sustainability Goals**
  - Strategies for zero-carbon, workforce, energy efficiency buildings, new markets, and other climate related goals.
- **STEM and Diversity Gap Bridge**
  - Larger workforce specialize in energy systems.
  - Close the gap between businesses and educational institutions.

Market Megatrends

- **Addressing Climate Change: Shift to Cleaner & Renewable Energy**
  - State policies, goals & mandates to reduce carbon emissions.
  - Global policies & agreements to address climate change.
  - Corporate initiatives to reduce carbon footprint.
- **Electricity demand in the U.S. will expand as electric vehicles increase market share**
- **Enabling Factors for Expanded Renewable Generating Capacity**
  - Recent coal plant closures are securitized by energy transition bonds.
  - ESG and infrastructure funds are seeking renewable energy investments.
  - Activist investors favor climate change.
- **Regional Utilities Integrated Resource Plans**

  Retire Coal Generators by 2031.
  Joined or joining the CAISO Energy Market.
  Plan for renewable resource additions.
  Access to Power Marketers to enhance reliability.
  Planned for energy efficiency targets and pursue demand-side management incentives.
  Increase investments to modernize the grid.
  Carbon Free by 2050.

Project Timeline of Events



Various Tohatchi Chapter Meetings

Tohatchi Chapter Resolutions

2019 Resolution

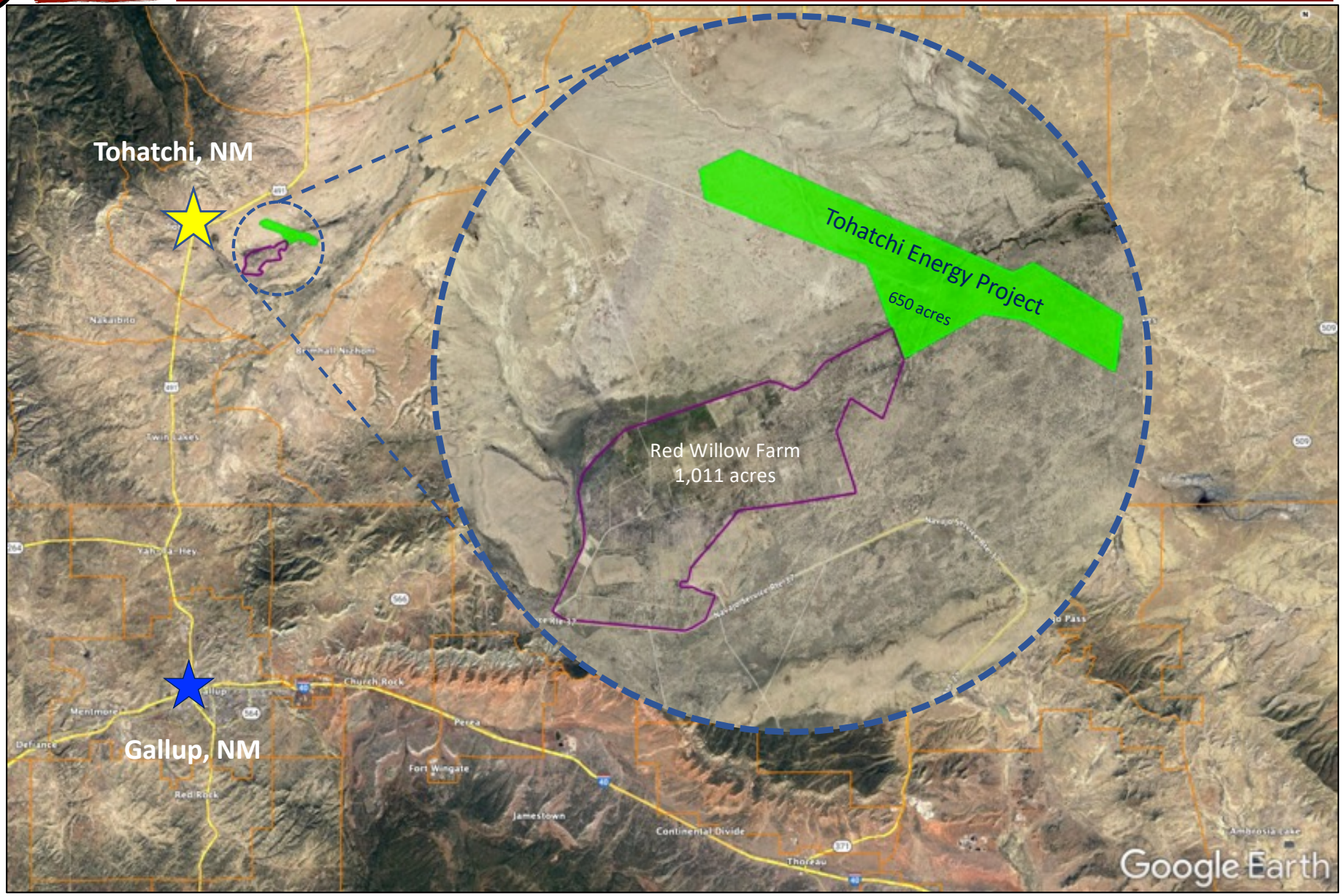
- Supporting and Approving the Study, Assessment, and Development of a Hybrid Energy Nexus Facility, in Partnership with Tosidoh Group, LLC.; The Tosidoh Energy Project will Integrate Proven and Innovative Technology Opportunities for the Tohatchi Community.
- To explore and conduct a project assessment to determine the feasibility of developing a clean and renewable energy project;
- Seek funding and grants on behalf of the Chapter to study, explore, quantify, evaluate, develop, research technology, and mitigate development efforts of any known energy resources;
- Results of the exploration and research will enable all parties to determine the feasibility of potential economic and energy development opportunities;
- A total of 650 acres, within the current Hot Springs for a multi-phase exploration and feasibility study and consents to potentially withdraw such lands for clean energy development and potential energy uses

2020 Resolution

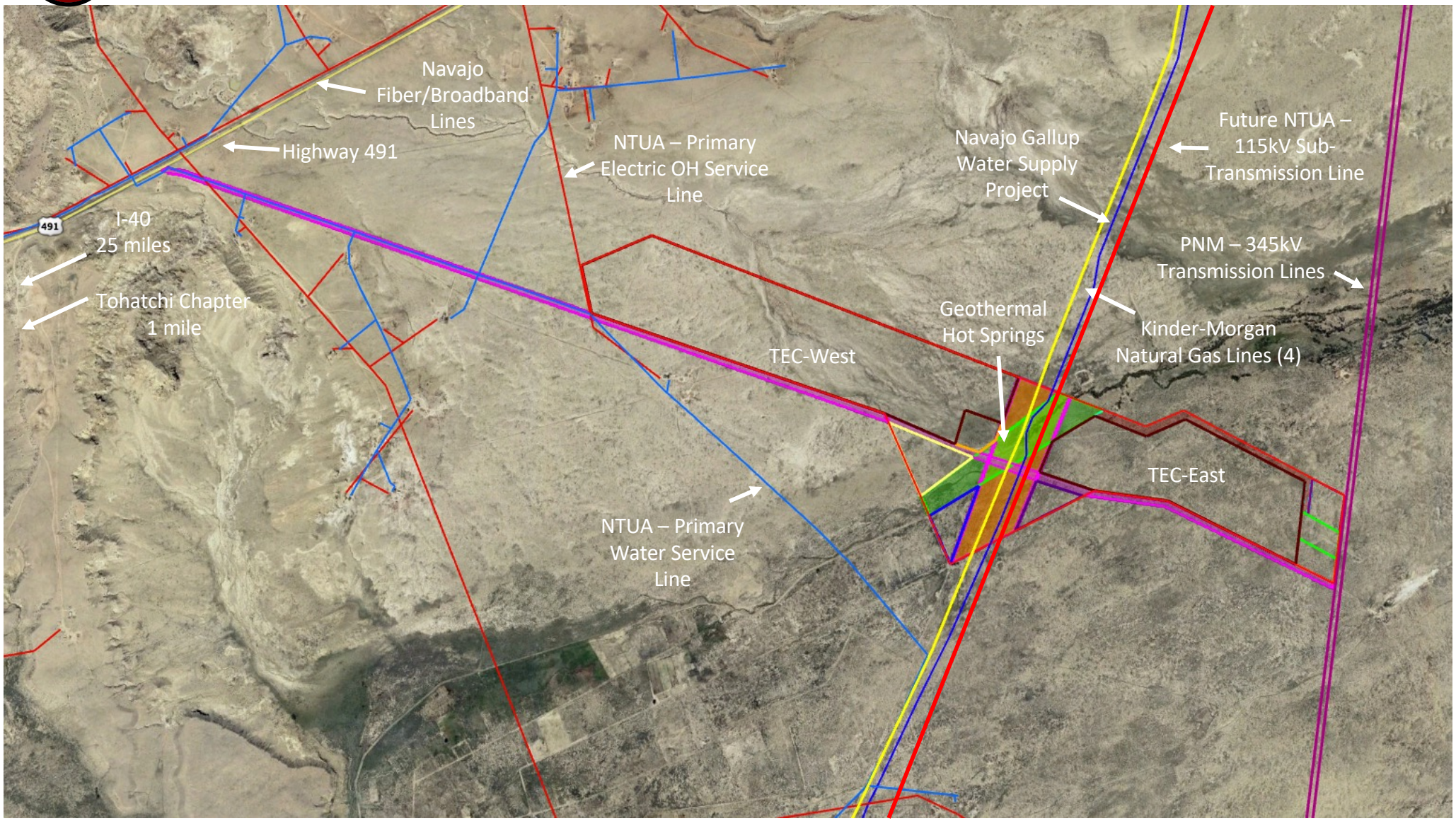
- Supporting and Approving the Land Withdrawal for up to 650 Acres within the Tohatchi Hot Springs Area; Supporting and Approving the Business Site Lease, or General Lease for the Tohatchi Hybrid Energy Nexus Project (”Tosidoh Energy Project”) to be developed and managed by Tosidoh Group, LLC.
- Tosidoh Group has studied, assessed, researched and investigated and concluded sustainable products can be developed from the Tosidoh Energy Project that would enhance the community’s agricultural, recreational, educational and local economic and energy security;
- Numerous reports and presentations to the community and concluded that a larger site for a renewable energy facility would be competitive in the marketplace.
- Resolution for land withdrawal designation for up to 650 acres for a renewable energy facility with a battery energy storage system, microgrid solution for the geothermal greenhouses, a demonstrated green hydrogen project and other ancillary equipment and infrastructure for the Tohatchi Energy Project, such as; roads & drainages, utility connections, electrical substation and associated buildings;

Tohatchi Energy Project

Tohatchi Energy Project Location

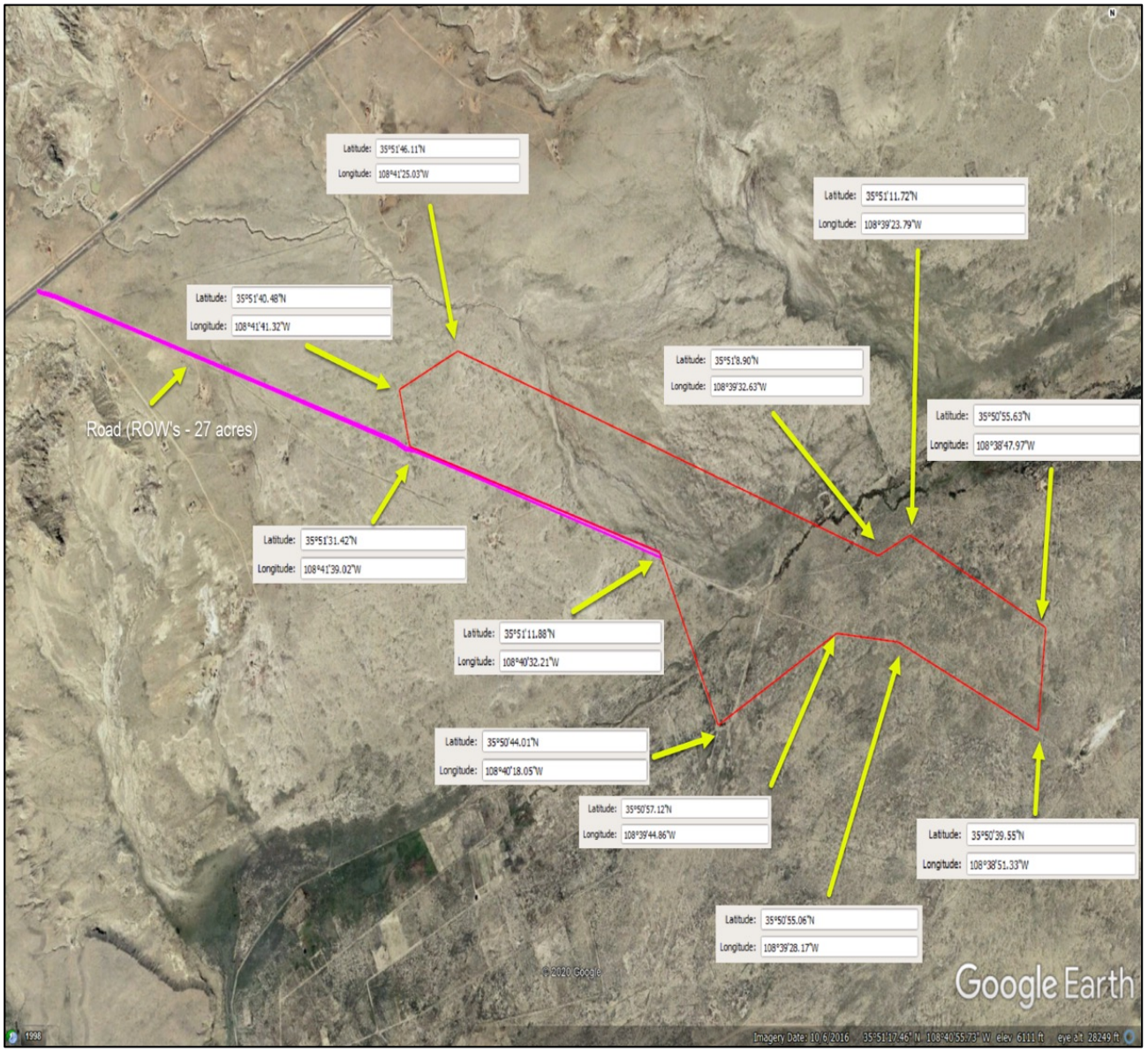


Tohatchi's Existing Infrastructure

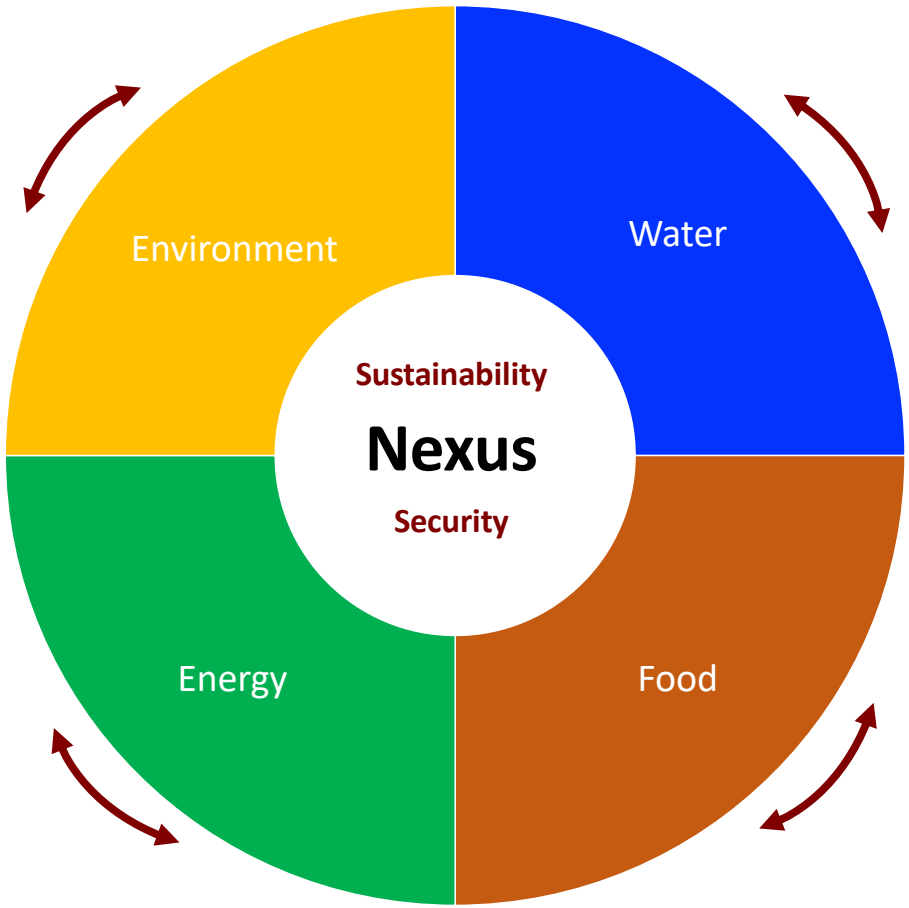


Approved Navajo Land Withdrawal Designation

- The Tosidoh (Tohatchi) Land Withdrawal Package was submitted to the General Land Development Department (GLDD) within the Navajo Land Department on July 24, 2020.
- The 650 acres and the surrounding land areas are currently being utilized for livestock grazing.
- A letter from the DOI-BIA, Fort Defiance Branch of Natural Resources (BNR) researched and indicated that there are **no grazing permit holders and permit holder names within the 650 acres (project area)**. However, there are permit holders surrounding the project area and BNR indicated there are twenty-two (22) grazing permit holders within a 2-mile radius of the project area.
- The Navajo Land Department, GLDD approved the Land Withdrawal 5-Year Designation for the 650 acres was approved on **September 15, 2020**.



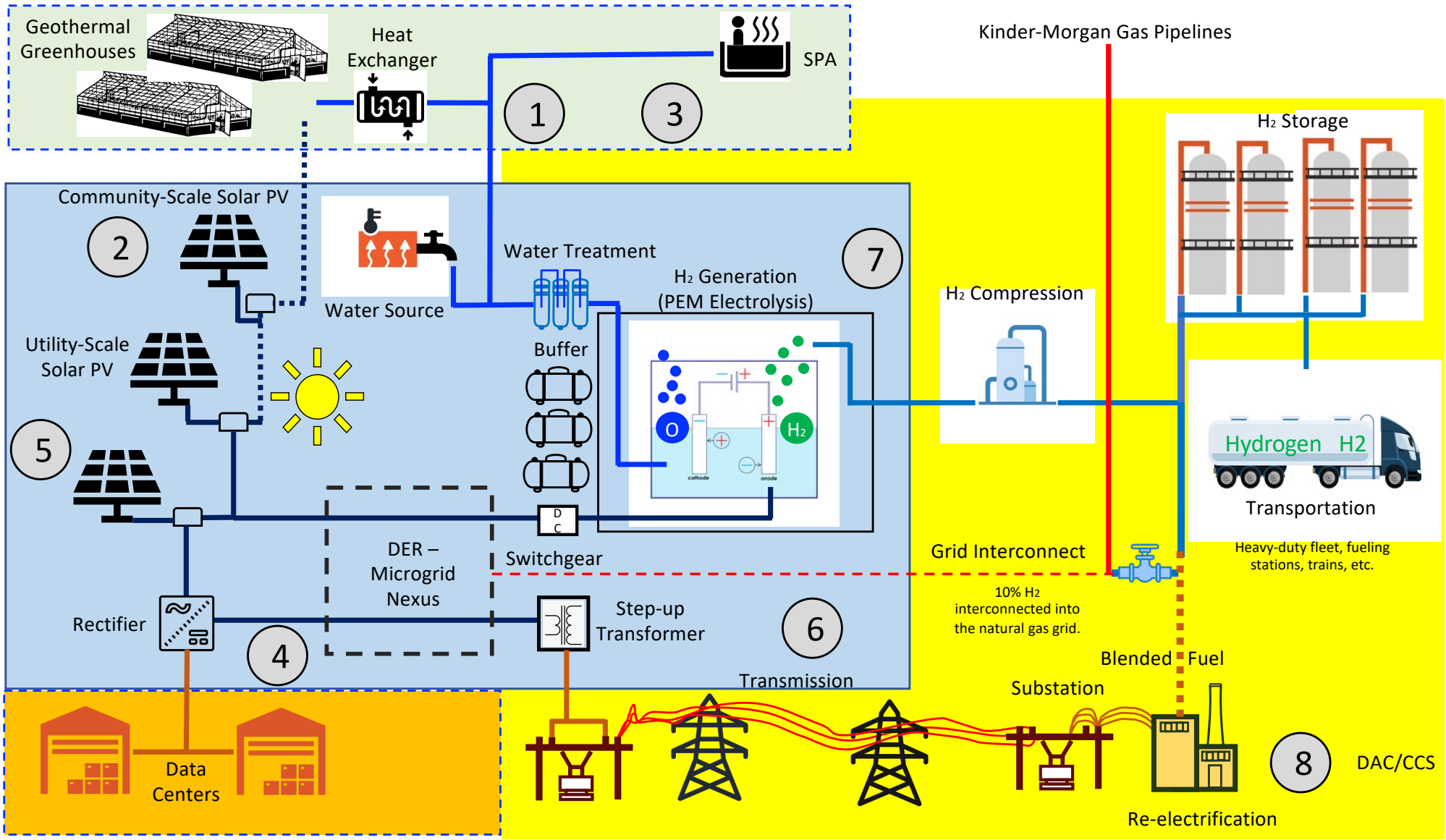
Brainstorming the "Big Picture"



- Chuska's geology is about 25-30 million years ago
- The ecological environment is estimated to be 5,000 years old since the dawn of the last mini-ice age
- Tohatchi Hot Spring is a free-flowing hot temperature artisan water that was drilled in the 1940's to conduct mineral assessments
- The well has an ambient temperature of 40-degree Celsius at the surface of the well. Bottom-hole temp is higher (est. 240 C)
- The Tohatchi Community local economy is depressed and desires to develop the lands and use the available resources for sustaining a localized economy. 650 acres is dedicated to this energy project
- The Tohatchi Project is a multi-phased approach to create empowerment, buy-in, capacity building a local economy with sustainable products.

Geothermal Greenhouses + Tree Farm + Solar PV + Battery Storage + Clean Fuels (CT or Fuel Cells)

Tohatchi Energy/Technology Hub Masterplan



Tohatchi Project Plan Phases

Project Ready: Feasibility Study, Community Approvals, Land Withdrawal Designation, Business Plan, Community Benefits & Other Agreements, Lease & ROW's, Etc.

Community

Phase 1: 1 MW Community Solar Project
- $2M from the State of New Mexico from the New Mexico Indian Affairs Department
- EPC Plan

Phase 2: Geothermal Greenhouse Project
- Business Plan

Phase 3: Commercial SPA
- EPC Plan

Microgrid

Phase 4: Microgrid Masterplan & Data Center Project
- Business Plan

Phase 5: Large Utility-Scale Solar Project
- ECP Plan

Phase 6: Interconnection to EHV Transmission System
- EPC Plan

Zero-Carbon

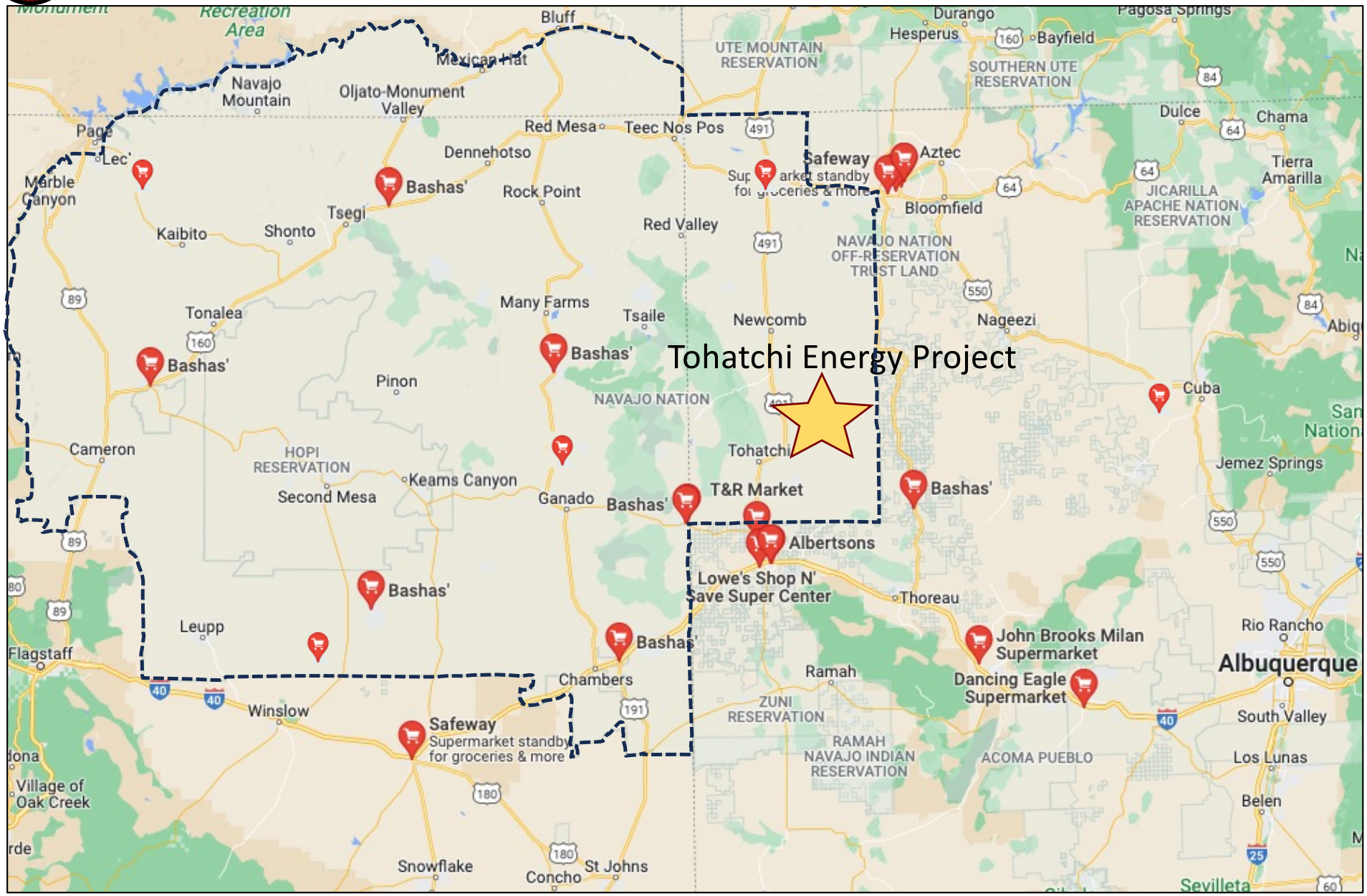
Phase 7: Green Hydrogen Project (Electrolysis, Compression, Storage, Pipeline Interconnect)
- EPC Plan

Phase 8: Zero Carbon Flex Fuel Simple-Cycle Turbine Project (CCS/DAC, etc.)
- EPC Plan

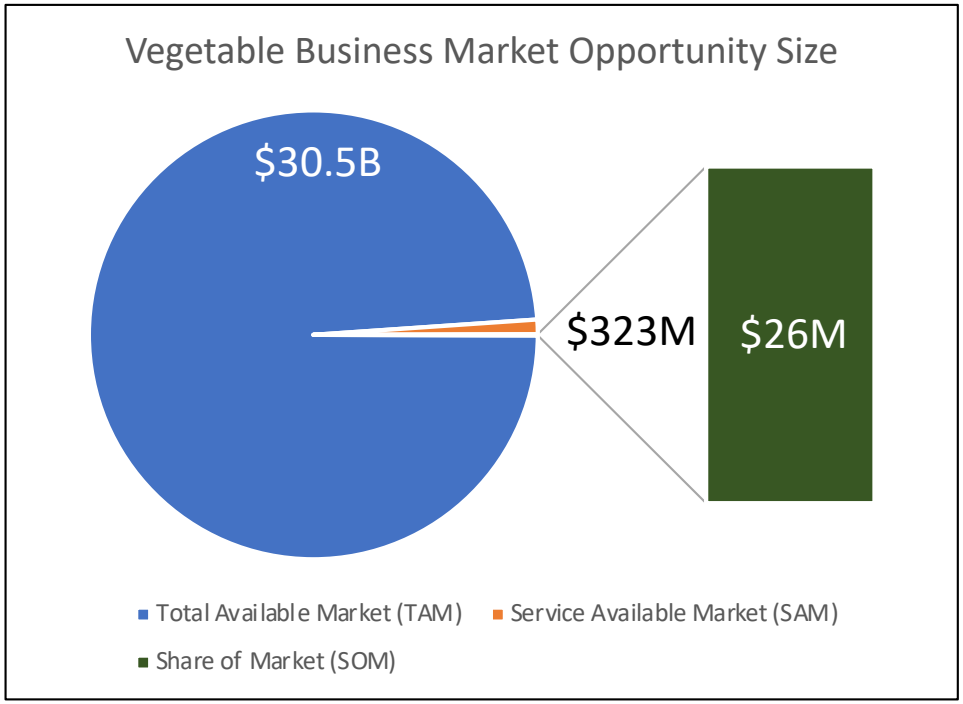
Tohatchi Community Infrastructure

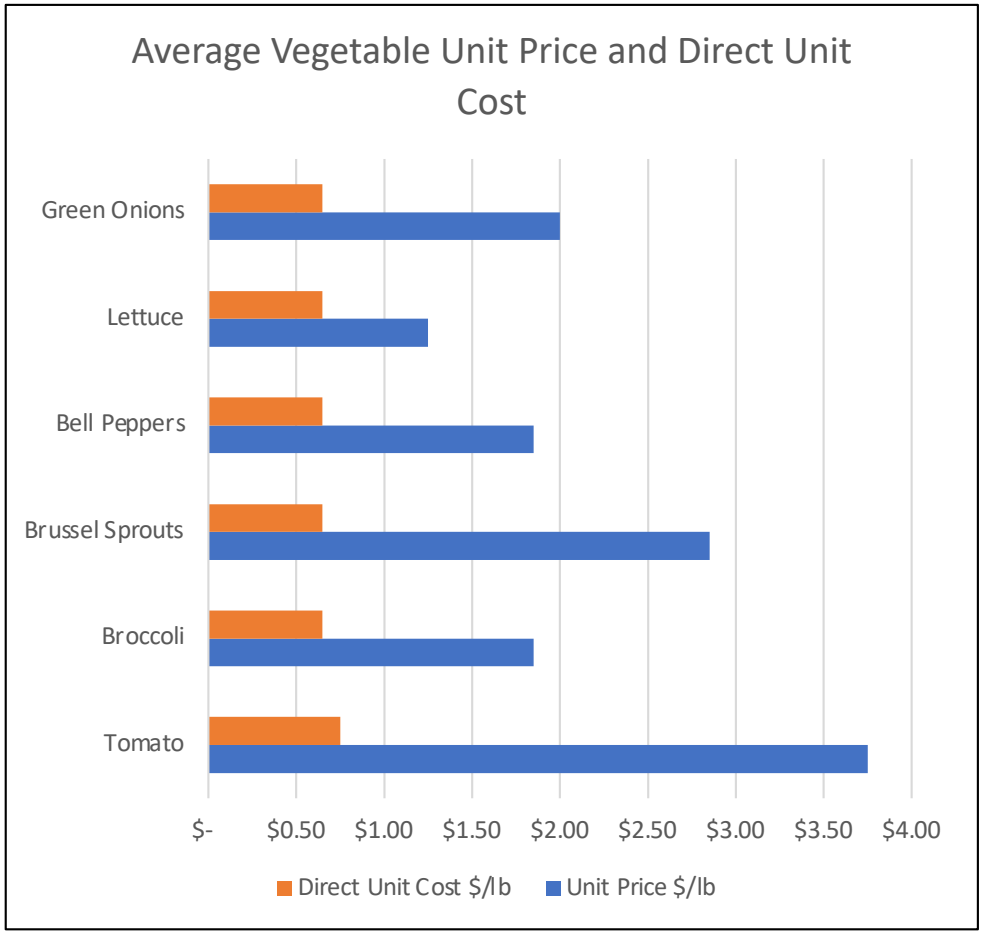
- Geothermal Greenhouse
- Tree Nursery
- SPA

Navajo Nation Food Market Location



Produce Market Size & Costs Analysis





- In 2020, we've surveyed and developed a business canvas under a **National Science Foundation** (NSF) Grant to determine if a fresh produce market would be a product-fit match for the community.
- Targeting a commercial greenhouse business in the community would support and foster the following:
  - Buy Navajo, integrated technologies will increase product sales by 20%, Increase Tohatchi's economy by 15%, Eating Healthier would provide a 70% healthier diet for the community.

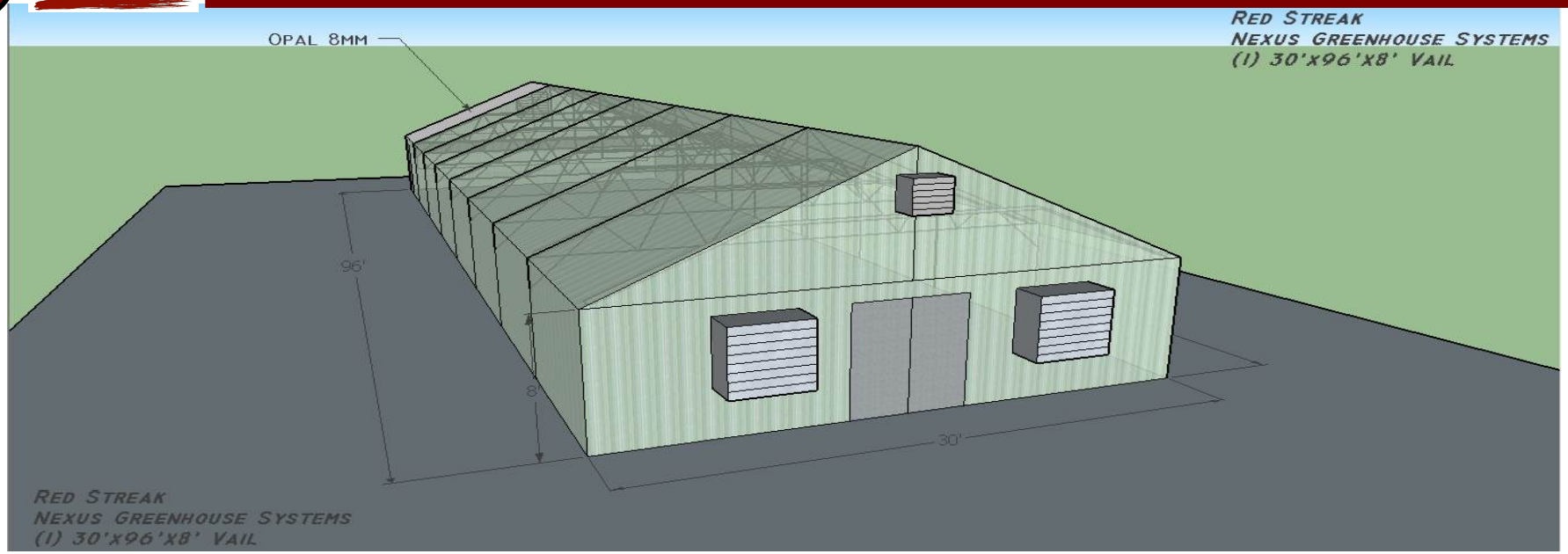
Tohatchi's Ch'iyáán Market Business Plan

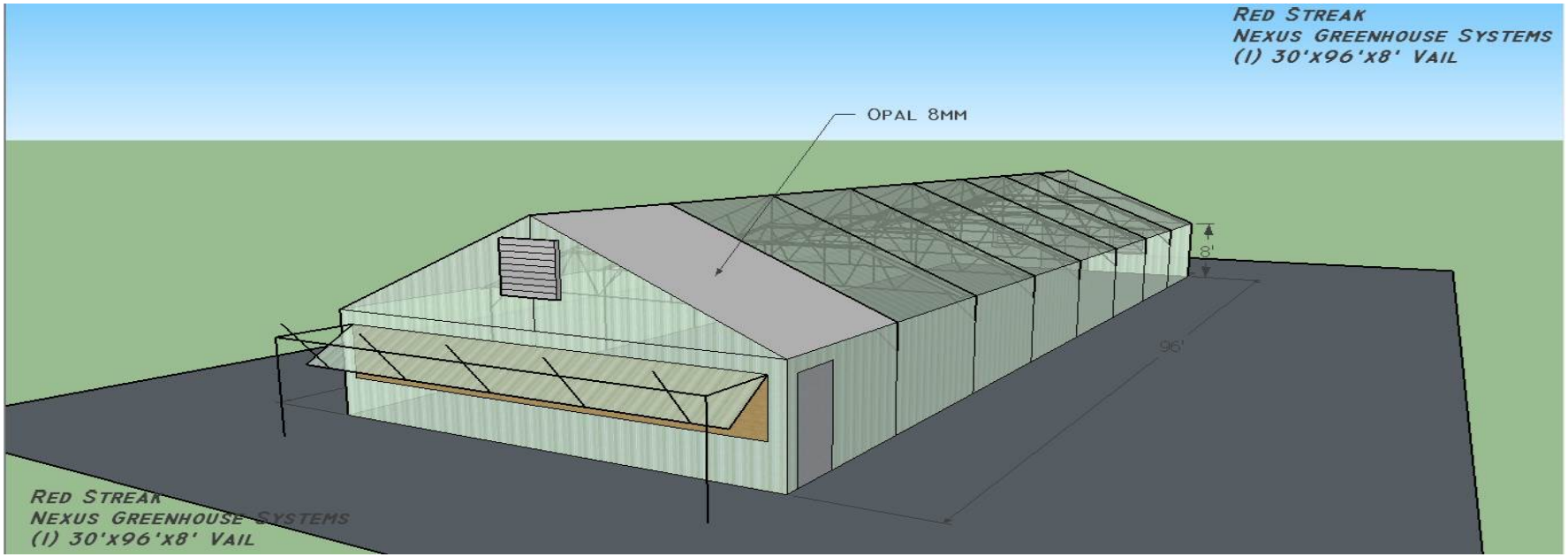
- The Tohatchi Ch'iyáán Market (TCM) is a unique business venture that utilizes a sustainable greenhouse garden utilizing a natural geothermal hot spring in Tohatchi, New Mexico
- Current production methods require vegetables and produce to be picked week's early and shipped vast distances to get to markets during the winter and spring months of the Desert Southwest
- There is an annual demand for vegetable in the Four Corners region, leaving TCM an opportunity to capitalize and to be very competitive in the marketplace
- TCM's products will be of higher quality, available year-round, and picked for the best taste and nutritional value
- TCM's revenue will be from prearranged purchasing agreements with local and regional retailers throughout New Mexico, Arizona and the Four Corners Region
- Mission

  "Provide the highest quality and be the most reliable producer in the region."

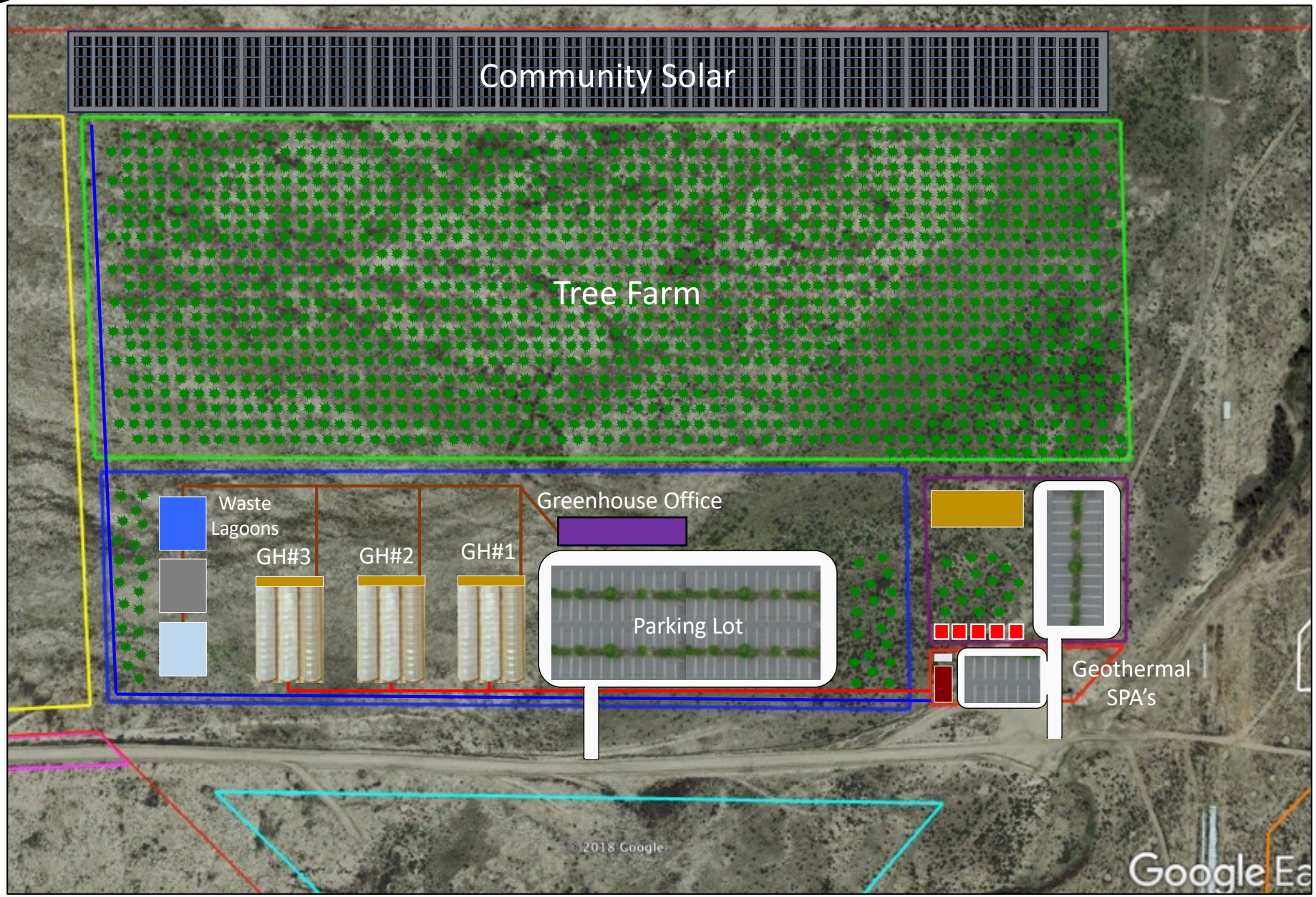
- TCM will be Genetically Modified Organism (GMO) free and TCM's vegetables are cultivated through practices that emphasize social and environmental stewardship
- TCM's vegetables will be characteristically known for their superior flavor, texture and wide coloration of the vegetable grown in a geothermal greenhouse
- TCM's vegetables will be marketed along the same branding as the "Navajo Beef" brand sold in nearby grocery stores and casinos
- Research shows, the vegetable market in New Mexico as well in the surrounding states is moderately large and continues to grow. TCM feels that many more potential customers exist. These potential customers could also be certain Navajo Chapters and Navajo Nation Programs

Greenhouse System Type - Concept





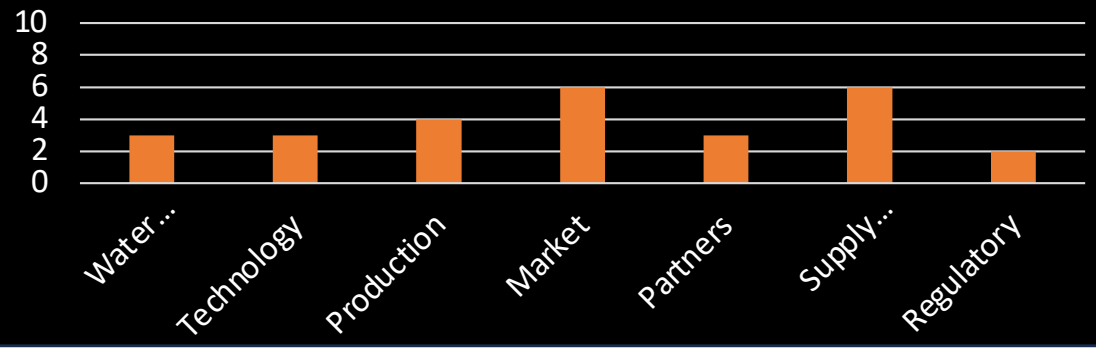
Planned Community Infrastructure Layout



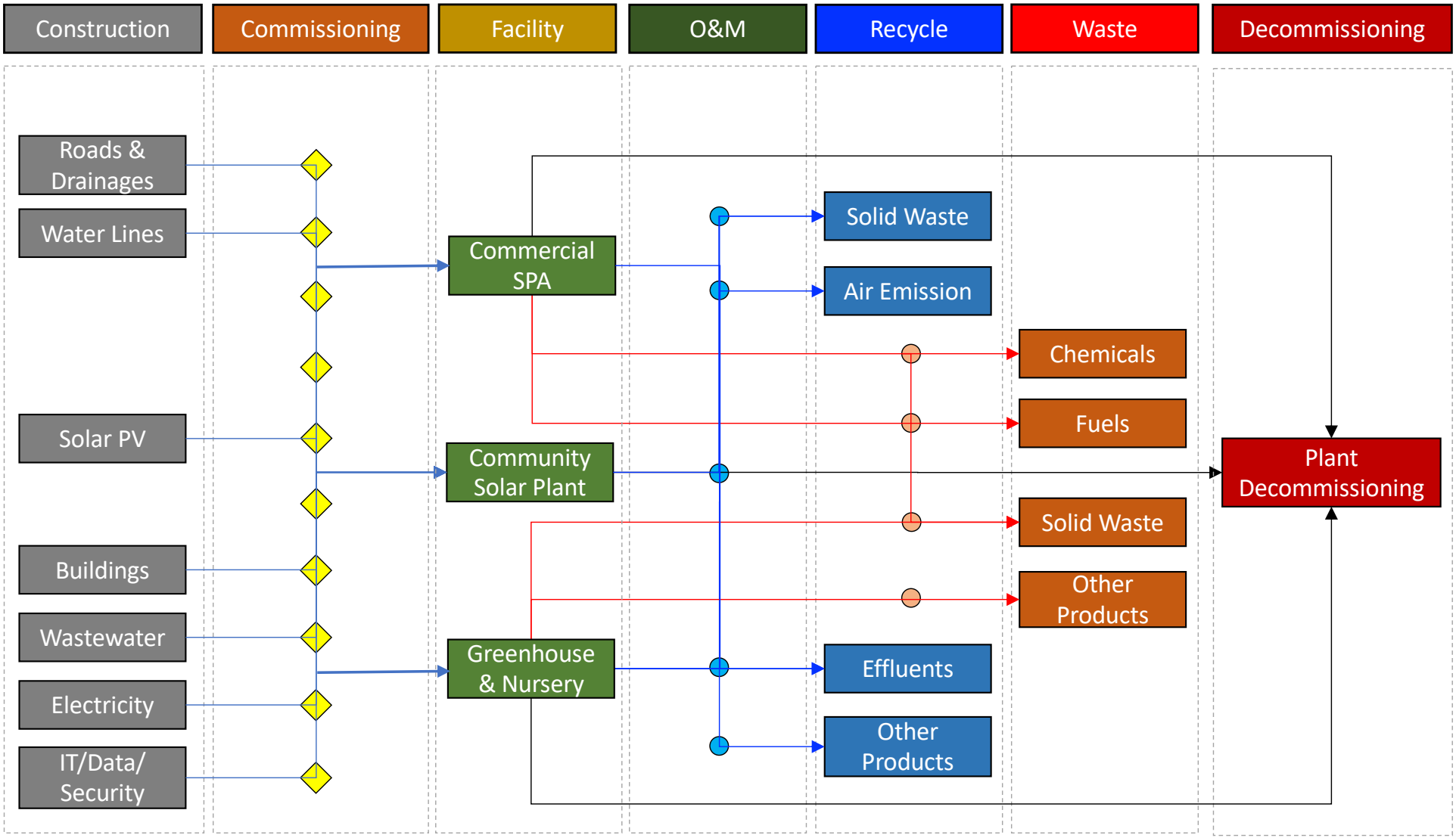
Greenhouse Risks and Mitigates

Project Component	Risks	Mitigates
Geothermal Greenhouse	Water Supply – Low	An adequate proven supply of meteoric water exists beneath the project area. Also available are NTUA's water distribution system and the Navajo Gallup Water Supply Project pipelines.
	Technology – Low	A plated heat exchanger system is commercially available to take 100˚F water and process heat /cooling for a temperature-controlled greenhouse.
	Production - Low	Produce production will yield high quality, nutrient-rich, fresh produce year-round. Locally source food is high in demand for the Navajo Nation.
	Market – Medium	Greenhouse produce is gaining more of the market share. Buying local is the modern trend. Greenhouse producers are profitable due to their consistent high quality and preferable taste.
	Partners – Low	NAPI and locally government operated programs, such as the Navajo Senior Citizens, Veteran's Program, K-12 Schools, and Churches are potential partners.
	Supply Agreements – Medium	Agreements could be made with the K-12 schools in a Food to School Program and with local food restaurants in a Food to Table Program.
	Regulatory – Low	Navajo Nation has complete regulatory authority. Current Navajo Nation taxing laws are 0% for foods and organic foods.

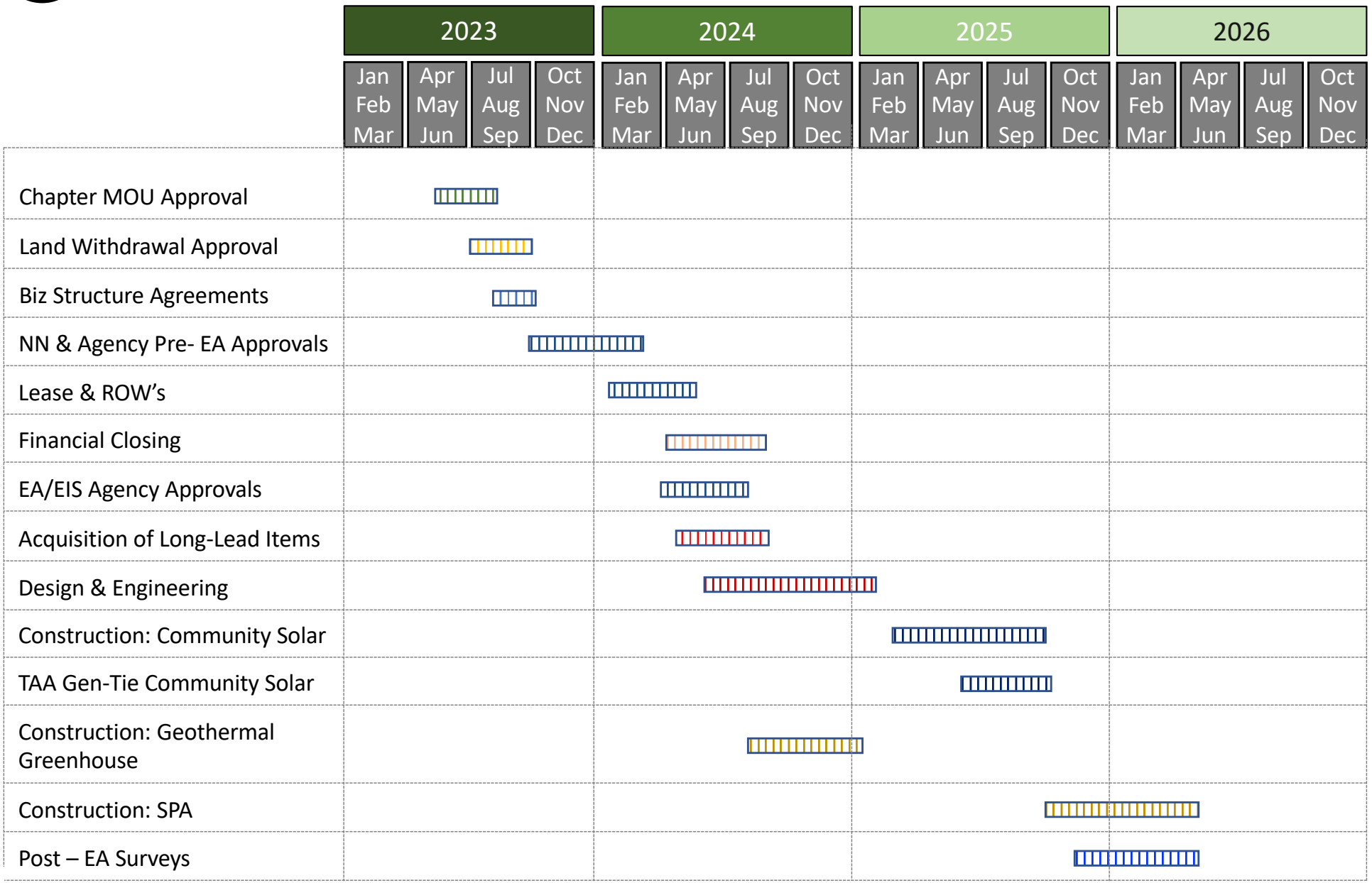
Risk Metrics



Life-Cycle Analysis: Community Infrastructure



General Timeline: Community Infrastructure



Greenhouse Project Capital Sources and Uses

Greenhouse Project

Sources and Uses of Cash

through Commencement of Operations

SOURCES	$MM	% Total Capital	% Equity
Community Grant	$ 802	51%	51%
Investors	$ 771	49%	49%
Total Equity	$ 1,573	100%	100%
Loan	$ -	0%	
Total Sources	**$ 1,573**	**100%**	

USES	$MM	% Total Capital
Green House(s) & Equip.	$ 680	43%
O&M Pre-Opening Exp.	$ 485	31%
Concrete Pads	$ 150	10%
Road Base	$ 220	14%
Electric	$ 38	2%
Total Uses	**$ 1,573**	**100%**

Note: Rough order of magnitude (ROM) cost estimate has an accuracy of -25% to +75%.

Community Solar Project Capital Sources and Uses

1 MW Community Solar Project
Sources and Uses of Cash
through Commencement of Operations

SOURCES	$MM	% Total Capital	% Equity
Community Grant	$ 2,644	100%	100%
Investors	$ -	0%	0%
Total Equity	$ 2,644	100%	100%
Loan	$ -	0%	
Total Sources	**$ 2,644**	**100%**	

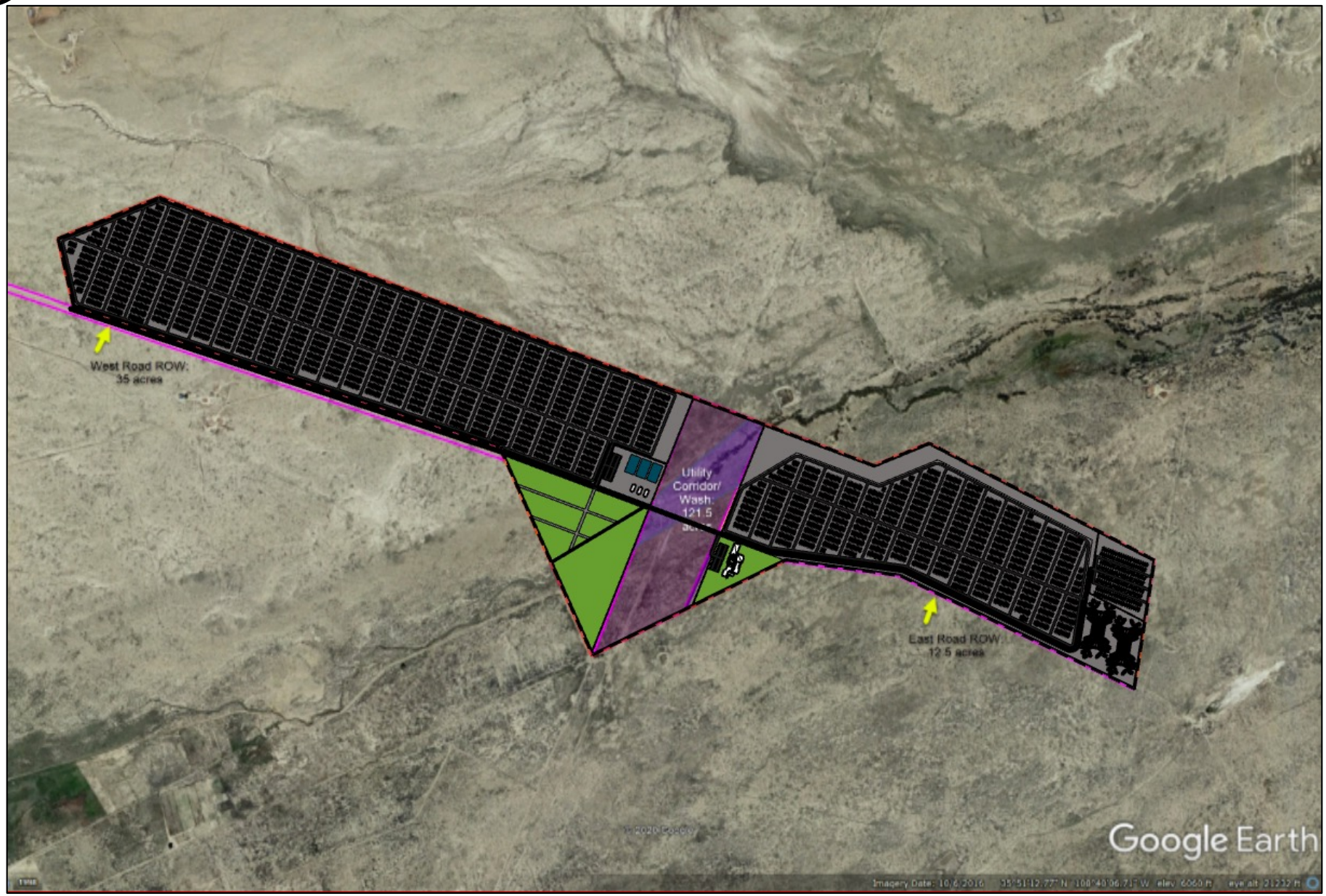
USES	$MM	% Total Capital
PV System & Equip.	$ 2,146	81%
O&M Pre-Opening Exp.	$ 78	3%
Interconnection	$ 96	4%
Bond/Ins & Contigency	$ 80	3%
OHP	$ 95	4%
Sales Tax	149.7	6%
Total Uses	**$ 2,644**	**100%**

Note: Rough order of magnitude (ROM) cost estimate has an accuracy of -25% to +75%.

Tohatchi Microgrid Infrastructure

- 70MW Utility-Scale Solar
- Microgrid System
- EHV Substation

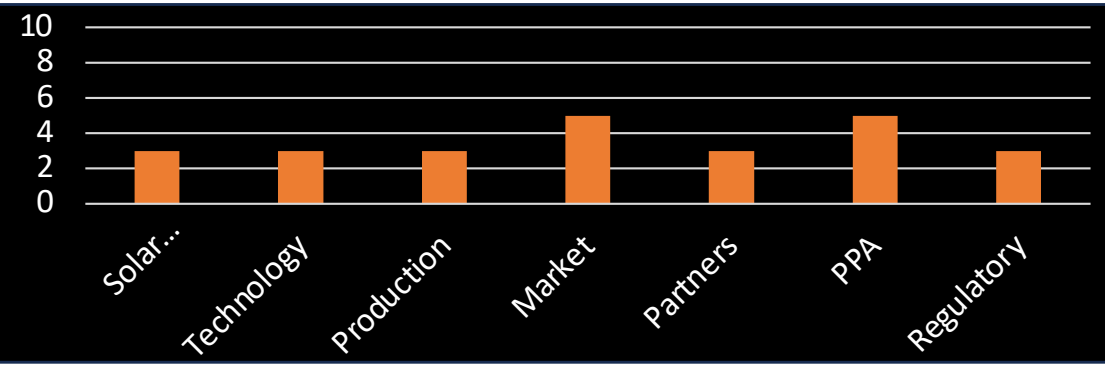
Planned Microgrid Masterplan Layout



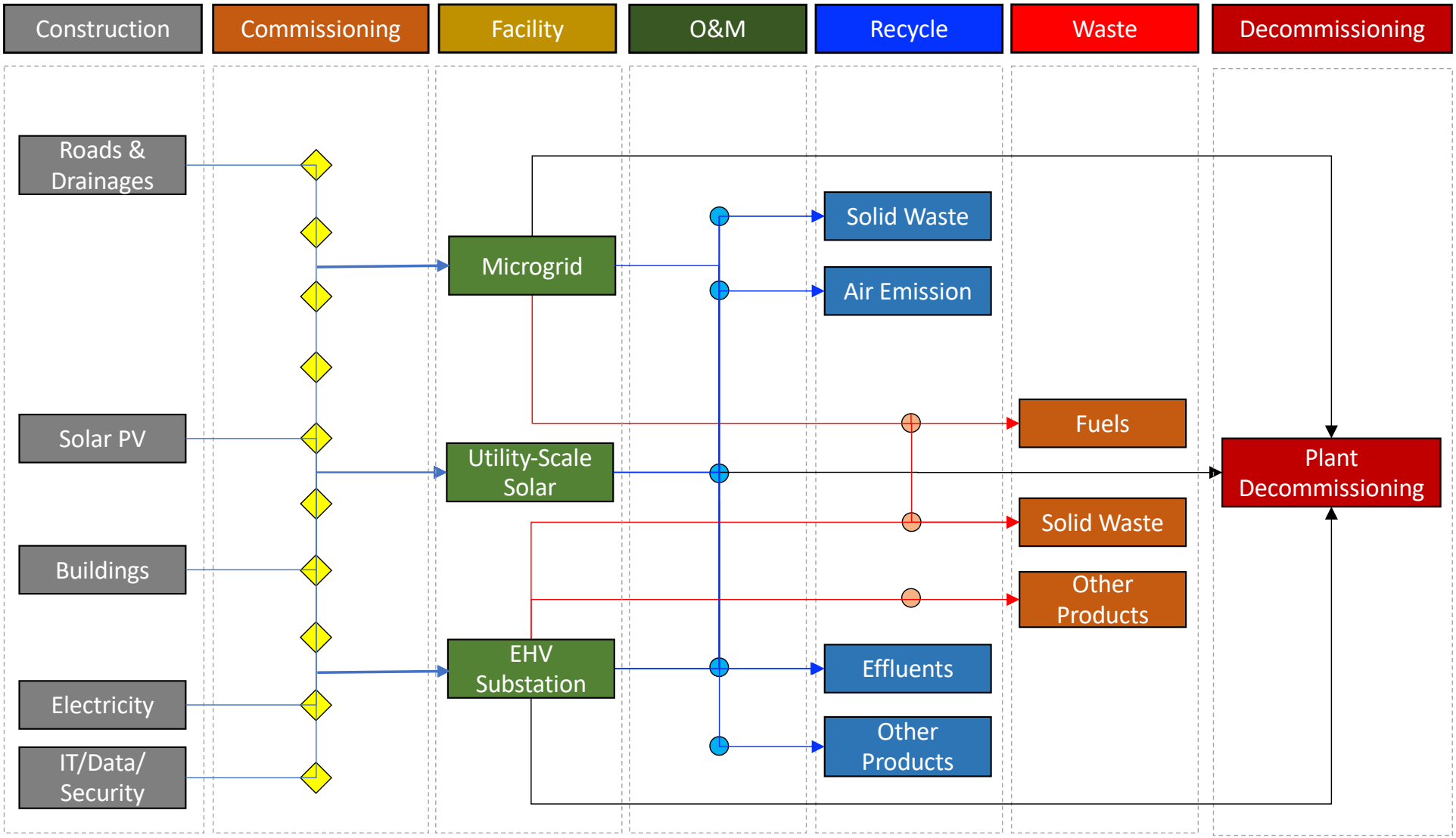
Planned Microgrid Masterplan Layout

Project Component	Risks	Mitigates
Solar PV & Battery Storage	Solar Supply – Low	Tohatchi's irradiance from Time 5:00 hours to Time 19:00 hours is 480 W/m^2 to 1,200 W/m^2. Highest average temperature is in July, at around 21.1°C. At -1.7°C on average for January.
	Technology – Low	Based on total irradiance, temperature, efficiency, and other characteristics, SunPower SPR-E19-310-COM modules with SMA America SC750Cp-US with ABB EcoDry Ultra Transformer will be installed.
	Production - Low	The targeted Solar PV generation annual average production is 188,233,962 AC kWh. This would equate to 70MWac.
	Market – Medium	The distributed energy markets would be the targeted market. A market analysis will be conducted for energy service pricing scenarios and impacts to service off-takers. The LCOE PPA price (real) is 1.69¢/kWh, or 2.07¢/kWh LCOE PPA price (nominal).
	Partners – Low	Project partners could be local utility companies in the region as their fossil assets are being retired and looking to replace with a supply-side mix of renewables with natural gas.
	Power Purchase Agreement – Medium	The targeted PPA price would between $19-$22 MWh. This target is reasonably within range of solar prices in the desert southwest.
	Regulatory – Low	Under the 2016 General Leasing Act, The Navajo Nation has full autonomy for regulation and primacy of permits for the Tohatchi Energy Project.

Risk Metrics



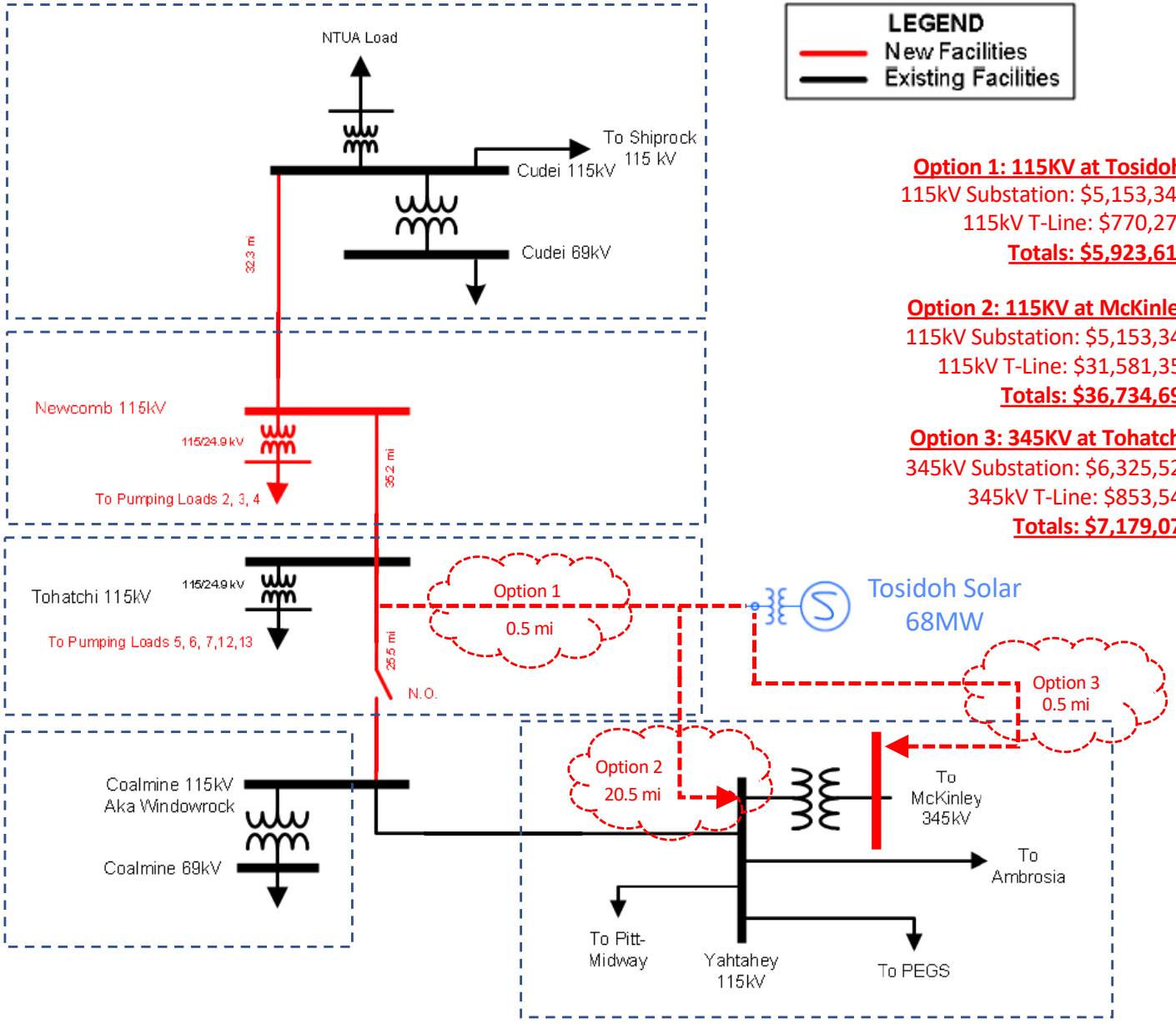
Life-Cycle Analysis: Microgrid Masterplan



NTUA/PNM Interconnection Analysis

PNM Queue Cluster Window Availability

- PNM PISIS: March 21, 2024, to June 18, 2024
- PNM DISIS: November 19, 2023, to February 16, 2024



Option 1: 115KV at Tosidoh
115kV Substation: $5,153,341
115kV T-Line: $770,277
Totals: $5,923,618

Option 2: 115KV at McKinley
115kV Substation: $5,153,341
115kV T-Line: $31,581,357
Totals: $36,734,698

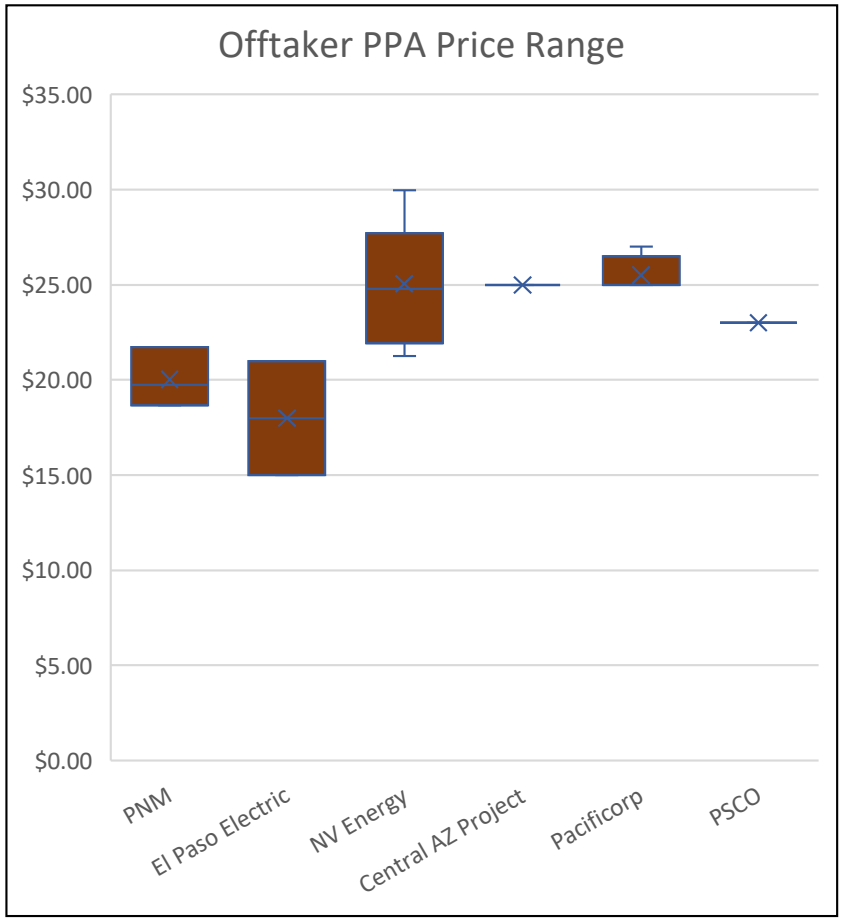
Option 3: 345KV at Tohatchi
345kV Substation: $6,325,528
345kV T-Line: $853,545
Totals: $7,179,073

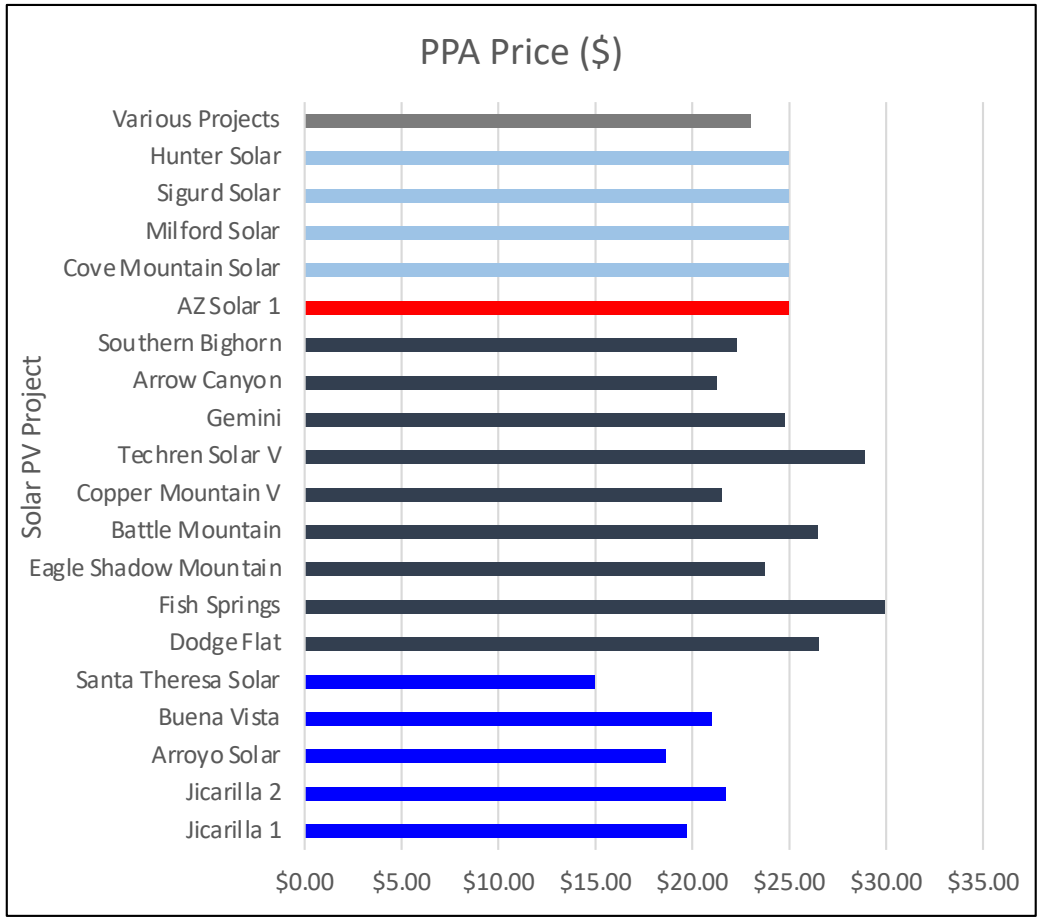
Option 4: 115KV at Tohatchi
115kV Substation: $1,200,000
345kV T-Line: $4,621,662
Totals: $5,821,662

Tohatchi Substation

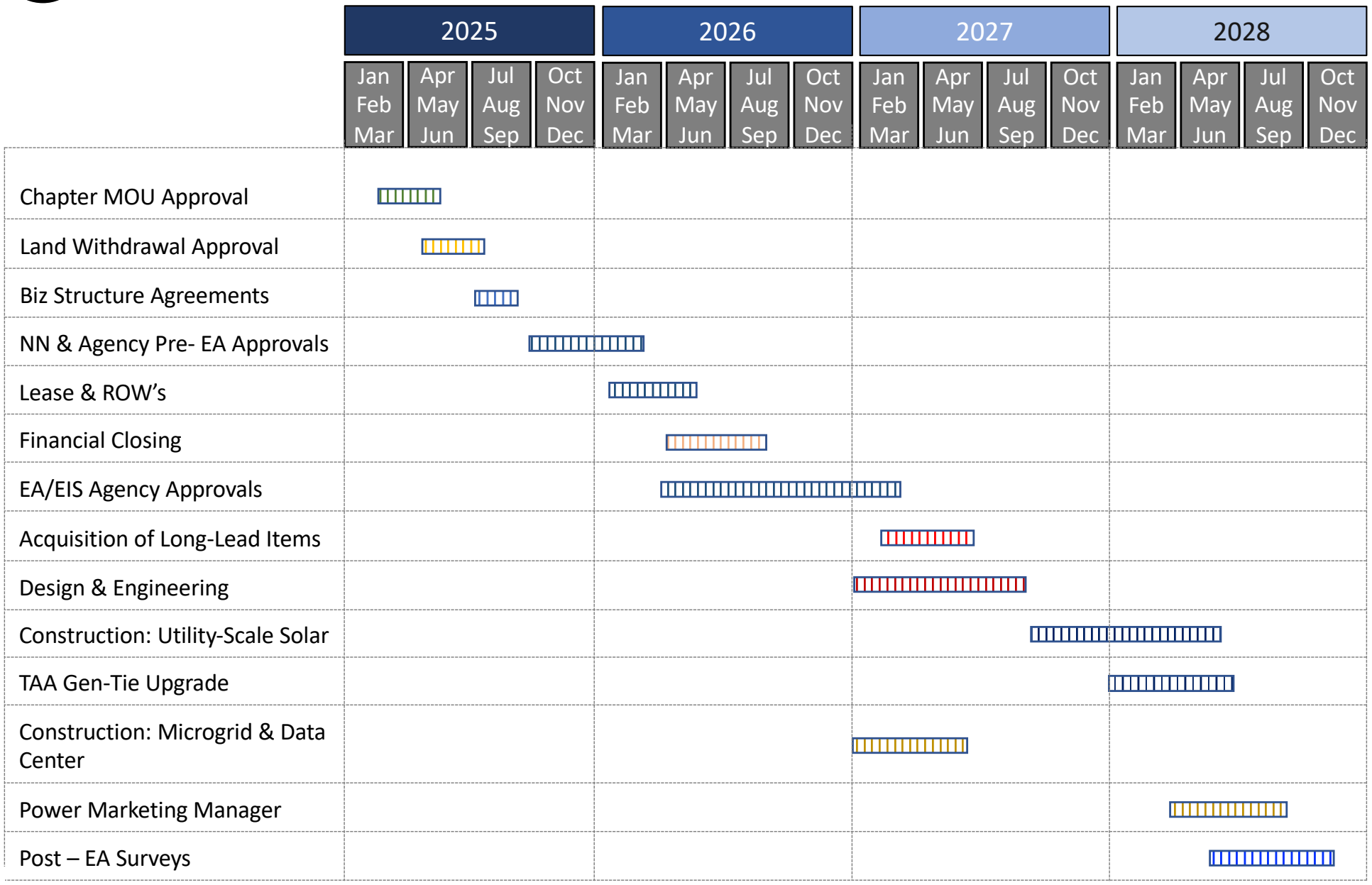
69kV/24.9/14.4kV
12.0 MVA

Regional Solar Energy PPA's

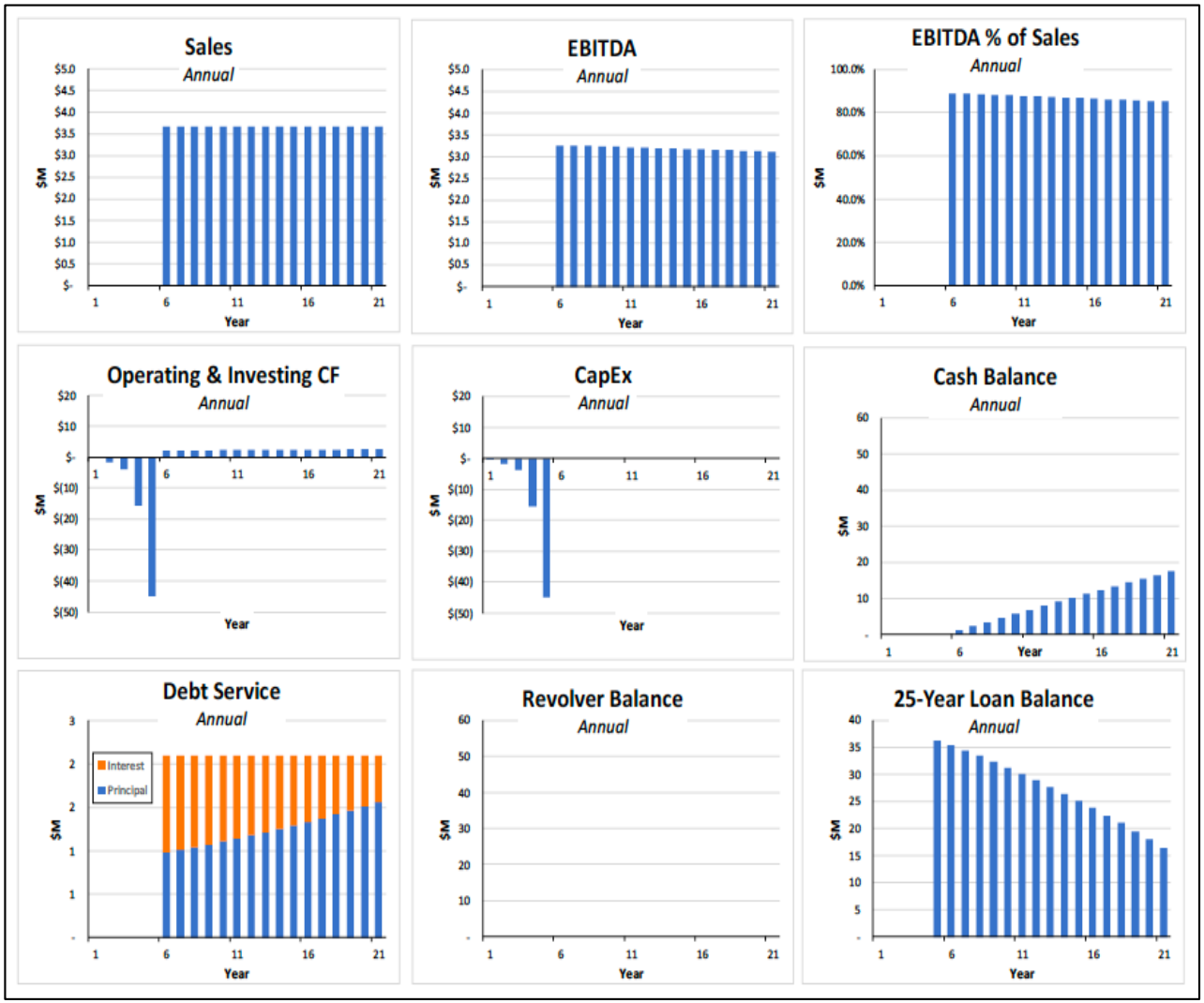




General Timeline: Microgrid Infrastructure



Equity / Tax Investor and Possible Solar Partner

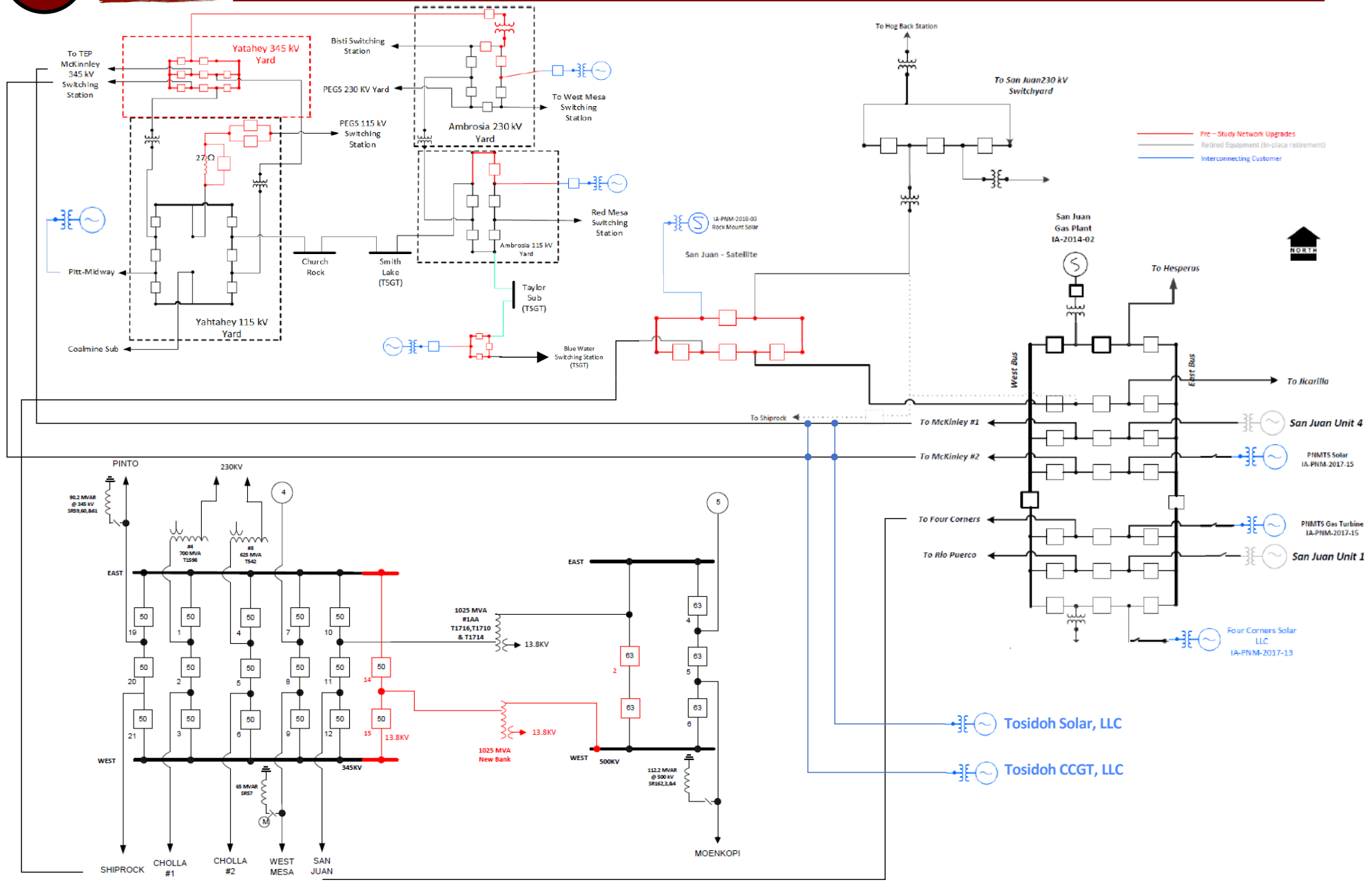


- Estimated Solar PV Capital, excluding the 345kV Substation costs is $70M.
- The total debt is estimated at $42M with a Tax Equity Investment of $23M. The Developer/Sponsor/Investor share is $5M.
- The 345kV Substation costs is $10M. This costs is reimbursable by PNM and PNM could purchased and assume the control of the substation post-COD.
- The annual percentage rate is modeled at 3.10%.
- The project has an opportunity be guaranteed at lower interest rate by the BIA or DOE Loan Guarantee Program.
- The 70MW Solar PV Facility is expected to be firmed up by a battery storage system component (BESS).
- Project may interconnect to NTUA's Tohatchi Substation. This is subject to SIS studies and other agreements.
- IRA 2022 supports Direct Pay and Incentives for Tribal/Private ownership.

Zero-Carbon Infrastructure

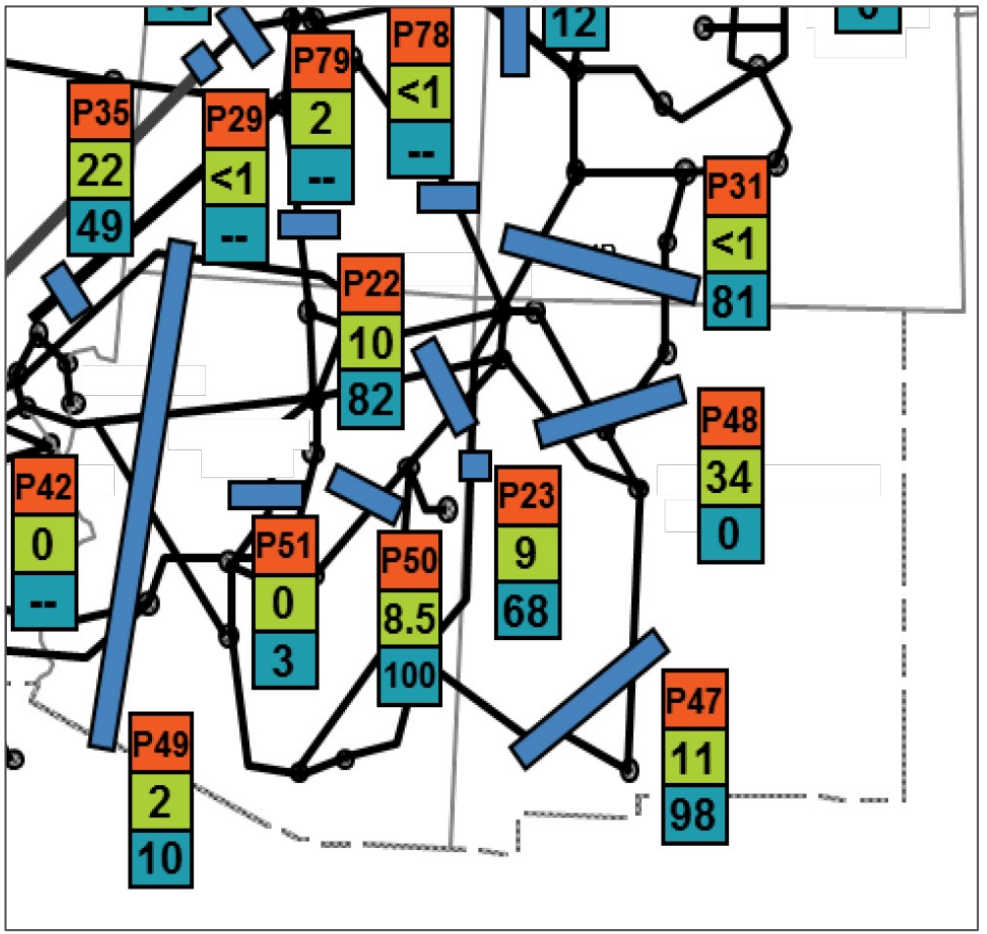
- Green Hydrogen Facility
- Storage & Compression & Interconnection
- Zero Carbon Flex Fuel Simple-Cycle Turbine Project (CCS/DAC, etc.)

One-Line Diagrams of FCCP, SJGS and McKinley

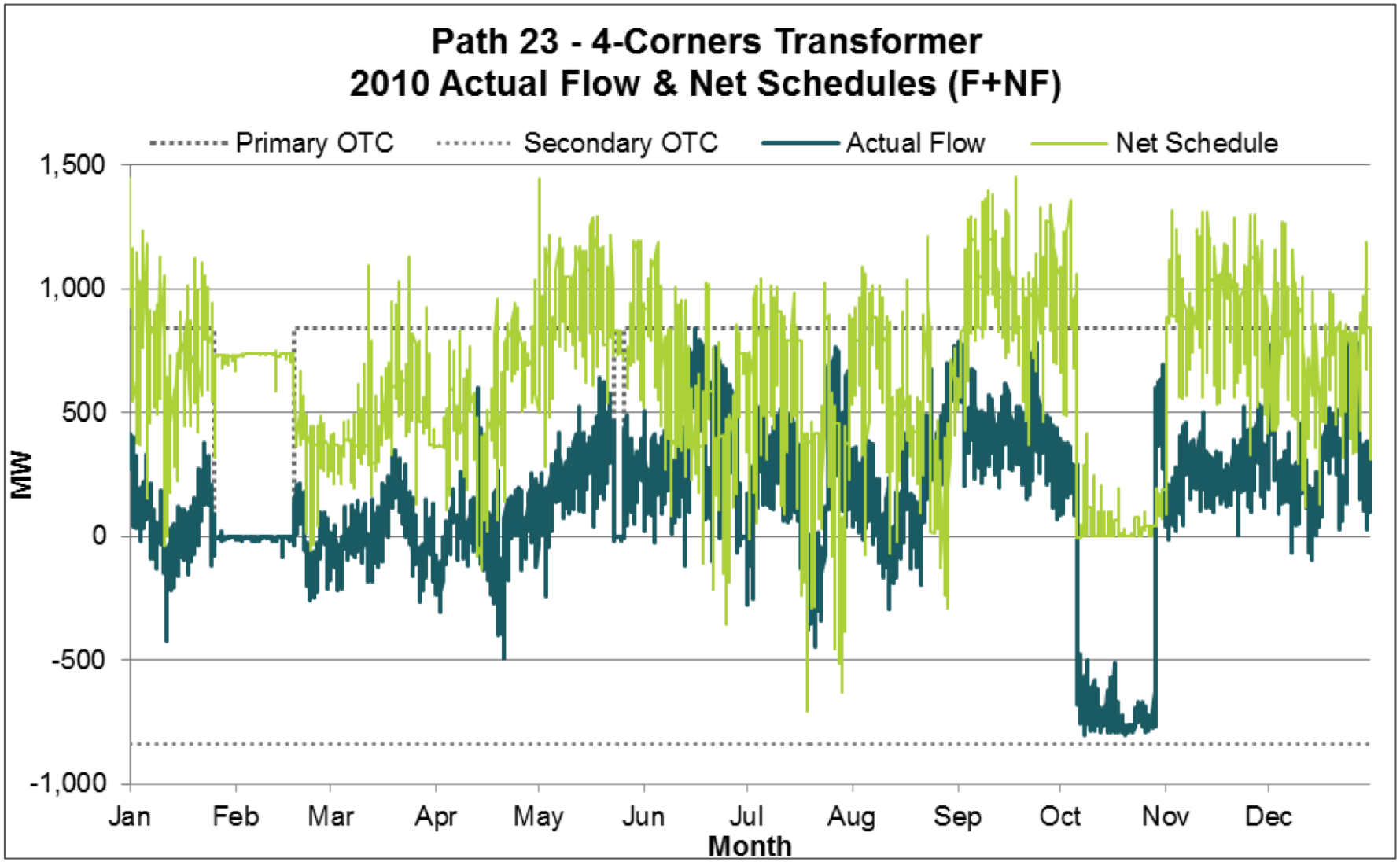


PNM/TEP's Path 23 Summary

- Path 23 is in northwestern New Mexico and id defined as the flow on the 345/500 kV Transformer.
- Flows in the area are generally from east to west due to the large amount of generation in the Four Corners area.
- The E to W path rating is 1,000 MVA.
- The W to E path rating is 1,000 MVA.

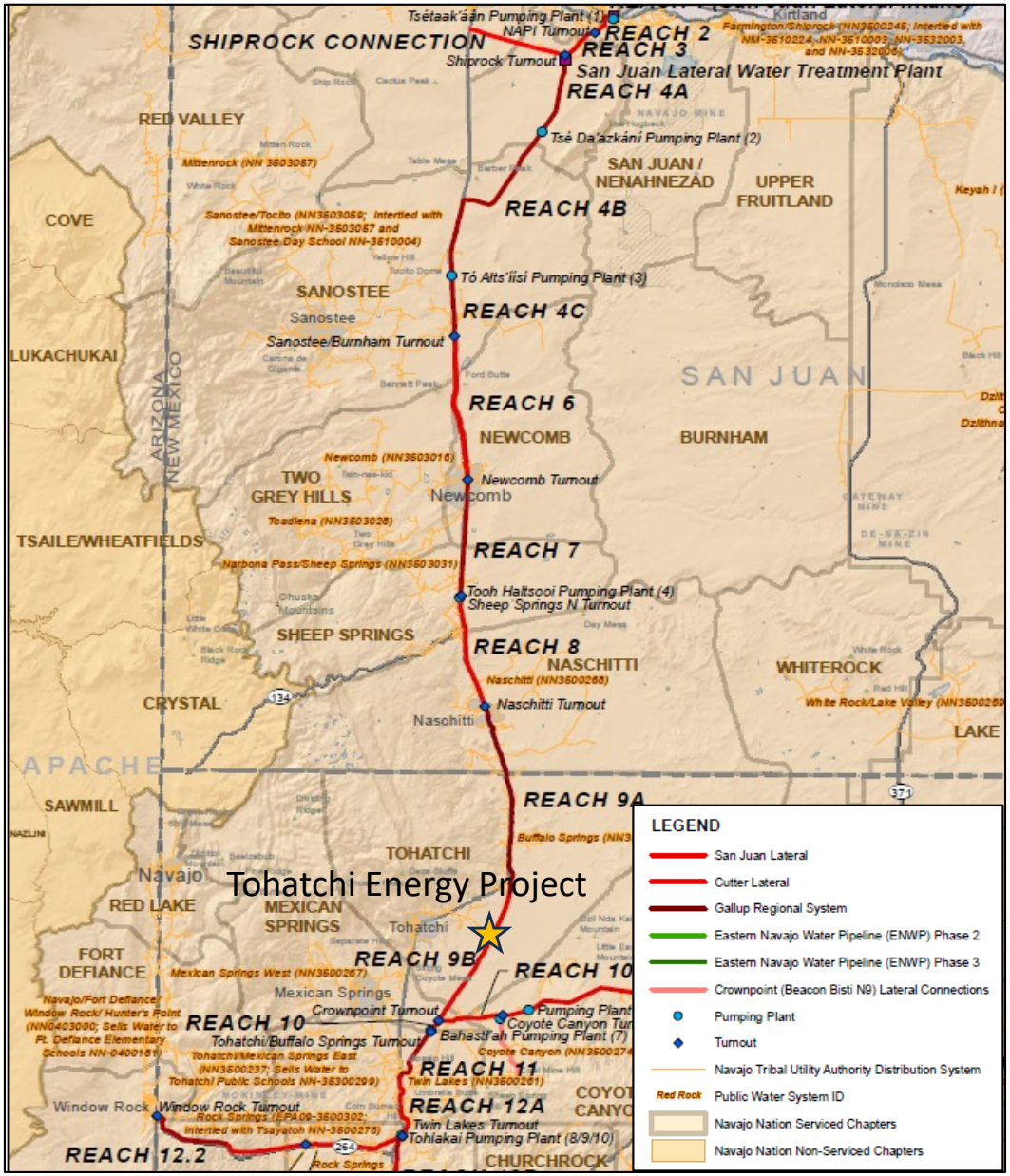


Path 23 Actual Flow & Net Schedules Comparison



Note: The figure shows the actual flow data and net schedule data for Path 23 in 2010.

Navajo-Gallup Water Supply Project



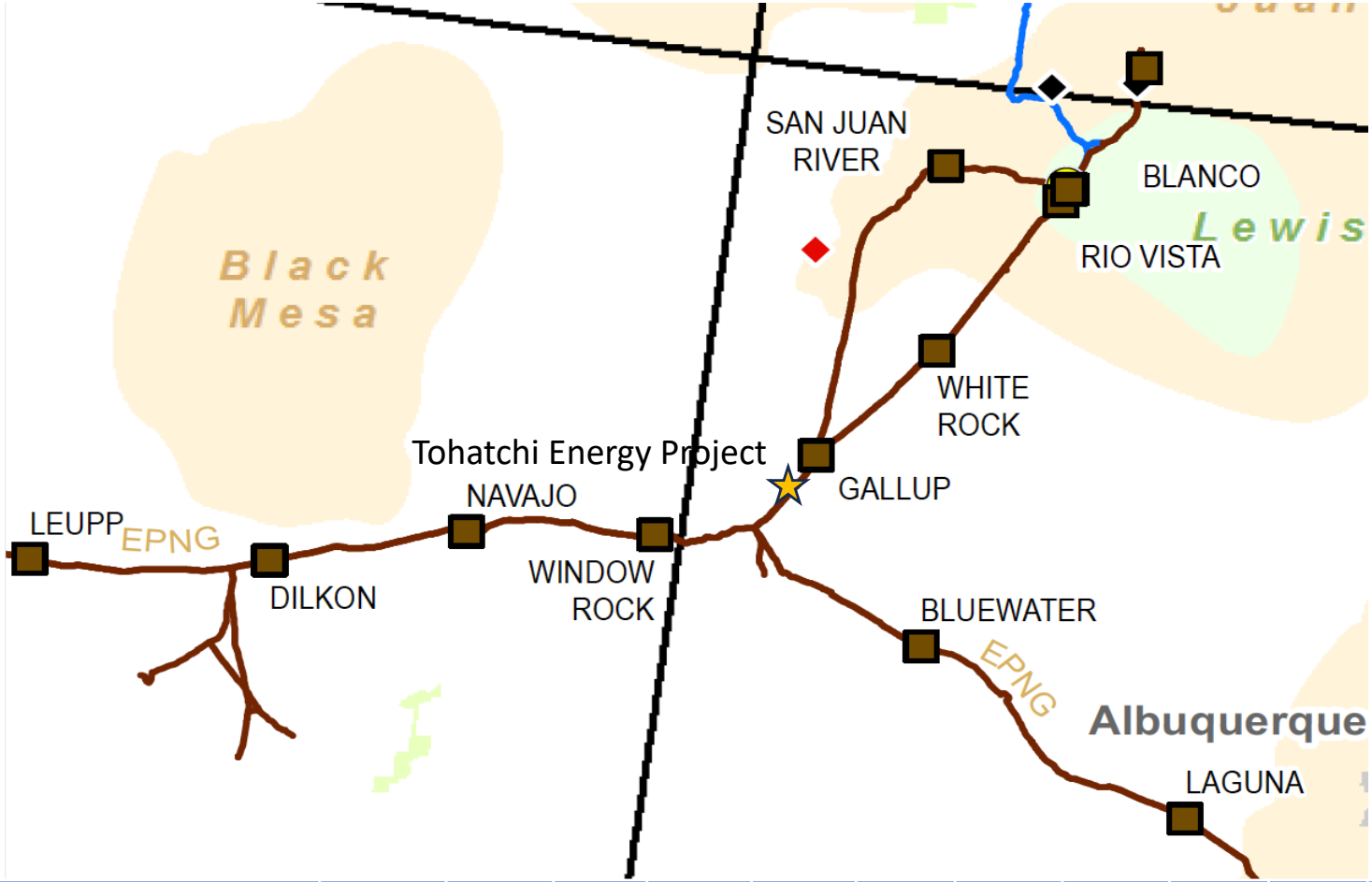
The NGWSP was born from the decades of negotiations of the San Juan River Water Rights Settlement, the Navajo Nation signed this settlement back in the mid-2000's and signed by Congress in 2011.

Years later you have industry, legislature and other non-governmental organizations that try to sue Navajo, or the State of New Mexico over this. The last challenges to the settlement was back in 2018 where the NM Supreme Court upheld the Navajo water allocations.

Under the San Juan River Water Settlement, Navajo has 633,000 afy of diversion and 336,000 afy of depletion. Some of the depletion is by NAPI, or NIIP, were Blocks 1-9 used about 353,000 afy. Navajo would still have to find facilities to use the remaing 296,000 afy.

Part of the agreement includes 26MW* (estimated at 40MW+) of power from the CRSP – administered by WAPA.

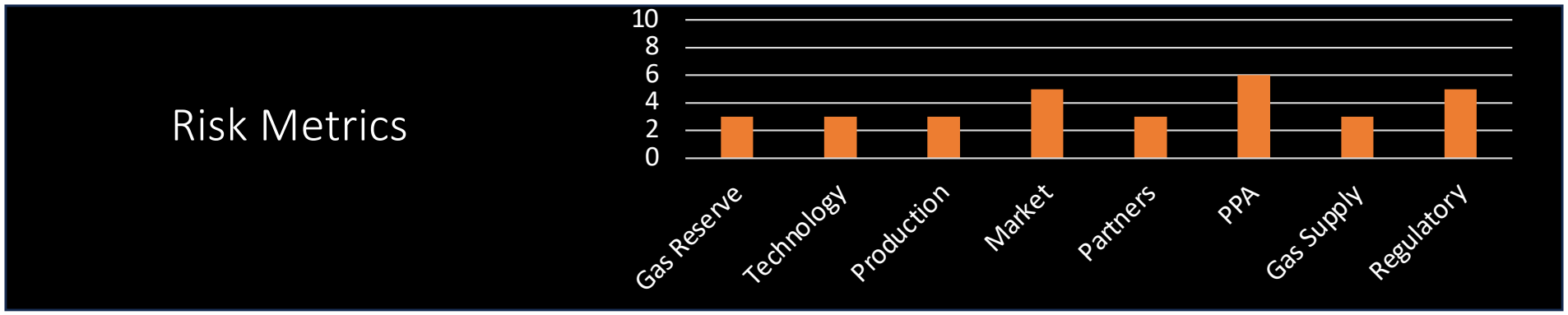
Kinder-Morgan (El Paso) Gas Pipelines



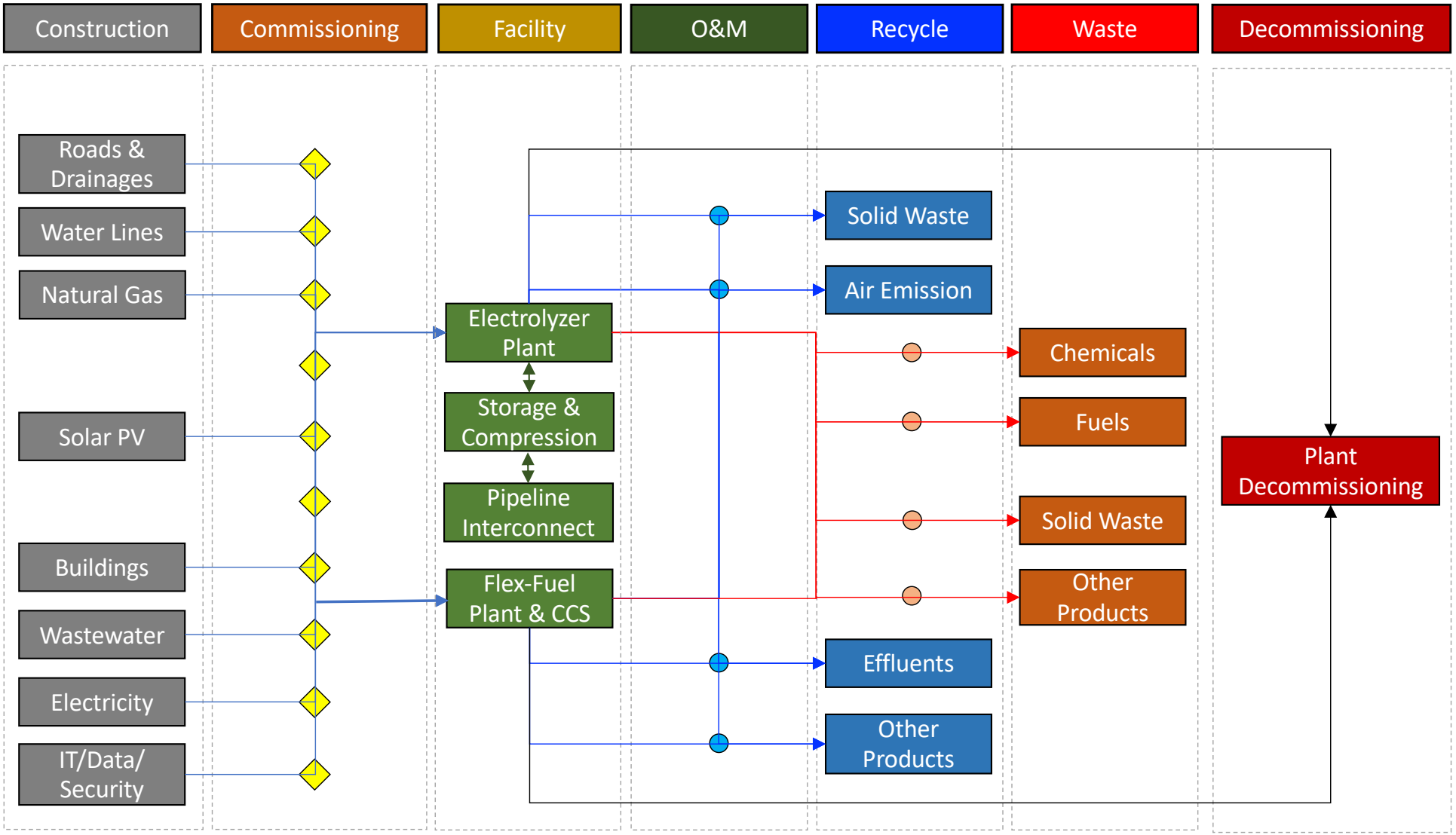
	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
New Mexico to Arizona Segment M2 (MMcfd)	4,679	4,497	4,497	4,497	4,497	4,497	4,497	4,497	4,685	4,685	4,685	4,685
New Mexico to Arizona Outflow (MMcfd)	5,992	5,810	5,810	5,810	5,810	5,810	5,810	5,810	5,998	5,998	5,998	5,998

CCGT Economics with Utility-Scale Solar

Project Component	Risks	Mitigates
CCGT Center	Gas Supply – Low	Southern Ute Indian Tribe has an abundant of natural gas resources located in the San Juan Basin. Operators in San Juan Basin are producing 127,920 MCF/day. Kinder-Morgan delivers the natural gas to various markets in Arizona, California, and Nevada. The New Mexico to Arizona Segment M2 currently delivers 4,685 MMcfd annually thru four pipelines.
	Technology – Low	The heat rate of a combined-cycle is 5,831 Btu/kWh in 2012. From 2012 to 1996, the heat rate has improved by 4.6% since the beginning of the last combined cycle boom. Matured technology has improved 10% or more in CCGT technologies.
	Production - Low	The targeted CCGT generation annual production is 3,600,000 KWh. This would equate to 618 MWac.
	Market – Medium	CCGT emerges as an integral dispatchable peaking or baseload energy resource. The estimated LCOE (real) is 3.5¢/kWh to 5.0¢/kWh .
	Partners – Low	Project partners could be local utility companies in the region looking to replace coal assets with a supply-side mix of renewables with natural gas.
	Power Purchase Agreement – Low	The targeted market price would between $4.5-$6.5/kWh. This target is reasonably within range of thermal generation supporting ancillary services, availability, and renewable energy support.
	Regulatory – Medium	Under the 2016 General Leasing Act, The Navajo Nation has full autonomy for regulation and primacy of permits for Tosidoh Energy Project.



Life-Cycle Analysis: Zero-Carbon



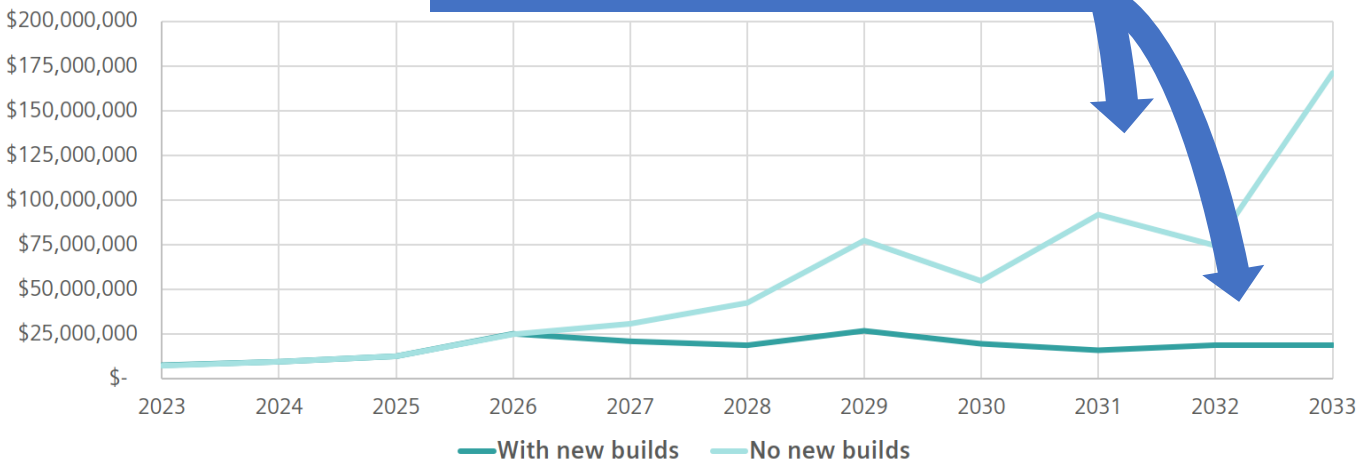
CCGT Economics with Utility-Scale Solar

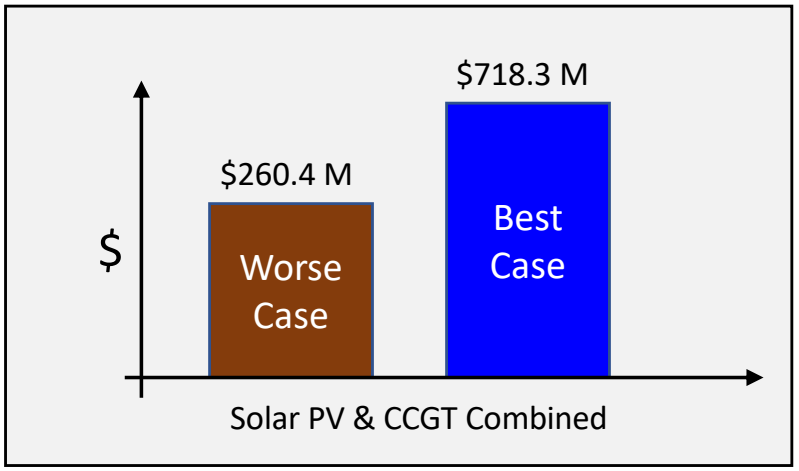
- Initial Project financial assessment for a 2x2x1: 2x170MW CCGT shows the positive contribution
  - Model dispatch based on plant efficiency (not optimized)
- Model is conservative and does not consider: -
  - Dispatch based on maximum profit
  - Ancillary services (including Synchronous Condensing) that can be captured by CCGT plant due to its flexible design
  - Revenue/profit generation from adjacent Grids

Plant profit over 10 years was calculated for: -

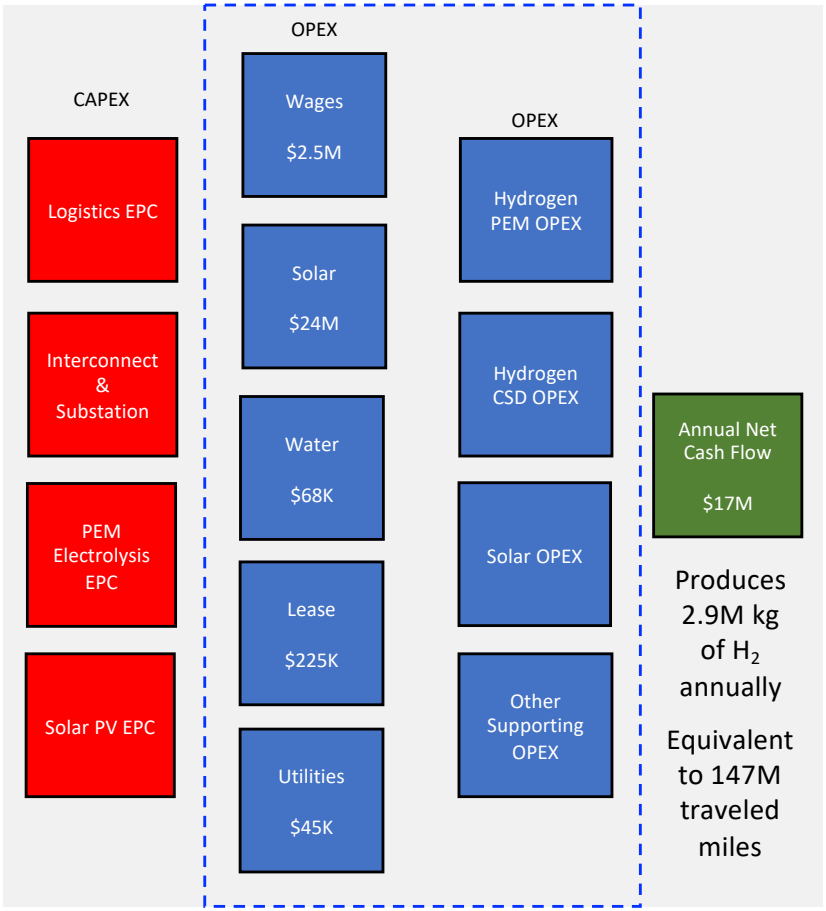
- Best case (no new builds) ~600M$
- Worse case (multiple new builds) ~230M$
- Average ~420M$

Further upside on profit numbers likely as model us was conservative!

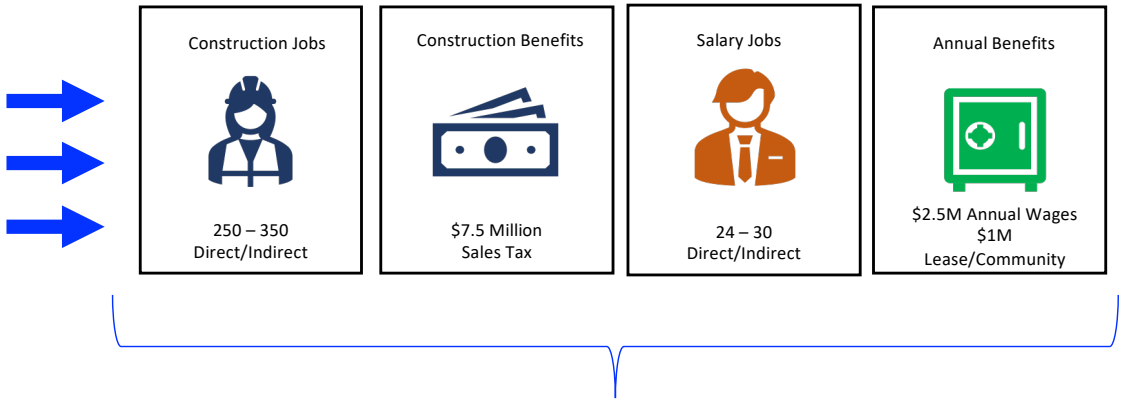




Preliminary Hydrogen Economics with Benefits



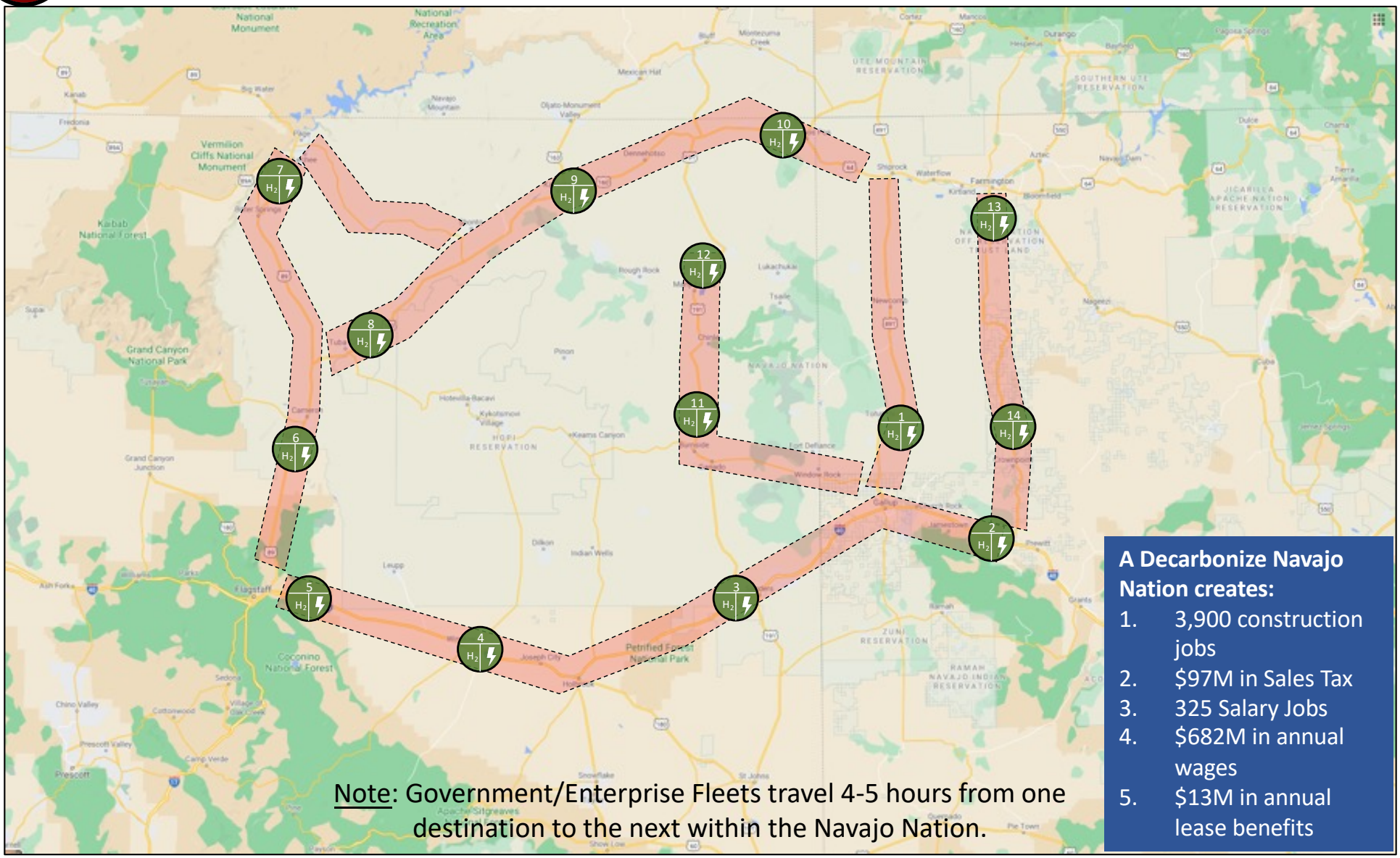
	FY2019
NN Fuel Excise Tax Collected ($0.18)	$14,272,586
NN Annuall Consumed Gasoline (gal)	79,292,144
NN Annual Total Gasoline Comption ($)	$206,159,576
NN Annual Traveled Mileage (mile)	1,982,303,611



Note: For the Navajo Nation To get to 100% Carbon-Free (Decarbonized Nation) – Multiply by 13 to achieve the annual (1.9B) traveled mileage on the Navajo Nation.

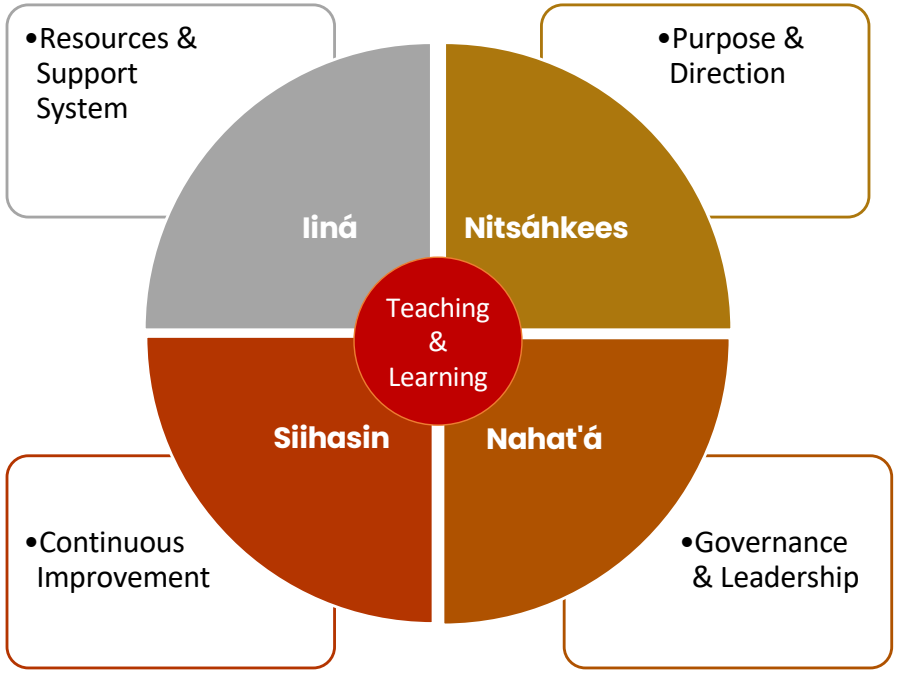
General Timeline: Zero-Carbon Infrastructure

Potential Green Hydrogen Station Map



Fair and Equitable Treatment – Environment, People & Justice

- Community – Empower & Build Relationships
- Partnerships – Stakeholder Engagements
- Social – Trends, Practices, & Plans
- Capacity Building – STEM Pipeline and other Career Paths Initiatives
- Jurisdictions – Land, Economy, Government, Policy, etc.
- Braintrust – Forward-Thinking Policy (Rulemaking: Environment, Energy, Economy, Law, etc.)
- Institute – Energy, Economy & Climate: Planning, Informed, Educate & Making Good Decisions



Source: Dine Institute, 2022

The Main Takeaways

- We're solving some of the local chapter and regional disparities by deploying the following:
  - A food and agricultural production facility stemmed from a water source drilled in 1945. The Tohatchi Hot Springs water source will be used to **source local and grown responsible foods** for the K-12 Schools, Senior Citizens and Veteran's Programs and the nearby supermarkets. The energy source is a **1MW community solar project** with storage integrated with a geothermal system that will used the water source to heat and cool the geothermal greenhouses.
  - The tree nursery will **support the home heating fuels program** by planting various species of fast-growing oak and **support landscaping shades** for most households in the region to also encourage healthy living styles.
  - Other herbs and plants could be grown to **support traditional medicines and post-fire regeneration** with ponderosa pine seedlings to support reforestation.
  - A distributed microgrid system coupled with community solar and a battery system supports **the reliability and resiliency of the community's electric grid** and the nearby chapters. The local regional electric market size is roughly 145 MW (60-mile radius of the project area to include NTUA and CDEC). This new microgrid system is eligible for direct pay thru the Inflation Reduction Act.
  - Green Hydrogen is an emerging **potential solution for a carbon-free future**. Green Hydrogen is recognized as a potential decarbonization solution for the following sectors: 1) long-haul transport, 2) aviation and marine shipping, and 3) the heavy industries. Green hydrogen is revolutionizing the renewable energy landscape. Hydrogen is found in great quantities in water, hydrocarbons and in the air we breath.
  - STEM and workforce development impacts. In every aspect of the Tohatchi Energy Project involves an in-house subject matter expert (SME), that are STEM professionals working to keep the integration, or **hybridization of technologies working effectively and efficiently.** This project can support nearby K-12, college and university educational pipelines.

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