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THE GREAT SEAL OF THE STATE OF UTAH
INDUSTRY
UTAH
1847
1896

Utah Intelligent Electrified Transportation Action Plan

Status Update
July 31, 2024





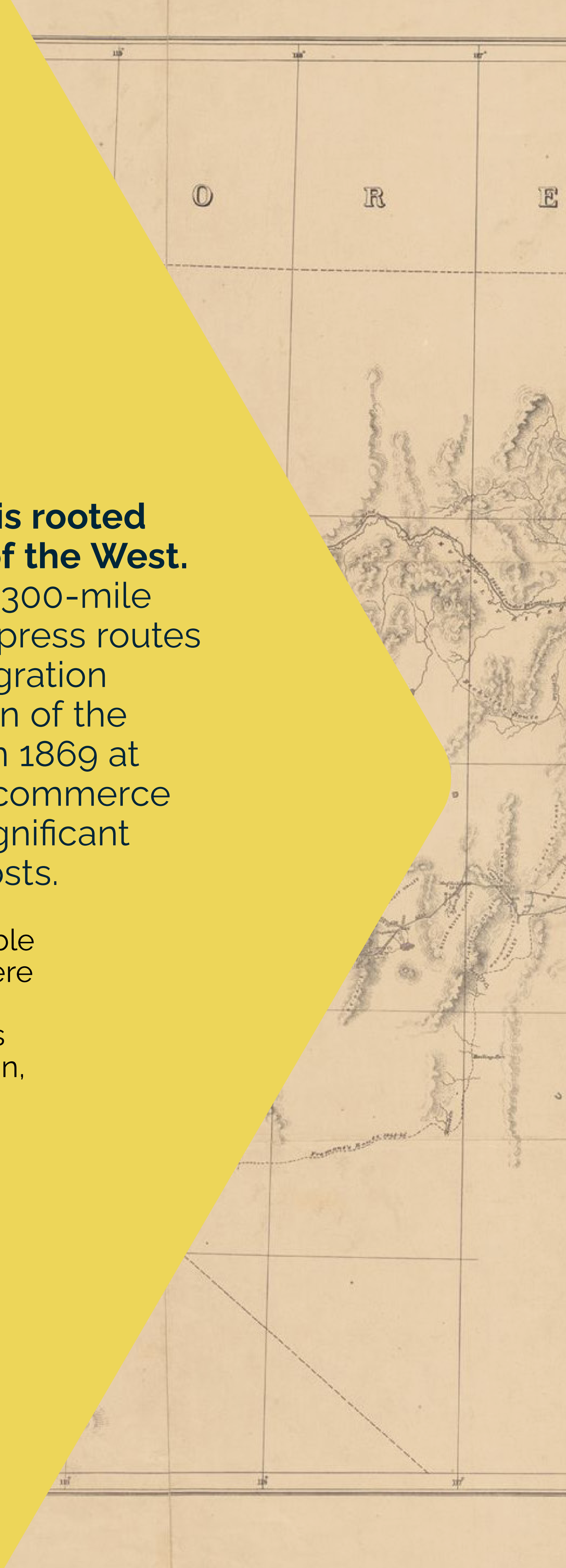


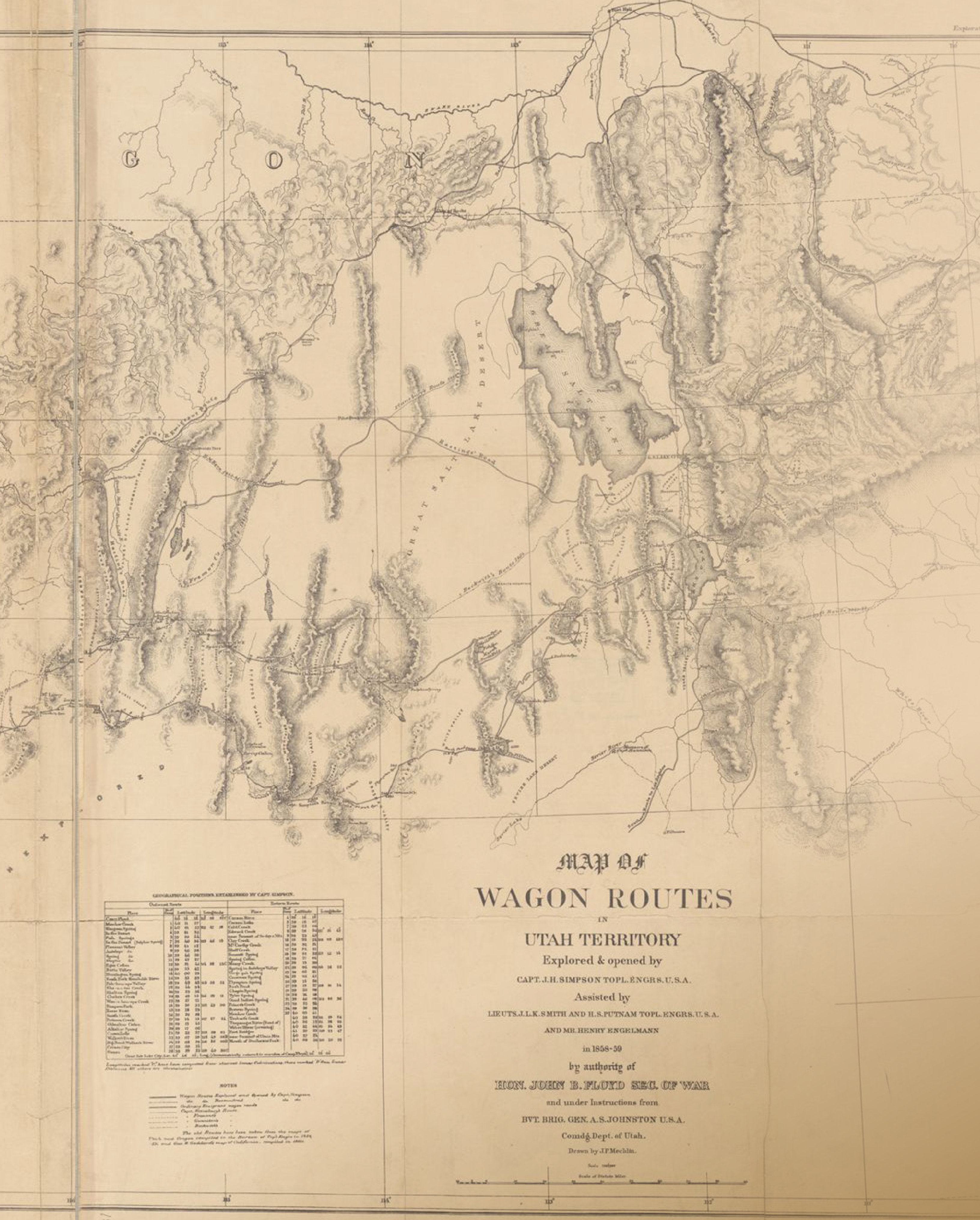

Contents

Our Story

Utah's transportation legacy is rooted in its role as the Crossroads of the West. Our history is marked by the 1,300-mile Mormon Trail and the Pony Express routes that fostered early settlers' migration and trade. Then the completion of the first transcontinental railroad in 1869 at Promontory Summit boosted commerce and connectivity, marking a significant reduction in travel time and costs.

Until personal vehicles were affordable and our current highway systems were created, Ogden, Logan, and Provo utilized electric street cars and trains to connect communities from Preston, Idaho to Utah County, and beyond.




MAP OF
WAGON ROUTES
IN
UTAH TERRITORY
Explored & opened by
CAPT. J.H. SIMPSON TOPL. ENGRS. U.S.A.
Assisted by
LIEUTS. J.L.K. SMITH AND H.S. PUTNAM TOPL. ENGRS. U.S.A.
AND MR. HENRY ENGELMANN
in 1858-59
by authority of
HON. JOHN B. FLOYD SEC. OF WAR
and under Instructions from
BVT. BRIG. GEN. A.S. JOHNSTON U.S.A.
Comdg. Dept. of Utah.
Drawn by J.P. Mechlin.
GREAT SALT LAKE DESERT
GREAT SALT LAKE
SEVIER LAKE DESERT
GEOGRAPHICAL POSITIONS ESTABLISHED BY CAPT. SIMPSON.
NOTES

Our Story

Over the years, Utah's commitment to infrastructure investments has improved safety and accessibility through bridges, roads, and tunnels, spanning the state's diverse landscapes. Embracing technological advancements such as electronic tolling systems, intelligent transportation systems (ITS), and electric vehicle infrastructure, Utah continues to build a more efficient and sustainable transportation network.

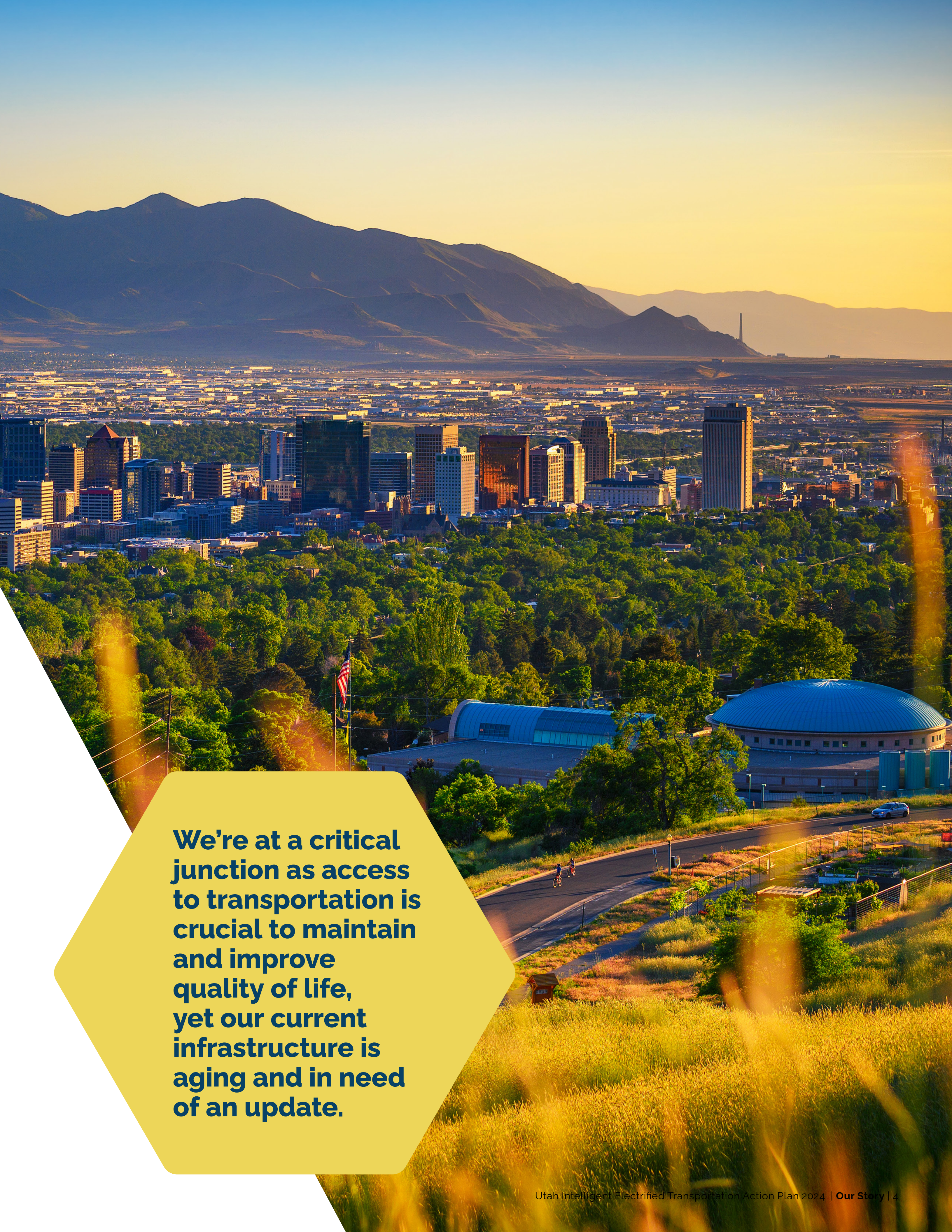
We're at a critical junction as access to transportation is crucial to maintain and improve quality of life, yet our current infrastructure is aging and in need of an update.

In October 2020, a 4th generation National Science Foundation-funded engineering research center, ASPIRE (short for Advancing Sustainability through Powered Infrastructure for Roadway Electrification) was born in Utah. Headquartered on the Innovation Campus at Utah State University in Logan, the ASPIRE Engineering Research Center is rethinking the interactions between power grids, transportation, and infrastructure to eliminate boundaries while pursuing proven and innovative technologies.

During the 2023 General Legislative Session, our state legislators passed Senate Bill 125 (SB125,) which was signed into effect by Governor Spencer Cox on March 23, 2023. This granted the ASPIRE Engineering Research Center authority to define and develop an action plan for electrification in an intelligent transportation infrastructure that fills the needs of communities throughout Utah. ASPIRE is preparing Utah's plan under the leadership and direction of a seven-member Steering Committee chaired by the Utah Department of Transportation's executive director with the assistance of an Industry Advisory Board to offer guidance for the strategic planning and development of the initiative.

For example, in Utah's Air Quality 2021 Annual Report, we learn that heavy-duty diesel vehicles account for only 7.5% of the total vehicle miles traveled in the state, yet they produce over 30% of the on-road air pollution. Electrifying transportation with innovative technologies presents an opportunity to improve Utah's air quality and reduce shipping costs as we renovate and rebuild our aging transportation infrastructure.

By integrating electrified transportation as an option now, we envision a greater quality of life for Utahns through better air quality, job creation, and workforce development ultimately improving the resiliency of Utah's power grid while growing our economy and reducing the cost of transporting goods.



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Steering Committee, Industry Advisory Board & Staff

Steering Committee

The Steering Committee is comprised of members from state and regional agencies, utility providers, and industry partners. It provides direction on the nature and priorities that define the essential elements of the intelligent electrified transportation action plan with guidance on the phased implementation of electrified transportation infrastructure. Additionally, they oversee matters related to the planning effort that include development and review of plan reports and the expenditure of planning funds.

Industry Advisory Board

The role of the Industry Advisory Board is to assist the strategic planning and development of the action plan by providing insights and needs from across industries while articulating industry support and perspectives relative to the analysis and recommendations found in the annual report. The Board is comprised of nine advisory teams that include stakeholders, industry partners, and government agencies who impart information and insight relevant to their specialized expertise. Each team is led by two co-chairs who, together with the co-chairs of all nine teams, form the Executive Team.

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Utah Department of Transportation

Bryce Bird
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Utah Division of Air Quality

James Campbell
Director of Innovation & Sustainability Policy
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Vice President of Products
Merge Electric Fleet Solutions

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Our Vision

Our goal is to define and develop a strategic action plan for intelligent electrified transportation infrastructure throughout Utah. This will entail strategies encompassing all vehicle classes and modes of travel — including public transportation — and charging infrastructure.

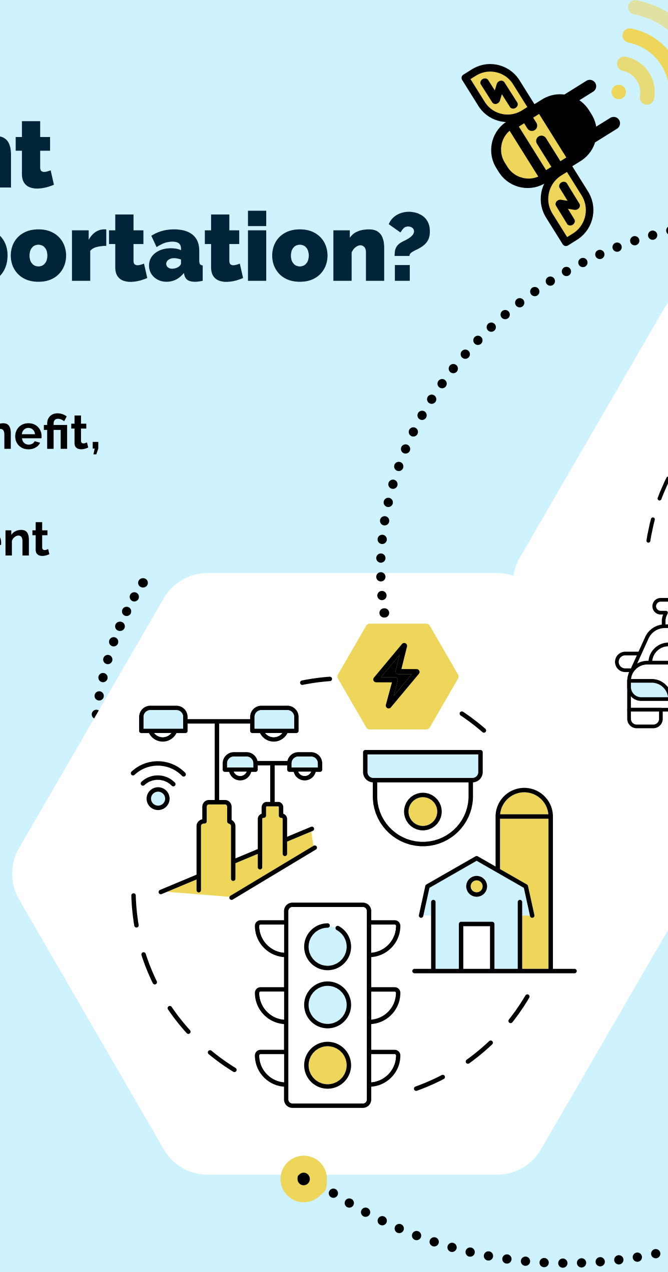
It is vital that we incorporate the expertise and lived experiences of people, communities, businesses, universities, state agencies, industry experts, and non-profits across the state to improve health and quality of life.

What Is Intelligent Electrified Transportation?

To revolutionize our transportation system in a way that all Utahns benefit, synergy is key. This is what we're referring to when we say, "Intelligent Electrified Transportation" — an integrated approach.

Our methods encompass not only the vehicles themselves but also the intricate web of systems that support them, from utilities and power grids to the seamless interaction between electric vehicles (EVs) and charging infrastructure.

Through collaboration, innovation, and a steadfast focus on community stewardship, we are driving progress toward a cleaner, smarter future for transportation in Utah and beyond.

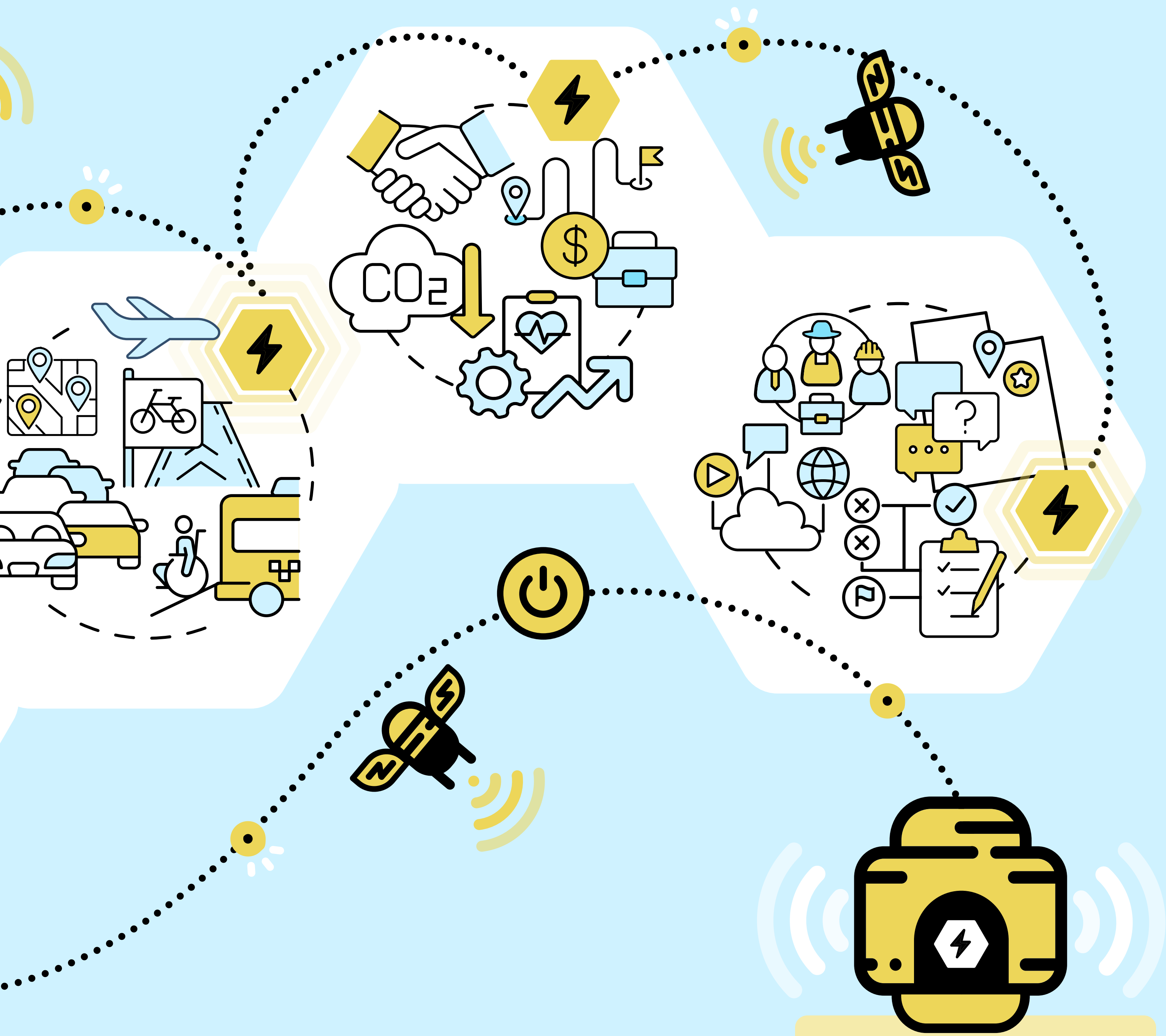


Integrated Systems:

Our commitment extends beyond individual vehicles to incorporate the entire ecosystem. By optimizing the interplay between utilities, power grids, traffic management systems, and electric vehicles, we are creating a harmonious system where all Utahns enjoy safe and reliable mobility as traffic flows efficiently — and the electric grid is balanced through the efficient flow of energy, benefiting consumers, industries, and the environment.

Multi-Modal Mobility

Building upon our integrated systems approach, we are at the forefront of significant change in our transportation, where electric vehicles across all modes of transportation thrive, offering consumers a plethora of options. Our commitment to sustainable mobility is reflected in our efforts to develop and integrate diverse modes for personal and public travel, as well as transportation of goods.



Unified Power Solutions

A balance between electrified transportation and infrastructure needs is crucial. We are actively engaged in harmonizing the needs of electric vehicles with the demands of buildings and infrastructure. Our goal is to create an ecosystem where transportation and development complement one another, leading to enhanced quality of life for communities.

Utah-Specific Strategies

As we develop the action plan to electrify Utah's transportation system, we are spearheading regional customization efforts that tailor intelligent electrified transportation solutions to local needs. From optimizing charging infrastructure placement to leveraging renewable energy sources, our initiatives in Utah serve as a blueprint for regional adaptation across the country.

Regional Adaptation:

Recognizing that transportation needs vary across regions, we advocate for a nuanced, regional approach to infrastructure planning. Our initiatives prioritize flexibility and adaptability, allowing communities to tailor transportation solutions to their unique circumstances while advancing the larger goal of intelligent electrification.

Why Pursue Intelligent Electrified Transportation Panning in Utah?

In 2023, the National Renewable Energy Laboratory (NREL) issued a report that set electric vehicle efficiency ratios for light-duty vehicles registered in the United States. This report established that electric vehicles (EVs) use energy more efficiently than gasoline vehicles, a primary attribute enabling other benefits such as improved torque and reduced operating costs and greenhouse gas emissions. For example, in the United States, the electric vehicle efficiency ratio was calculated as 4.4, meaning that the average EV travels 4.4 times farther on a given amount of energy than the average gasoline vehicle.

This efficiency transfers to larger public transit and freight vehicles, as well. Research from the California Air Resources Board (CARB) established an estimated energy efficiency ratio (EER) for battery electric trucks compared to diesel trucks that included 40-foot transit buses, Class 8 drayage trucks and parcel delivery trucks. The results show the vehicle energy efficiency ratio is about 3.5 at highway speeds and 5 to 7 times the efficiency of conventional diesel vehicles when operated at lower speed duty cycles where idling and coasting losses from conventional engines are highest. Recognizing the potential benefit that EVs can add to our transportation system, the federal government launched initiatives in harmony with the planning effort we are engaged in. Many also recognize Utah as a strategic Intermountain West location where electrified transportation projects can be successfully deployed. Many of these initiatives have been developed through the Electric Vehicle Working Group formed in 2022 by the Joint Office of Energy and Transportation — a collaboration between the U.S. Departments of Energy and Transportation, with a charter to "make recommendations regarding the development, adoption, and integration of light-, medium-, and heavy-duty electric vehicles into the transportation and energy systems of the United States."

Further engagement with additional federal agencies occurred on January 10, 2023, when the Departments

The average EV travels 4.4 times farther on a given amount of energy than the average ICE.

of Energy, Transportation, Housing and Urban Development, and the Environmental Protection Agency released the U.S. National Blueprint for Transportation Decarbonization, a landmark strategy for cutting all greenhouse gas (GHG) emissions from the transportation sector by 2050. The blueprint builds on the Bipartisan Infrastructure Law and Inflation Reduction Act, which together represent historic investments in the future of our nation that will transform how we move and live while we build the backbone of a safer and more sustainable transportation system.

More recently, on March 12, 2024, the Joint Office released the first National Zero-Emission Freight Corridor Strategy. In collaboration with the Department of Transportation, the Environmental Protection Agency, and other strategic partners, this plan identifies opportunities to implement nationwide infrastructure over the next 15 years that supports electrification of our nation's freight. This ambitious strategy supports the federal government's commitment to identifying viable pathways and implementation actions that promote at least 30% zero-emission medium- and heavy-duty vehicle sales by 2030, with a goal of 100% by 2040.

The Zero-Emission Freight Corridor Strategy is guaranteed to impact Utah. Salt Lake City International Airport received Phase 1: 2024-2027 designation as an intermodal freight air-to-truck hub. Likewise, the Union Pacific Salt Lake City Intermodal Terminal within the Utah Inland Port received Phase 1: 2024-2027 designation as an intermodal freight-to-rail hub. Several sections of Utah interstate also received Phase 1: 2024-2027 designation as listed below.

- Interstate 15 (I-15) between Box Elder and Juab counties
- Interstate 80 (I-80) between Salt Lake and Tooele counties
- Interstate 215 (I-215) in Davis and Salt Lake counties

These Phase 1 designations establish Salt Lake City, and the interstate corridors that intersect there, as a strategic hub in the intermountain west for embarking on a nationwide freight electrification plan.

In addition to electrifying our ground transportation from personal vehicles to transit and freight, advanced air mobility (AAM) is quickly becoming part of our mobility ecosystem. According to a report by WSP entitled "Getting Ready for Advanced Air Mobility", AAM represents the next generation of aircraft innovation, bringing mobility options to communities for passenger, air cargo, and emergency services.

The Industry Advisory Board Electrified Aviation Team notes that electrically powered training aircraft are now being designed and built, and Utah has recently received its first one. Manufacturers are designing new electric aircraft and retrofitting current designs with electric powerplants. As battery technology improves and offers more flight time per charge, training for initial pilot certification will be possible without consuming fossil fuels.

The future includes new electric powerplants for existing aircraft types and new designs that have never been seen before. Multiple aircraft manufacturers have reached the flight testing phase for electric vertical take-off and landing (eVTOL) aircraft which will revolutionize the way people and cargo are transported around urban areas and beyond. ASPIRE's planning effort is evaluating the best scenarios to integrate AAM in our urban and rural communities as part of broader metropolitan and regional mobility plans.

By strategically developing our own intelligent electrified transportation plan, Utah will be able to chart our own path forward, shaping the future of transportation and infrastructure in our state while leveraging federal funding to implement our Utah-specific solutions. Similarly, this will mean Utah reaps regionally focused benefits.

In 2023, Utah legislators recognized that there is work to be done in the state to create systems that will lead to better air quality, economic growth and workforce development opportunities, plus improvements to our power grid and infrastructure. With the national strategy targeting freight corridors for electrification and other zero-emission fuel alternatives, it is logical to start our electrification planning by exploring the benefits of electrification from this perspective.

Benefits of an Intelligent Electrified Transportation Plan

Improved Air Quality:

Transportation is the largest contributor of air pollutants like nitrous oxide (NOx), volatile organic compounds (VOCs), and particulate matter 2.5 (PM2.5). Based on Utah's triennial emissions inventory, as reported in the Utah Division of Air Quality's 2021 annual report, heavy-duty diesel trucks produce more than 30% of the state's on-road air pollution, despite making up only 7.5% of all vehicle miles traveled. Switching to zero-emission freight has the potential to significantly reduce NOx, VOCs, and PM2.5 pollutants in and around the Salt Lake City Inland Port thereby improving the health of 250,000 residents who live within a five-mile radius of the port.

Economic Growth:

Electric vehicles have the ability to increase the disposable income of drivers through the savings realized to power the vehicle as compared to powering an internal combustion vehicle (ICE). While electric vehicles tend to have higher upfront costs than ICE vehicles, they are often less expensive over time, partially from the savings derived to power the vehicle. For example, the cost of regular gas in Utah on May 9, 2024, was $3.83 per gallon, and diesel was $3.66, per AAA. In contrast, Rocky Mountain Power rates are among the lowest in the nation where the typical customer pays between 9 to 11.7¢/kWh in the summer and 8 to 10.4¢/kWh the rest of the year.

When considering that the average fuel tank holds between 10.5 to 18.5 gallons, Utah drivers can expect to pay between $40 and $70 to fill their gas tank whereas it would be $3.50 to $15.33 to fully charge an EV using typical prices in Utah.

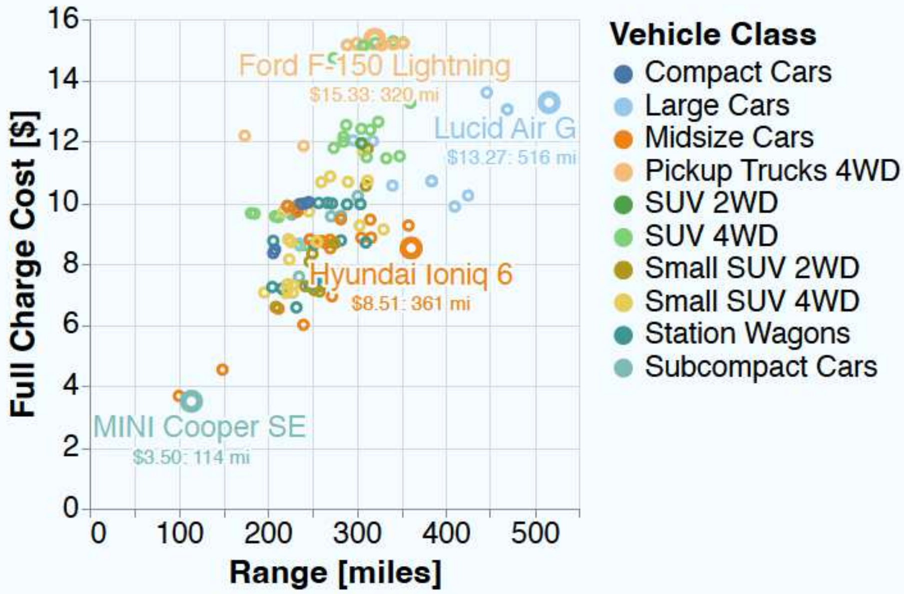
For drivers who choose to participate in a market-driven time of use electricity pricing schedule, these costs can drop as low as $1.75 to $7.67 when charging at non-peak times. These prices will charge a vehicle for between 114 and 516 miles of range depending on the vehicle chosen.

Figure 1 shows the relationship between range and cost to charge for all EVs on the market in 2023. Additionally, Figure 2 shows a comparison in cost per 100 miles between vehicles fueled by electricity, gasoline, and diesel.

In February, the Kem C. Gardner Policy Institute at the University of Utah released an analysis that showed visitors to Utah "spent a record $11.98 billion in

Our Vision

Figure 1: *EV Range vs Cost to Fully Charge colored by vehicle class. Data from EPA, cost to charge assumes 10¢/kWh and battery size is computed using combined efficiency and range.*



Utah's economy in 2022, generating 98,600 direct travel-related jobs and $1.37 billion in direct state and local tax revenue. The report notes that overall, state visitation and other tourism-related economic indicators remained strong despite surging inflation, high gas prices, and fears of a possible recession."

Some of the areas most visited in the state are its "Mighty 5" National Parks as shown below in the 2023 visitation numbers released by the National Park Service:

- Zion National Park
  (4.62 million visitations)
- Arches National Park
  (1.48 million visitations)
- Canyonlands National Park
  (800,322 visitations)
- Bryce National Park
  (2.46 million visitations)
- Capitol Reef National Park
  (1.27 million visitations)

High volumes of traffic traveling to the national parks located in Utah results in long lines that lead to significant air pollution in these sparsely populated regions that would otherwise enjoy a pollution-free environment. In 2023, the Zion Canyon Shuttle System switched to electric buses to continue serving visitors while reducing traffic congestion and crowding in the park. Given that charging an electric vehicle is less expensive than fueling an ICE vehicle, and knowing there are opportunities for further investment, there is potential for Utah to lead as a destination for electrified transportation tourism while simultaneously reducing emissions-related pollution in our National Parks.

Outside of tourism, Salt Lake City forms a national hub of freight transportation, which led to its priority

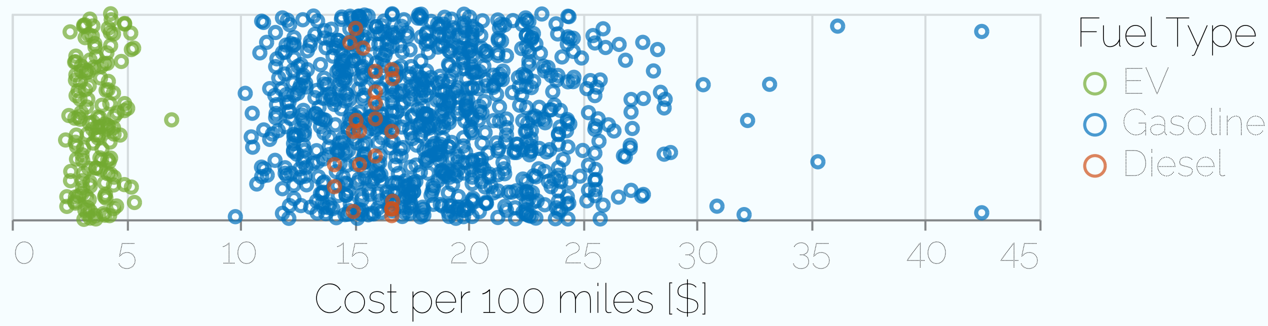


Figure 2: *Comparison of fueling costs for vehicles fueled by electricity, gasoline, and diesel. Efficiency data from EPA and fuel prices assume $3.83/gallon Gas, 3.60/gallon Diesel, and 10¢/kWh.*

designation on the National Zero-Emission Freight Corridor Strategy. According to the American Trucking Association, nearly 8 million people in the U.S. work in the trucking and transportation industry and play a crucial role in upholding the supply chains that support economies throughout the nation. CALSTART, a national nonprofit focused on transportation initiatives, found three-quarters of goods in the country are moved by freight, generating nearly $1 trillion in revenue each year.

Workforce Development:

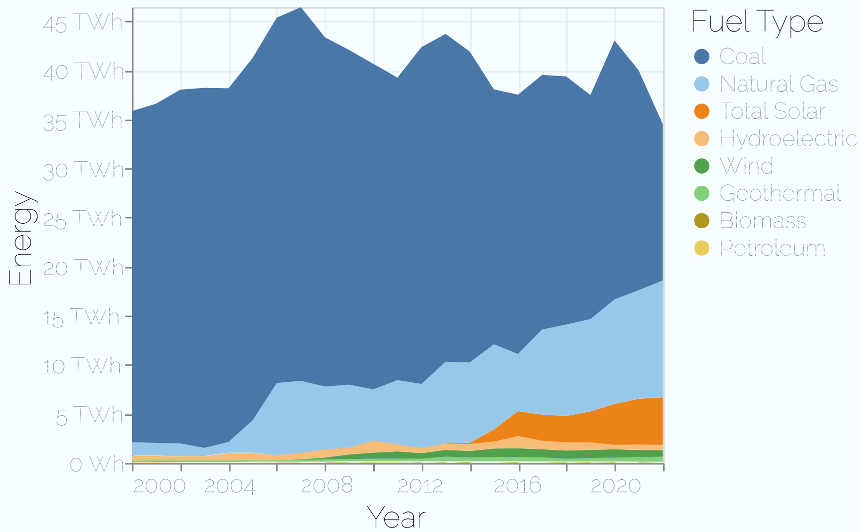
With the entire transportation industry at the precipice of this momentous change, we will need to train future generations to build, operate, and maintain these innovative new systems.

We need to explore training and educational opportunities for those in all levels of the workforce, from engineering to production to maintenance. For example, what will the automotive service technicians of the future need? The Bureau of Labor Statistics projects this career path to grow at a rate of nearly 70,000 new positions each year for the next decade. We need to prepare the workforce in terms of training from day 1 as well as advancing certification for experienced mechanics.

In Utah, we are lucky to work with partners throughout the state to determine these needs while working with existing programs in automotive technology and service offered at universities along the Wasatch Front, like Weber State University and Utah Valley University, plus Utah State University's Statewide Campuses and the Utah System of Higher Education's (USHE) technical colleges.

As we explore charging methodologies and infrastructure improvements that support electrification, this also leads to an increased need for more training of utility and power production technicians, operators,

Figure 3: *Utah electrical energy use by fuel type from 2000-2023. In recent years natural gas and solar have increased, while coal has decreased.*



and engineers as it relates to both Utah's and other states' power planning and grid infrastructure.

Improved Grid Resilience & Electric Generation:

Goals to decarbonize energy in the U.S. by 2035 have been set, but how we get there will likely be determined regionally. The general consensus, as reported by The New York Times in May, is "that there aren't nearly enough high-voltage power lines being built today, putting the country at greater risk of blackouts from extreme weather while making it harder to shift to renewable sources of energy and cope with rising electricity demand."

Utah's current electric power portfolio utilizes a blend of fossil fuels and renewable energy to power its electric generation. As shown in Figure 3, nearly 80% of the electric power generated in Utah is fueled by natural gas and coal. According to the state energy profile analysis published by the U.S. Energy Information Administration (EIA), Utah is home to three of the largest natural gas fields in the country. The state's electric power sector became the largest consumer of natural gas in 2021 leading to one-third of the natural gas consumed in the state being used to generate 26% of Utah's electricity in 2022. The EIA analysis shows almost 90% of Utahns use natural gas as their primary heating fuel — the highest consumption of all states in the U.S. — which accounts for 30% of the natural gas consumed in Utah. Similarly, four-fifths of the coal mined in Utah is consumed in the state and was used to generate 53% of the state's electricity in 2022, down from 75% in 2015.

Production in coal mining, natural gas, and crude oil has been slowing in recent years. However, NYT also reported the country's electrical grid is not yet prepared for decarbonization. We need to be strategic and future-focused in our planning to find ways to improve our grid now and in years to come without harming the communities that rely on our current energy production methods.

In May, the Federal Energy Regulatory Commission issued the first rules to oversee interstate electricity transmission to promote more high-voltage power lines fueled by renewable energy resources, like wind and solar.

The EIA reported that 16% of Utah's electricity was generated from renewable resources in 2022, with solar as the majority source at 9%. As carbon-neutral energy demands increase, the state could increase solar as it's ranked by the EIA as one of the greatest states for solar resources. However, one of the biggest challenges to renewable energy is storing any power generated. It's most energy efficient and affordable if the energy generated goes directly to source charging delivery, but there's not always constant generation from renewable resources. Battery storage technology already exists and can be used at scale to counter this disadvantage.

Other alternative energy sources used include hydropower, wind energy, geothermal, biomass, and hydrogen — which could include the Advanced Clean Energy Storage (ACES) project in Delta, Utah. The ACES project is expected to be completed in 2025 and will be the world's largest hydrogen production and storage facility where hydrogen will be stored underground in two massive salt caverns each capable of storing 150 GWh of energy. The facility will supply the hydrogen feedstock to the Intermountain Power Agency's (IPA) Intermountain Power Plant (IPP Renewed Project) in Delta. The IPP — an 840 MW hydrogen capable gas turbine combined cycle power plant — will initially run on a blend of 30% green hydrogen and 70% natural gas starting in 2025 and will increase to 100% green hydrogen by 2045.

Noting that nearly all freight transportation runs on oil and gas and demand is projected to grow nearly 50% — 30 billion tons — by 2050, freight will become the highest emitting sector of greenhouse gas emissions. Electrifying freight transportation presents the greatest opportunity to make a positive impact toward improving our air quality while reducing the cost to move goods.

ASPIRE, in partnership with NREL, is currently developing a plan for heavy-duty freight electrification along the Wasatch Front as a recipient of a Department of Energy (DOE) grant to improve heavy-duty freight corridors. This plan will also integrate onsite hydrogen (H_2) storage, fueling, and electric power generation at transport terminals or truck stops where hydrogen can provide fuel to generate electric power for battery-electric vehicle charging in the event of a power outage. The hydrogen storage will also enable fueling of heavy-duty trucks designed to operate on battery-electric equipment in areas where electric charging infrastructure is available and then transition to operating on hydrogen fuel to cross vast distances where electric charging may not be readily available.

Regarding hydrogen and fuel cell manufacturing, there are 52 projects in the U.S. to enable a target of $2/kg H2 by 2026 and $80/kW fuel cells by 2030. These efforts are targeted at producing 10 GW per year (1.3M metric tons of H2 per year) and 14 GW per year of fuel cells, corresponding to 50,000 trucks (about 15% of annual sales).

Renewable Innovations, located in Lindon, Utah, produces grid-independent mobile power solutions consisting of H2 storage, fuel cells, battery storage, and chargers to energize electric vehicles in remote locations while providing mobile charging where grid capacity is limited. Love's Travel Stops operates seven locations in Utah where H2 delivery is part of their strategy. They have indicated interest in building out this H2 infrastructure at their locations but are not likely to make the investment unless they can get a fleet customer to sign up for utilization. A potential Utah strategy is to use local H2 generation where needed to support the grid, followed by direct fuel delivery for vehicles where we begin by focusing on off-road vehicles.

Additionally, electric utilities are planning forays of nuclear power to be introduced into Utah's energy portfolio. As the second largest source of low-carbon electricity in the world behind hydropower, nuclear power could become a major generator of the electricity needed to power our electrified transportation.

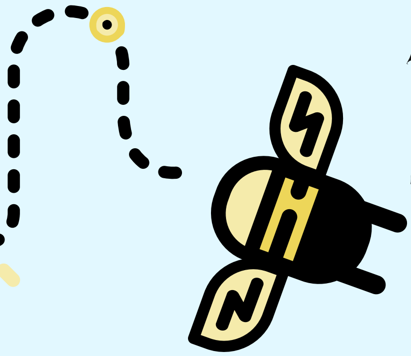
The United States produces more nuclear-generated electricity than any other nation in the world with 20% of the electricity generated in the U.S. coming from nuclear power. This clean energy resource produces zero emissions, protecting our air quality. When compared with solar and wind farms, it requires a very small land footprint. Additionally, nuclear fuel is extremely energy dense, about 1 million times moreso than that of other traditional energy sources. Because of this, the amount of used nuclear fuel is not as big as one might think. According to the Department of Energy, all of the used nuclear fuel produced by the U.S. nuclear energy industry over the last 60 years could fit on a football field at a depth of less than 10 yards. That waste can also be reprocessed and recycled, although the United States does not currently do this.

Evaluating emerging innovations in the nuclear sector will be important to optimizing the future grid.

State of the State

Utahns identify with the beehive as an expression of a tenacious people who consistently work together to achieve innovative solutions that yield high quality of life.

In another bold endeavor, Utahns are coming together to develop an action plan for the electrification of our transportation system over the next 30 years in response to Senate Bill 125 (S.B. 125) passed in 2023 by the Utah State Legislature. The process employs a carefully balanced market-driven approach that is responsive to the legislation while providing strategic direction founded upon common ground and empirical evidence.



11 Highlights For Utah Electrification

1. Electrifying Transportation
2. Utah's Ideal Electrified Transportation System
3. Strategic Objectives
4. This is the Place
5. Buzzworthy Takeaways
6. State Projects Driving Electrification
7. Mitigating Risk & Vulnerability
8. Powering Electrification Transportation
9. Industry Advisory Board (IAB)
10. Addressing Key Gaps
11. Legislative Priorities for Implementation

Electrifying Transportation:

Reliable, Intelligent, & Life-Enhancing

Utah's Intelligent Electrified Transportation Action Plan is establishing processes that design, fund, and build a highly reliable electrified transportation system (ETS) that intelligently communicates with traffic management systems and the electric grid.

State of the State!

Market-Driven

Utah's EV market share is 8%, ranking No. 16 in the U.S. according to the Alliance for Automotive Innovation. Infrastructure to broadly support EVs statewide is needed as more Utah consumers choose to own EVs.

Beneficial

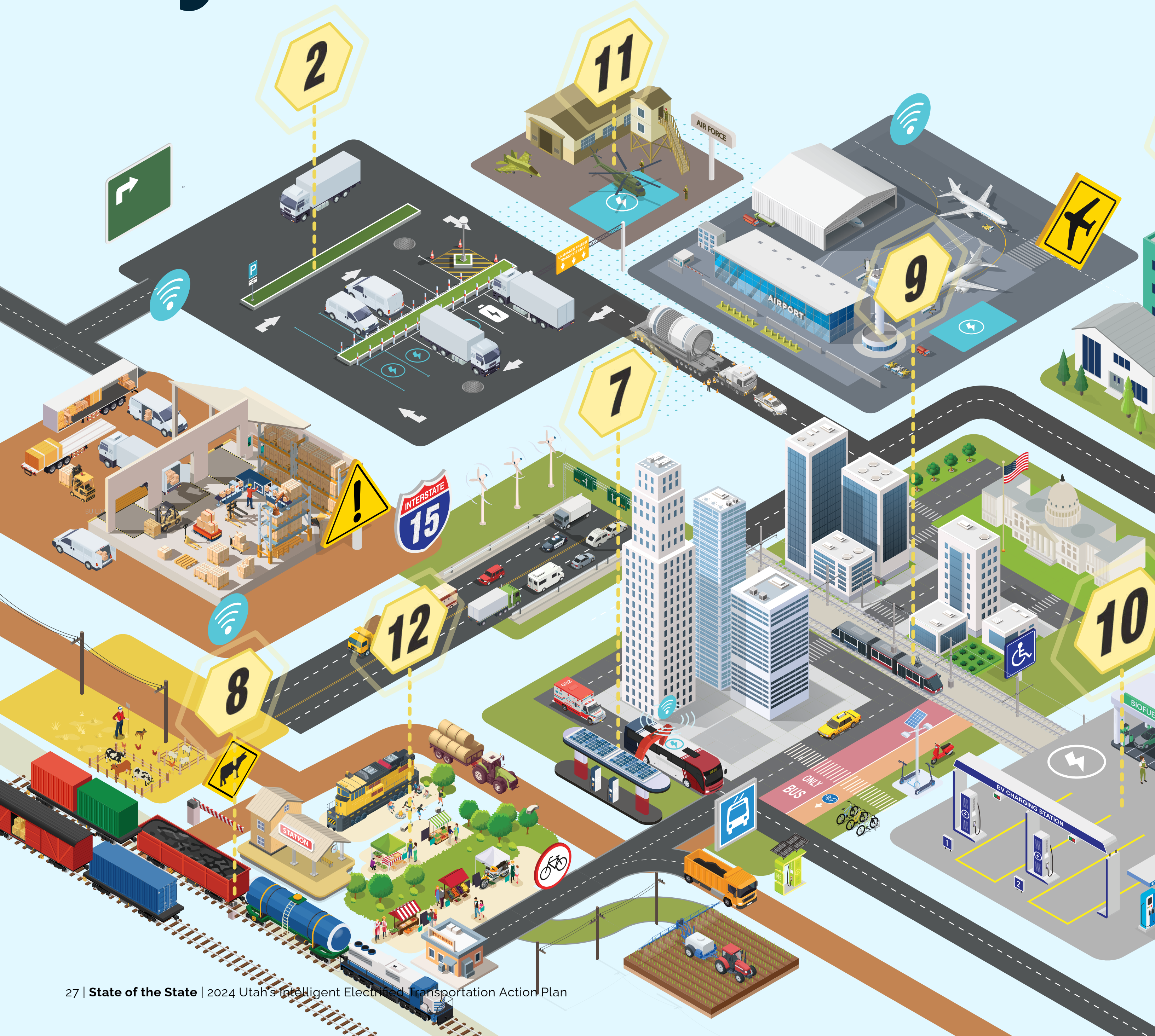
Providing electrified transportation options enhances our quality of life by reducing travel and freight costs, improving air quality, and creating new jobs within the state in an innovative and high-demand industry.

Viable

Proven technologies are being deployed across the state by multiple agencies demonstrating the feasibility of electrifying the transportation system.

Buzzworthy points indicating the Utah Legislature's timeliness in calling for this planning effort.

Utah's Ideal Electrified Transportation System



Scan to watch Rocky Mountain Power's ETS concept video

2 State of the State!

Features for Utah's Ideal ETS

1. **CHARGING:** Home, workplace, & fleet.
2. **SHARED INFRASTRUCTURE** at intermodal hubs
3. **ONSITE BATTERY STORAGE** to reduce peak demand during charging
4. **UTILITY MANAGED** clean energy generation
5. **INTELLIGENT SYSTEMS** Optimized efficiency by intelligent electrical grid and traffic management systems
6. **IN-MOTION CHARGING** lanes
7. **OVERHEAD** bus charging
8. **BATTERY-ELECTRIC TRAINSETS** for regional/ commuter rail transit
9. **ELECTRIFIED LIGHT RAIL** transit
10. **FAST CHARGING STATIONS** distributed throughout the state
11. **ELECTRIFIED VERTIPORTS** for advanced air mobility (AAM)
12. **FULLY CONNECTED COMMUNITIES** allow the grid to deliver more clean energy

Strategic Objectives

Welcoming the world to the 2034 Winter Olympic Games is a unique opportunity to showcase the ideal electrified transportation system as innovated by the people of Utah and unlike any other in the world.

Given that vehicles account for half of Utah's winter air pollution, electrifying our transportation with efficient, accessible, and affordable mobility is perhaps the single-most important step that can be taken to significantly improve our air quality in time for the Olympic Games.

IMG SOURCE: *Courtesy of Wikimedia Commons*

State of the State! 3

These key electrification objectives, informed by Utah Code 53B-18-1805 & 53B-18-1806, are in progress

Train an elite workforce prepared to work in associated industries at workforce development and training programs made available statewide by trade associations and the Utah System of Higher Education's universities and technical colleges.

Create industry-related high-tech businesses catalyzed by the Utah Innovation Fund to produce highly desirable jobs that strengthen local economies throughout the state.

Improve air quality by reducing vehicle and electrical power generation emissions in critical air sheds.

Earn community trust by addressing concerns through research and community engagement.

Build a multi-modal system that integrates across and supports all transportation modes and vehicle classes in complementary ways.

Secure significant federal funds to build shared infrastructure by leveraging state funds already committed to several electrification projects.

Reduce transportation costs to move people and goods.

Improve electrical grid resiliency and security to ensure a safe, secure, and reliable electrified transportation system.

Incorporate hydrogen and renewable natural gas power generation, storage, grid support, and fuel cell vehicles in complementary ways.

Develop a planning process that builds an intelligent electrified transportation system over thirty years by reaching key benchmarks in 10-year phases beginning with the 2034 Winter Olympic Games.

This is the Place

Leading with innovative solutions, Utah is the ideal location to deploy electrified transportation. It features varied climates and elevations with hot deserts and high alpine terrain where the potential for extreme weather conditions exists year-round.

Its rural communities are dispersed across wide open spaces and agricultural lands — with scenic mountain valleys and basins — require innovative solutions for connectivity to the system. And its urban corridor is perfectly sized in geography and population to implement a comprehensive electrified transportation system that can scale to both smaller and larger urban areas across the nation and throughout the world.

With support from the state legislature, several public and private entities based in Utah are developing technologies that are revolutionizing the electrification of transportation. Their cumulative accomplishments are being incorporated into the action plan. Utah's thriving tech industry fosters a culture of innovation and collaboration that is attracting top talent and investment to the state.

Likewise, a dynamic workforce with transferable skills is another key asset. Strong emphasis on education ensures a steady pipeline of skilled professionals ready to tackle

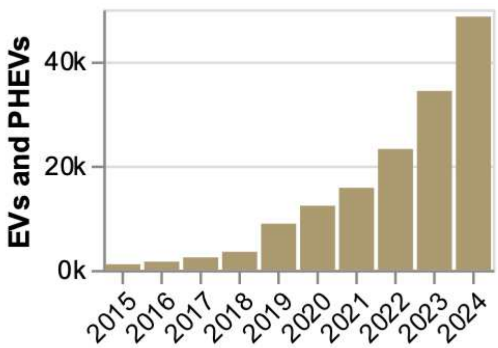
new technological challenges. Trade associations, universities, and technical colleges in Utah offer programs tailored to the tech and engineering sectors, fostering a knowledgeable and adaptable workforce.

The people of Utah are well positioned to lead the nation in showing the path forward in intelligent electrified transportation. Through a careful and balanced approach, Utah's action plan is on target to achieve the state's goals of improving air quality while reducing transportation costs and creating new jobs.

Buzzworthy Takeaways

Utahns are increasingly choosing to drive electric.

Utah Electric Vehicle Registrations



1:10 EV-to-diesel truck ratio in Utah in 2023

Top 10

Utah counties by percent adoption of Electric, Hybrid and Plug-In Hybrid (PHEV) vehicles:

1. Summit **5%**
2. Utah **4%**
3. Salt Lake **4%**
4. Davis **4%**
5. Washington **4%**
6. Wasatch **3%**
7. Morgan **3%**
8. Cache **3%**
9. Weber **3%**
10. Grand **2%**

45,000+

EVs were registered in Utah in 2024.

8%

Of all vehicles sold in Utah for the first ¾ of 2023 were EVs.

56%

Year-over-year increase in EV adoption in Utah.

Top 10

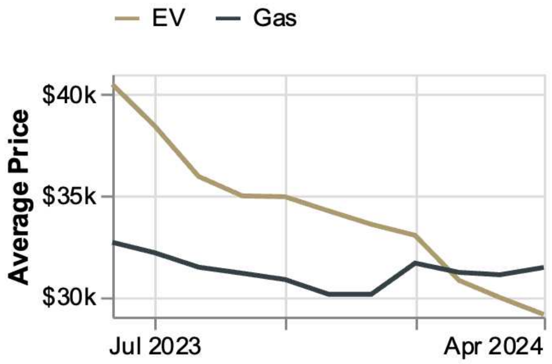
Utah counties by Electric, Hybrid and Plug-In Hybrid (PHEV) vehicle registrations:

1. Salt Lake **39,764**
2. Utah **20,120**
3. Davis **10,790**
4. Washington **7,166**
5. Weber **5,737**
6. Cache **3,281**
7. Summit **2,915**
8. Tooele **1,608**
9. Wasatch **1,386**
10. Iron **1,224**

EVs are increasingly affordable.

5
State of the State!

Used EV Prices from July 2023-2024



Used EVs are becoming cheaper than used gas vehicles.

4-11X

Less Expensive

To fully charge an EV than fill up a gas tank (and up to 23x cheaper if charging at non-peak times).

5-7x

More Efficient

Than conventional diesel vehicles when operated at lower speed duty cycles where idling and coasting losses from conventional engines are highest.

$6 - $12k

Lifetime Savings

In EV-ownership compared to owning a similar gas-powered vehicle.

Travel

4.4X

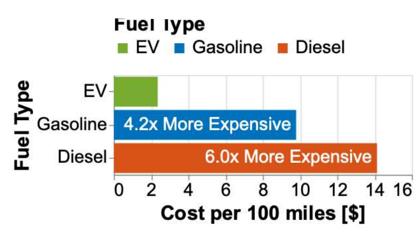
Farther

On a given amount of energy for an average EV in the U.S. compared to the average gasoline vehicle.

$3.50- $15.33

Cost to fully charge an EV in Utah at typical prices.

Best in Class Cost Per 100 Miles



Cheaper to power an EV than a similar gas-powered vehicle, and half as much to repair and maintain it.

SOURCES: greencarreports.com • TransAtlas, 2023 • DMV Data • Freight Analysis Framework (FAF) (ornl.gov) • Consumer Reports, 2023 National Renewable Energy Laboratory (NREL), 2023 • California Air Resources Board (CARB) • ASPIRE NSF ERC

Buzzworthy Takeaways

Utah roads move a lot of freight.

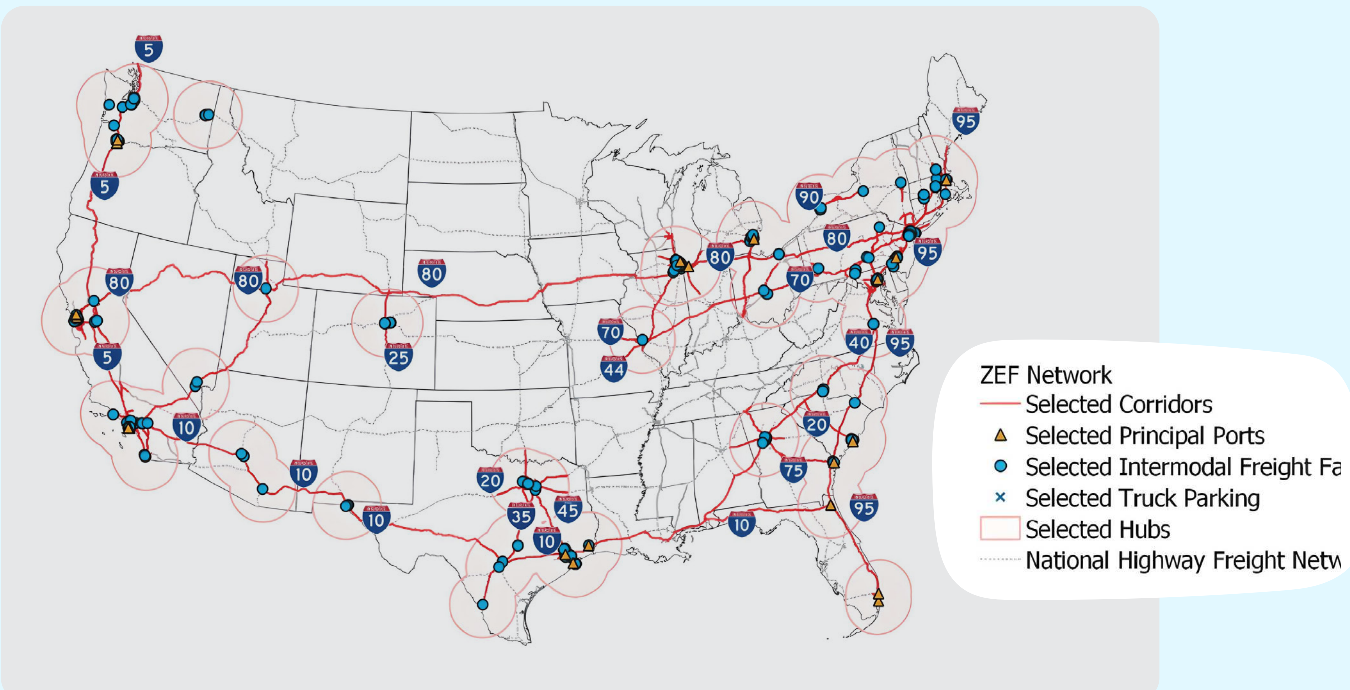
This 2017 Federal Highway Administration (FHWA) map shows the flows of freight passing through Utah.

More than 10,000 trucks per day originate in California. 5,000 to 10,000 trucks per day originate from each of the following seven states: Colorado, Idaho, Illinois, Michigan, Ohio, Oregon, and Washington. Utah is a critical junction for freight moving between the Pacific Coast seaports and the upper Midwest and Northeast.

Scan to learn more about the Zero-Emission Freight Corridor Strategy

5 State of the State!

... A lot.



The freight flows passing through Utah merit its designation as a Phase 1 electrification hub.

The 2024 Joint Office of Energy and Transportation National Zero-Emission Freight Corridor Strategy indicates locations and interstate highways where the federal government desires to invest heavily in electrified transportation charging infrastructure for medium and heavy-duty vehicles traveling through Utah on Interstates 15 and 80.

Buzzworthy Takeaways

Utahns are entitled to superior air quality.

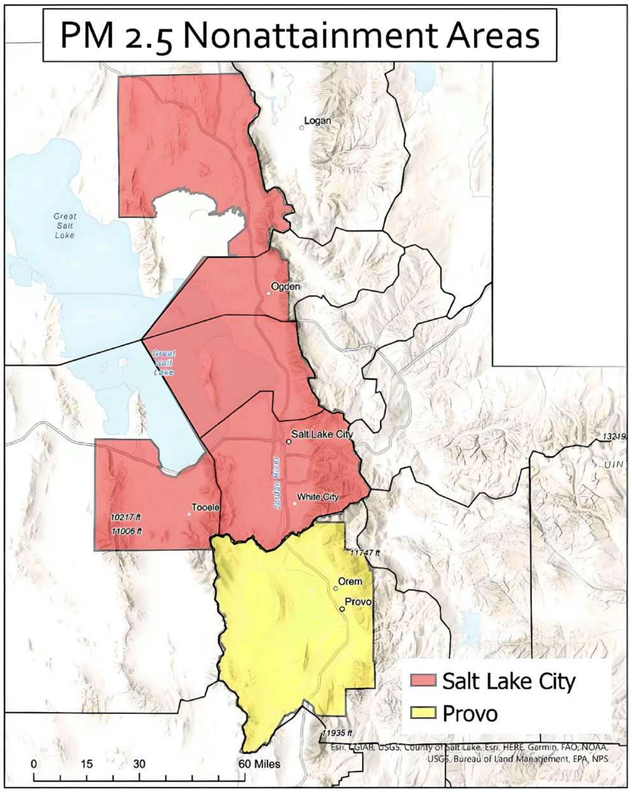
Retiring engine model from 2009 and older diesel trucks that are currently operational and have a minimum of three years remaining in their useful life and replacing them through programs like the "Utah Clean Diesel Program" with current model years can achieve approximately:

- **71-90%** reductions in NOx
- **97-98%** reductions in PM2.5
- **89-91%** reductions in VOCs

Direct tailpipe pollutant emissions from transportation sources per year

(Utah Department of Air Quality)

CO	326,000 tons
NH_3	1,050 tons
NOx	74,000 tons
PM10	15,400 tons
PM2.5	5,600 tons
SO_2	550 tons
VOC	32,000 tons



According to the Utah Division for Air Quality's 2021 annual report:

1. Mobile sources have historically been the largest source of emissions in Utah areas not meeting the National Ambient Air Quality Standards (NAAQS).
2. Motor vehicles are the largest source of oxides of nitrogen (NOX) within the Wasatch Front Ozone nonattainment area.
3. Elevated ozone coincided with elevated levels of VOCs and NOx, which are the primary chemical precursors of ozone formation.

39%

Of annual man-made pollution (NOx, PM2.5 exhaust, and VOC) along the Wasatch Front comes from on-road mobile sources.

30%

Of vehicle pollution is produced by heavy-duty diesel vehicles, which account for only 7.5% of the vehicle miles travelled.

5 State of the State!

Utahns' access to charging infrastructure is increasing.

NEVI
National Electric Vehicle Infrastructure

849
EV charging stations in Utah

15
NEVI fast charging sites
(4 chargers at each site)

Including fast charging options available throughout the state, even in rural areas.

The scale and density of charging infrastructure reflects Utah's readiness to pursue a comprehensive electrified transportation system. As reflected in the map to the left, UDOT's National Electric Vehicle Infrastructure (NEVI) program is just one of several deploying hyper-fast charging stations in strategic locations on key corridors statewide to meet EV market demands for reliable charging options.

SOURCES: Alternative Fuels Data Center, 2023 • driveelectricutah.org • Electric Vehicle Charging Plan - PublicInput (utah.gov) EPA Emissions Standards for Heavy-Duty Highway Engines and Vehicles.• DAQ

State Projects Driving Electrification

Access to transportation is a key component for a high quality of life. A lack of transportation options creates barriers to education, jobs, health, and recreational opportunities that we all need to find fulfilment and enjoyment in our lives.

This planning process envisions the real impacts and limitations of our current transportation system on air quality, the economy, and our communities. It recognizes that transportation and electric utility infrastructure across the nation need extensive renovation.

Through our collaborative efforts, projects are being deployed and major investments are underway that lay the foundation for the ideal intelligent electrified transportation system. These projects are moving us in a direction that is beneficial and advantageous for the consumer, fleet operators, and electric utilities by improving our mobility, enhancing our air quality, and reducing transportation costs.

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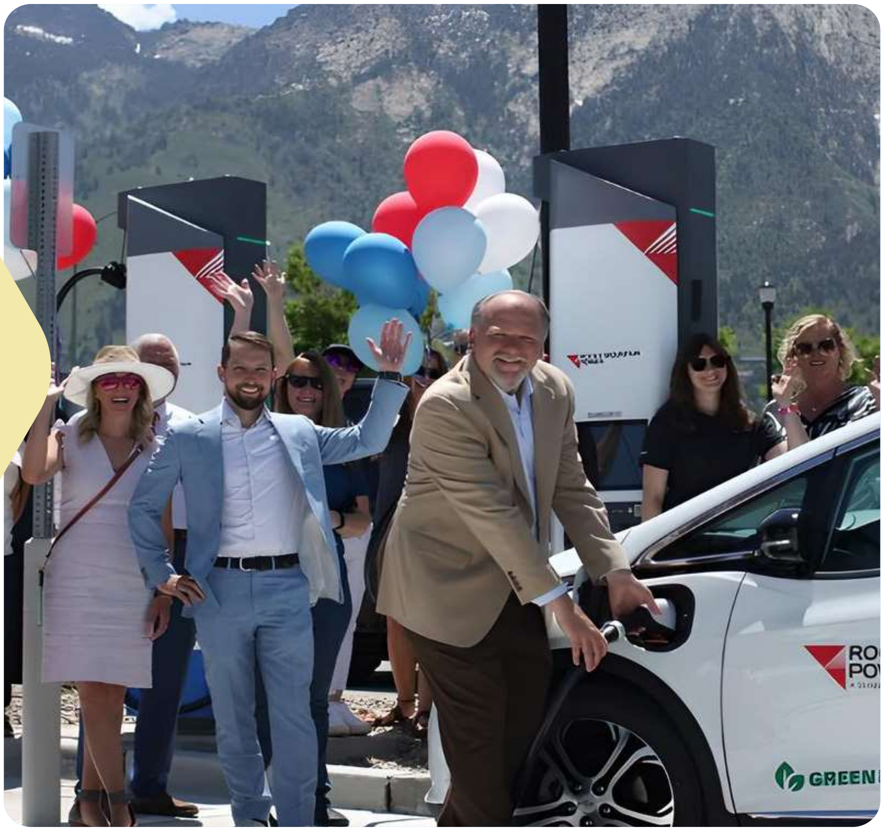
State of the State!

Here's a look at some of the highlights over the last 12 months...

Rocky Mountain Power Electric Vehicle Infrastructure Program (EVIP)



#Fast Charging Stations

June 2024 • Rocky Mountain Power celebrated the opening of a hyper-fast public charging station at UTA's Olympus Cove Park and Ride lot in Millcreek — one of 20 fast charging stations planned in Utah. This project was developed in partnership with Electrify America. Funding was made possible using Rocky Mountain Power's EVIP funds.

Rocky Mountain Power Electrification Projects

Rocky Mountain Power was able to bring the first EV charging stations to I-15. In addition, they are leading the charge on utility improvements and bringing transmissions lines to Utah, along with fostering greater opportunities for workforce development.

WestSmart EV@Scale

#Charging Infrastructure

July 2020 • PacifiCorp received a $6.6 million Department of Energy award to create an enduring regional electric vehicle ecosystem across seven western states. It addresses challenges in critical EV application focus areas that include destination highways, underserved regions, urban mobility, freight and port electrification, along with community and workplace charging. The project coordinates efforts to electrify over 42,000 miles of regional interstate and state highway networks. It includes more than $10 million in cost share, and sustains accelerated growth in freight, business and consumer use of electric vehicles.

PacifiCorp Grid Resilience & Innovation Partnership Grant

#Innovative Technology

#Workforce Development

October 2023 • DOE awarded $150 million to PacifiCorp for grid resilience projects that touch six western states. Just under 100 million will support PacifiCorps PEER project for grid resilience, which is designed to reduce the impact of extreme weather events on portions of the electrical grid serving disadvantaged communities in areas at highest risk of wildfire. An additional $50 million will go toward the company's Resiliency Enhancement for Fire mitigation and Operational Risk Management (REFORM) project, which enhances control center capabilities with technological improvements.

eMosaic: Electrification Mosaic Platform for Grid-Informed Smart Charging Management

#Innovative Technology #Transit #Charging Infrastructure

October 2020 • Rocky Mountain Power partnered with ABB, ASPIRE, Idaho National Lab, and Proterra to develop a scalable, secure, and resilient eMosaic platform to provide localized and bulk grid services and smart charge management by field deploying, validating, and demonstrating the platform. It provides a combined view of multiple charging sites, levels, and types to form a full picture of EV charging for utility informed smart charging management.

Rocky Mountain Power Wattsmart Battery Program

#Innovative Technology

October 2021 • This new model for existing rooftop solar customers transforms thousands of intermittent rooftop solar systems into firm dispatchable grid assets by retrofitting each home with a Sonnen battery. In other words, their 50,000 customers with rooftop solar systems can now be equipped with batteries controlled by the local utility for the greater operation of the grid, removing many of the grid integration issues inherent with existing stand-alone rooftop solar systems.

PacifiCorp/Rocky Mountain Power Electrified Transportation Projects

#Workforce Development

Beginning in 2020 • Rocky Mountain Power was the first organization to make significant investments in charging infrastructure across the state along principal corridors such as Interstate 15. Additionally, they are leading the charge on utility improvements by building new transmission lines and establishing workforce development training programs in Utah.

Connected Communities Grant

#Innovative Technology

November 2021 • PacifiCorp received a $6.4 million Department of Energy award to establish a connected community, which will be a group of grid-interactive efficient buildings with diverse, flexible end-use equipment and other distributed energy resources that collectively work to maximize building, community and grid efficiency, while meeting occupants' comfort and needs.

UDOT National Electric Vehicle Infrastructure (NEVI) Program

#Fast Charging Stations

June 2024 • Rocky Mountain Power and UDOT celebrated the opening of eight hyper-fast public chargers near the entrance to Arches National Park in Moab. This project was developed in partnership with Electrify America. Funding was made possible using UDOT's NEVI funds and Rocky Mountain Power's EVIP funds.

Stadler Rail Battery-Electric Trainset

#Innovative Technology

#Transit

June 2024 • The Utah Legislature funded development of the first battery-electric passenger train in the U.S. in partnership with ASPIRE, headquartered at Utah State University, and Stadler Rail, which will build the trainset at their North America Headquarters in Salt Lake City. Testing will begin in Fall 2025. The trainset has garnered national attention with Chicago Metra announcing in February 2024 its intent to purchase eight trainsets to replace some of its oldest — and highest polluting — trainsets. The $154 million order includes an option to purchase an additional eight trainsets.

In Utah, these trainsets could replace FrontRunner's diesel engines and be deployed by the 2034 Olympic Games.

6 State of the State!

Utah Innovation Fund

#Innovative Technology

2023 • The Utah Legislature created the Utah Innovation Fund in 2023 to solve complex and high-impact problems by investing in promising local startups. The fund targets startups connected to higher education institutions which ensures a continuous flow of innovative ideas and solutions to some of Utah's largest challenges including those related to electrified transportation. The fund connects startups with investors, testing centers, and experts in engineering, business, and negotiations.

Utah Office of Energy Development (OED) Rural EV Infrastructure (REVI) Program

#Fast Charging Stations

June 2024 • Managed by OED, REVI is a $3 million matching grant program designed to provide funds to rural electric cooperatives for upgrading and installing new charging infrastructure. OED is preparing to announce grant recipients in August 2024.

High Valley Transit Electric Bus Grant Recipient

#Transit

July 2024 • the Federal Highway Administration (FHWA) awarded $16.2 million to High Valley Transit in Summit County to purchase 10 electric buses and upgrade its charging infrastructure. UTA is assisting the agency with the charging infrastructure construction. High Valley Transit currently operates an electric bus commuter line between Kimball Junction and Salt Lake City.

Utah Transit Authority (UTA) Electrified Transit Projects

UTA is at the forefront of advancing electrified transportation in Utah. Their efforts to electrify transit are reducing emissions, improving air quality, and providing efficient and reliable transportation options. Here are a few highlights of their recent accomplishments.

Tooele On-Demand

#Transit

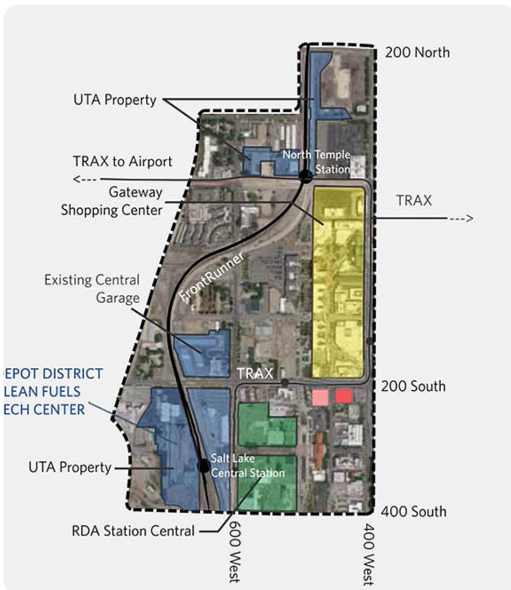
October 2023 • UTA launched an all-electric fleet of 10 Ford E-transit vans to provide UTA's On-Demand service in Tooele County. The service provides enhanced coverage, access, and flexibility for riders while reducing carbon dioxide emissions by an estimated 2.7 metric tons in the initial months of operation.

Ogden Express (OGX)

#Transit

August 2023 • After two decades of planning, UTA successfully launched its second rapid transit system — the Ogden Express (OGX) — in August 2023. This innovative system features 11 electric buses that connect the Ogden FrontRunner station with Weber State University. Thanks to a federal grant, OGX is fare free for the first three years.

Depot District



#Transit #Innovative Technology #Charging Infrastructure

May 2023 • UTA's Central Depot District Garage, or Depot District, was opened in May 2023. It was uniquely designed as a one-stop shop to accommodate alternative fuel and clean-air transit vehicles. Depot District also houses a fleet of 47 compressed natural gas (CNG) buses. In addition to administrative offices and UTA tech center, the depot features charging stations for 24 of its e-buses, diesel refueling, outdoor bus parking under modern canopies, and a bus wash.

TRAX

#Transit

July 2024 • UTA received Federal Transit Administration funding to upgrade TRAX light-rail service with 20 new low-floor light rail vehicles that enhance accessibility and improve efficiency.

Electric Bus Grant

#Transit

July 2024 • UTA was awarded $18 million to purchase 15 electric buses that will operate on Salt Lake County's west side routes by 2027.

S-Line Expansion

#Transit

April 2024 • UTA announced the expansion of the S-Li ne service in Sugar House. The project extends the line to Highland Drive to support economic development and serve the growing population.

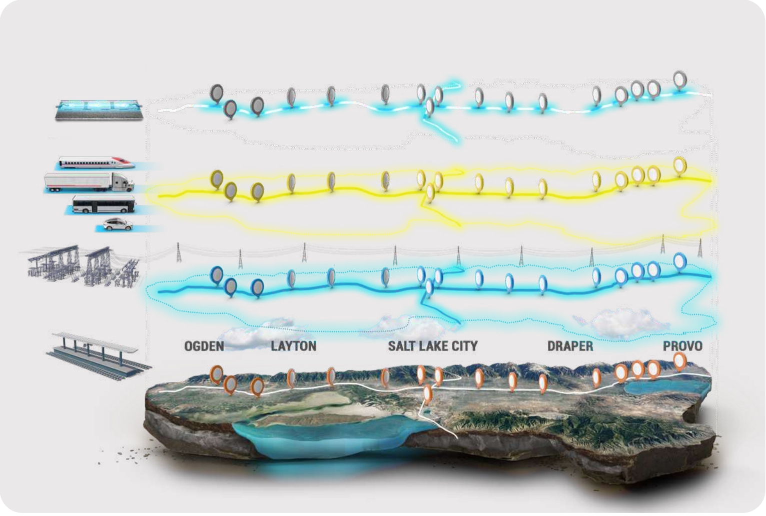
ASPIRE Electrification Projects in Utah

ASPIRE is implementing electrification projects throughout the state, includingwork with fleets, public transit, and personal vehicles. These projects, which involve advanced electric charging infrastructure and automated logistics systems, have proven effective in real-world scenarios, and they align with the National Zero-Emission Freight Corridor Strategy.

These deployments have demonstrated measurable success in reducing emissions and improving efficiency, showcasing their effectiveness and practical benefits.

Here are three of ASPIRE's electrification projects, including two at the Utah Inland Port Authority (UIPA)'s Northwest Quadrant Project Area in Salt Lake City.

Multi-Modal Planning



#Fast Charging Stations #Freight #Transit #Innovative Technology

October 2023 • ASPIRE received a grant from the Department of Energy to develop a plan for multi-modal electrification along the Wasatch Front. The project will deliver a 20-year medium- and heavy-duty zero-emission vehicle (MHD ZEV) infrastructure deployment plan — benefitting the communities that experience the most impacts from freight emissions.

This electrification plan involves a comprehensive network of charging systems, hydrogen generation, intelligent grid management, and transportation planning.

It will demonstrate affordable, energy-efficient transportation planning to benefit all users — from electrified commercial fleets and freight transportation to public transit and private vehicles, and even airspace and drone charging technologies.

1-Megawatt Static Charger

#Innovative Technology #Freight

Zero-Emissions Long Distance Shipping

To address the poor air quality along the Wasatch Front, ASPIRE has partnered with Kenworth, UPS, and WAVE to create two zero-emissions routes using a battery-electric Kenworth truck powered by two static 1-megawatt chargers. Developed by ASPIRE's team at USU, this 1-MW WPT system will be deployed at the EVR in Logan and the Utah Inland Port in Salt Lake City.

The project, beginning in Fall 2024 and lasting at least 3 months and 10,000 miles, will demonstrate fast charging for a Class-8 truck on challenging routes. It aims to prove that current technology can support the electrification of long-haul freight in extreme conditions.

1/4-Mile Electrified Roadway

#Innovative Technology #Freight

Zero-Emissions Short-Range (Drayage) Deliveries

To reduce emissions from short-distance drayage routes, ASPIRE will install a dynamic charging system at the Utah Inland Port. This will include two dynamic wireless power transfer (DWPT) systems: one co-developed with ASPIRE's team at Purdue University and one using the Electreon DWPT system. The Electreon system, previously tested at USU's EVR facility, will be deployed within the port near the Union Pacific rail yard. The USU-Purdue system builds on Purdue's pilot deployment in Indiana, where a quarter-mile test bed will power a heavy-duty electric truck at highway speeds. Results from these pilots will inform future electrification projects, including Utah's I-15 corridor and the Utah Intelligent Electrification Action Plan.

Beehive Emissions Reduction Plan

The U.S. Environmental Protection Agency (EPA) awarded Utah's Division of Air Quality (DAQ) $74.7 million in July 2024 to implement the Beehive Emission Reduction Plan, a comprehensive initiative aimed at significantly reducing greenhouse gas (GHG) emissions across the state. Programs within the plan are targeted to achieve notable environmental benefits for buildings, electric power, industry, and transportation.

Electric Vehicle Deployment: Provides incentives primarily intended to assist low-income communities with purchases of electric vehicles, electric bikes, electric yard equipment, and installation of electric vehicle chargers.

Methane Emission Reduction: Technology to reduce fugitive methane emissions will be installed at 800 oil and gas facilities in the Uinta Basin.

Outreach and Education: Conducts outreach, education, and workforce training programs to inform individuals and small businesses about emission reduction opportunities.

Electric Fleet Incentive: Available to fleet operators to help purchase light-, medium-, and heavy-duty electric vehicles.

Electric Vehicle Incentive: Available to help income-qualifying individuals purchase electric passenger vehicles.

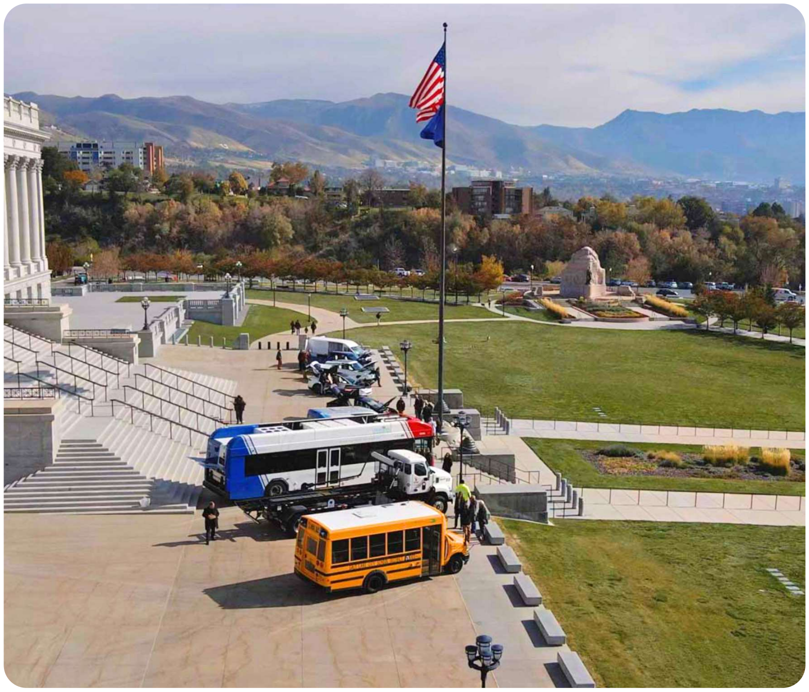
Cumulative GHG Reductions Projected:

2025-2030

0.43 million metric tons CO_2 equivalent reduction

2025-2050

1.4 million metric tons CO_2 equivalent reduction



Utah Clean Cities Coalition

One of over 75 DOE-designated Clean Cities & Communities Coalitions across the U.S., UCCC leverages resources to bring funding, technical assistance, and other resources to Utah, supporting development and deployment of alternative fuel infrastructure and vehicles, idle-reduction technologies, new mobility choices, and emerging transportation technologies.

ChargeWest

This initiative, led by Utah Clean Cities Coalition, is a collection of Intermountain West states which are committed to improving electric corridors across the western United States; building infrastructure on rural gateway communities, state and national parks, monuments, recreation areas and scenic by-ways. The states involved are Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

Mitigating Risk & Vulnerability

We recognize that significant endeavors inherently involve some degree of risk and require careful deliberation.

Our approach is proactive rather than reactive and incorporates input from a wide range of stakeholders across the state through our Steering Committee and Industry Advisory Board.

For example, the plan must:

1. Address the crucial component of Utah's electric power generation by managing natural resources appropriately to ensure stability and availability.
2. Analyze production capacity, raw material sourcing and the comprehensiveness of charging and maintenance infrastructure to ensure a stable supply chain that supports longterm operations.

Powering Electrified Transportation

Key Observations

1. **Steady use of the electrical grid** throughout each day helps the grid delivermore power for consumption driving down electricity prices.
2. **Additional power generation will be needed,** significantly improving how and when energy is consumed on the grid. This combined with energy storage, will better balance the grid making it possible to power our electrified transportation system with reasonable amounts of additional power removing the need to generate massive amounts of expensive electricity at peak times.
3. **Some grid locations are very stressed while others are not.** It is helpful to consider the following when scaling the grid to deliver more energy:
   - iv. What areas are zoned for high-density residential and commercial warehouse?
   - v. What is the anticipated income in substation service zones (electricity consumption highly correlates with income)?
   - vi. Where will new data centers be built?

Experts on the Industry Advisory Board are working with the action plan technical team to define our electrical needs to power the system.

Our collaborative approach involves working closely with industry leaders, government agencies, and community partners to ensure that our solutions are not only technically sound but also practically viable and beneficial to all stakeholders. Through these partnerships, we have consistently produced real-world deployments that address critical transportation and environmental challenges, paving the way for a cleaner, more efficient future.

Industry Advisory Board

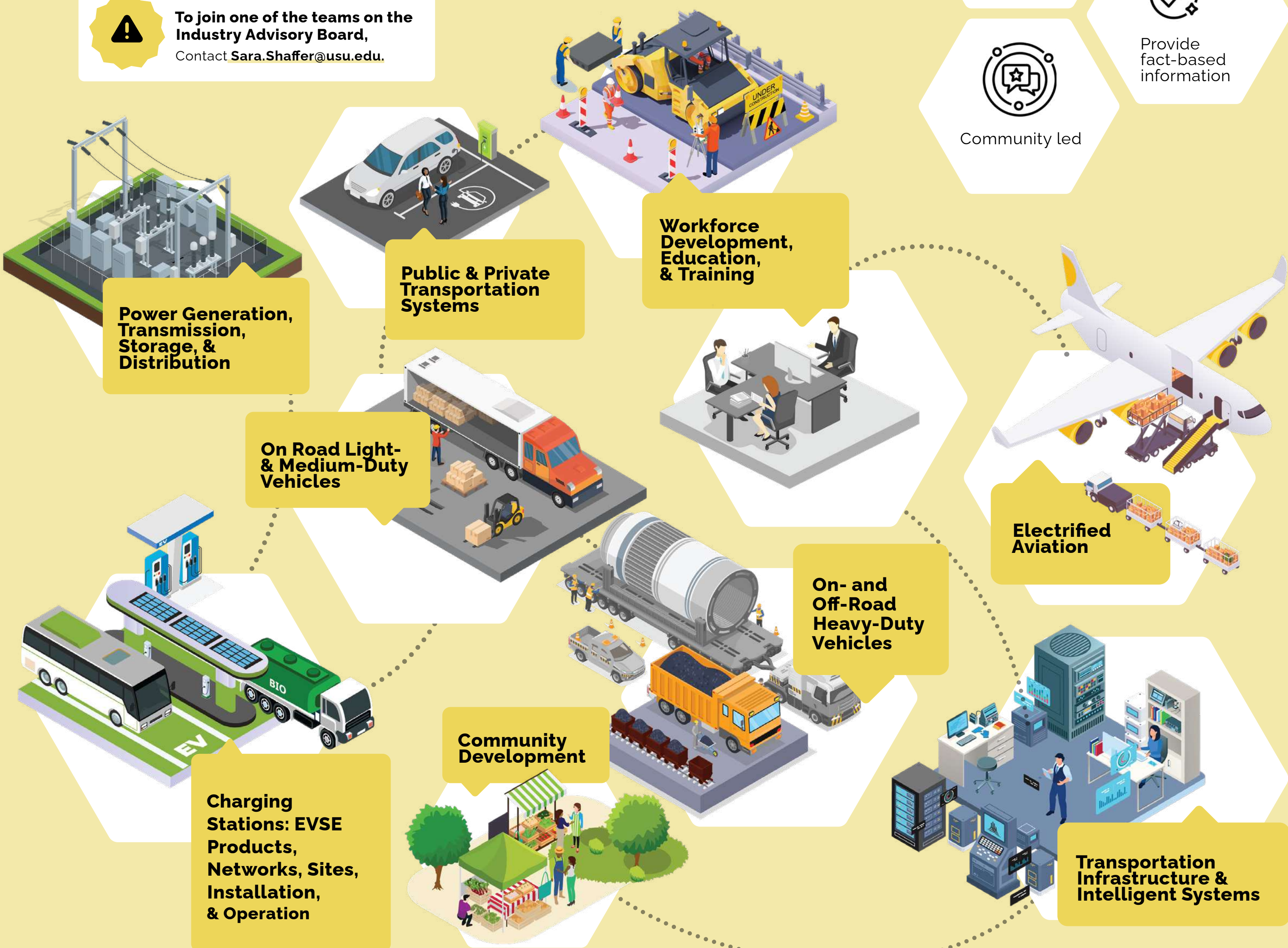
Pursuant to the legislation, this initiative's efforts are under the direction of a Steering Committee and Industry Advisory Board (IAB). The IAB is comprised of an 18-member executive team who chair nine advisory teams.

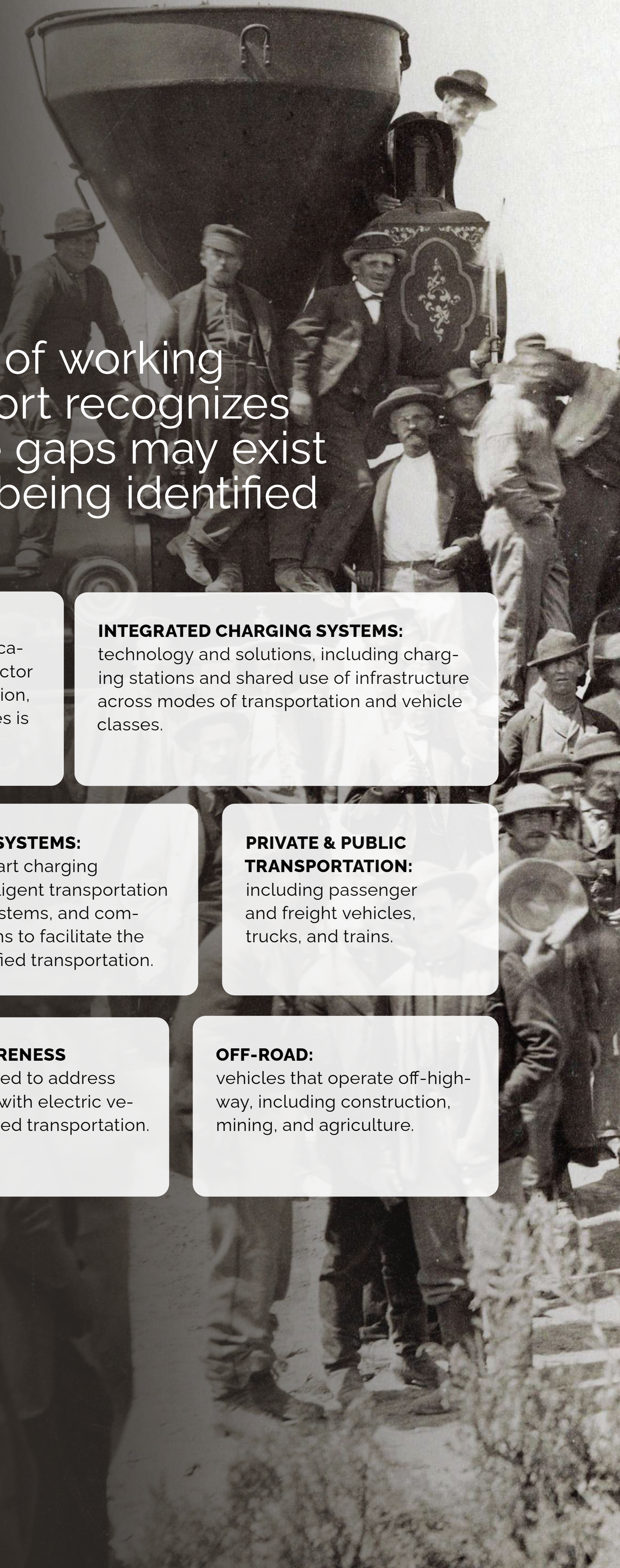
Each advisory team includes stakeholders, industry partners, and government agencies to provide guidance to the planning effort by imparting information and insight relevant to their specialized expertise.

The IAB provides another level of risk management through our active collaboration with board members.

Risks and vulnerabilities encountered are minimized as we develop recommendations that are:

To join one of the teams on the Industry Advisory Board,
Contact Sara.Shaffer@usu.edu.





Addressing Key Gaps

Building on Utah's legacy of working together, this planning effort recognizes the following areas where gaps may exist that are in the process of being identified and properly addressed.

WORKFORCE DEVELOPMENT:
including analysis of the capacity and types of education, vocations, trades, and certifications necessary in each relevant sector to develop the local workforce needed to accomplish the vision, and any other sectors that the steering committee determines is substantially necessary to fulfilling the stated mission.

INTEGRATED CHARGING SYSTEMS:
technology and solutions, including charging stations and shared use of infrastructure across modes of transportation and vehicle classes.

ENERGY INFRASTRUCTURE:
electrical power generation, distribution, and utility-scale energy storage infrastructure and capacity, including reliability, cost, and availability standards.

SMART MOBILITY SYSTEMS:
interconnected smart charging infrastructure, intelligent transportation systems, control systems, and communications systems to facilitate the transition to electrified transportation.

PRIVATE & PUBLIC TRANSPORTATION:
including passenger and freight vehicles, trucks, and trains.

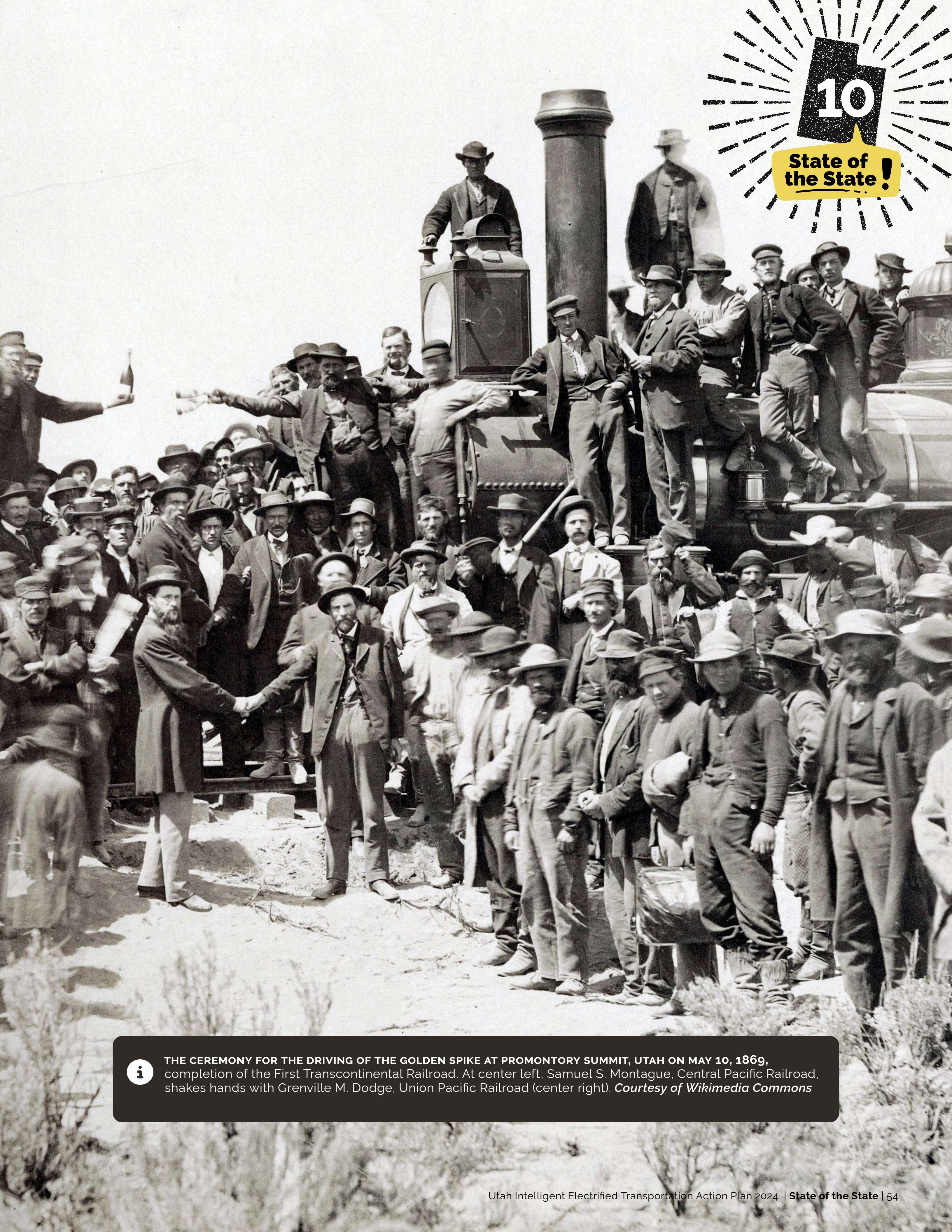
AIR TRANSPORTATION:
including private commercial aircraft and unmanned aircraft systems.

CONSUMER AWARENESS MATERIALS: needed to address Utahns' concerns with electric vehicles and electrified transportation.

OFF-ROAD:
vehicles that operate off-highway, including construction, mining, and agriculture.

10

State of the State!



THE CEREMONY FOR THE DRIVING OF THE GOLDEN SPIKE AT PROMONTORY SUMMIT, UTAH ON MAY 10, 1869, completion of the First Transcontinental Railroad. At center left, Samuel S. Montague, Central Pacific Railroad, shakes hands with Grenville M. Dodge, Union Pacific Railroad (center right). ***Courtesy of Wikimedia Commons***

Legislative Priorities for Implementation

The Utah Intelligent Electrified Transportation Action Plan is a living document and planning process being designed to identify market-driven electrification projects with scaled integration.

As specified by State Code, the process incorporates the following priorities:

1

Simultaneously manage stakeholder interests while building an electrified transportation system informed by the needs of Utah's citizens.

2

Uses a community-centric, research-informed approach that balances data with community needs and perspectives.

Accounting of Funds

This planning effort ensures full transparency and accountability in the utilization of resources. Funds are dispersed in accordance with approved budgets, policies, and procedures. Additionally, significant effort is made to collect and report the impact of federal and state grants received by agencies and organizations throughout the state.

3

Build awareness among stakeholders, industry partners, state and federal agencies of Utah's progress in leading the nation as we electrify our transportation system.

4

Attract industry partners and federal investment to the state. Collaboration in design, development, and delivery of the systems is crucial to implementation.

5

Focus on 10-, 20-, 30-year horizons that guide development of the system and programming of funds for its implementation.

How do we get there?

The ASPIRE Engineering Research Center is at the forefront of innovative transportation solutions, dedicated to advancing sustainable and efficient infrastructure. As experts in this field, we are uniquely positioned to lead the Utah plan, leveraging our extensive experience and cutting-edge research.

Real-World Deployments

The state of Utah has identified and promoted the deployment of electrification projects at the Utah Inland Port Authority (UIPA)'s Northwest Quadrant Project Area in Salt Lake City. ASPIRE is implementing several electrification projects that will further demonstrate the benefits of electrified transportation and its potential for widespread adoption. The hardware team has met with Port leadership, Salt Lake City and Salt Lake County officials, public works representatives, and UDOT for road installation requirements and permitting.

These initiatives cover multi-modal approaches, involving commercialized fleets and freight transportation, as well as public transit and personal vehicles. These technologies are not theoretical — they have been effectively deployed in real-world scenarios, proving their capability to meet our strategic goals. Key deployments include advanced electric charging infrastructure and automated logistics systems, aligning with the National Zero-Emission Freight Corridor Strategy and addressing Utah's specific logistical and environmental needs. These deployments have demonstrated measurable success in reducing emissions and improving freight efficiency, showcasing their effectiveness and practical benefits.

ASPIRE Director Regan Zane meets with contractors at the Electric Vehicle and Roadway research facility in Logan, UT.

Passenger Transit

Battery-Electric Trains

Stadler FLIRT: The Utah Legislature made an appropriation to ASPIRE to partner with the Swiss company Stadler to develop and build a battery-powered two-car-trainset at their North American Headquarters in Salt Lake City. The Battery-electric FLIRT — a single-decker, lightweight train — will be the first passenger train in the U.S. to demonstrate electrified public transportation without overhead electric infrastructure, enabling emission-free travel and allowing for longer routes.

While Stadler's focus is on the design and build of the trainset itself, ASPIRE will focus on charging infrastructure, workforce development, and potential outcomes, such as economic impacts and improving air quality.

This demonstration coincides with Phase 3 of Utah's Unified Transportation plan, which designates electrification upgrades to North- and South-bound FrontRunner routes as a priority by 2050.

Electric Buses

Since 2016, the **Utah Transit Authority (UTA)** has aimed to make its fleet zero-emissions. As technology matures, UTA plans to electrify more than 1/3 of its buses in operation along the Wasatch Front by 2040, and supplement other portions of the fleet with alternative fuel sources.

ASPIRE is working with UTA to analyze and develop smart charge management strategies to power electrified transit routes while optimizing the vehicles' health and shaving peak load times for the grid. Together, the goal is to create an ecosystem of reliability for charging infrastructure where communities, vehicles, and agencies all benefit.


First in US
STADLER
STADLER
ASPIRE


UTA

Types of Wireless Charging

Static:

Refers to technology that enables the transfer of electrical energy to a device or vehicle without the need for physical connectors or cables, while the vehicle remains stationary on a charging pad or induction surface. (Think: MagSafe charging for iPhones, but for vehicles.)

Dynamic:

Allows the transfer of electrical energy to a moving device, such as an electric vehicle, enabling it to charge while in motion without the need for stopping or connecting to a fixed power source.

Opportunity Charging:

Refers to a versatile technology that provides power transfer to a vehicle both in motion and while stationary, allowing for flexible charging options based on the vehicle's needs, thereby optimizing efficiency and convenience.

Zero-Emissions Long-Range Deliveries

1-Megawatt Static Wireless Power Transfer (WPT) System:

Areas along the Wasatch Front tend to have some of the worst air quality in the nation — particularly in the wintertime with ozone due to the bowl-shaped valleys, the cool temperatures, and the sunlight interacting with fine particulate matter.

As freight shipments tend to contribute higher amounts of emission-related pollution, ASPIRE has partnered with Kenworth, UPS, and WAVE to create two zero-emissions routes: one running from Salt Lake City to Logan, Utah, and the other from Salt Lake City to Provo, Utah, using a battery-electric Kenworth truck. The truck will be powered by two static 1-megawatt chargers. This 1-MW WPT system was developed by ASPIRE's engineering staff, faculty, and students at USU and will be deployed at the EVR in Logan and on a leased parcel in the Northwest Quadrant of the Utah Inland Port in Salt Lake City.

Deployment is anticipated to last a minimum of 3 months and 10,000 miles, and is scheduled to begin Fall 2024. This project will demonstrate fast charging for a Class-8 truck on routes with significant elevation changes and cold climates, while meeting fleet requirements. The project will test the extremes of freight deliveries in Utah, such as pulling a double combination trailer over Sardine Canyon's steep inclines showcasing that the technology at its current standing can support electrification of regional freight transportation.

Zero-Emissions Short-Range Deliveries*

¼ Mile (Drayage) Electrified Roadway:

To address the disproportionate emissions that come from short-distance drayage routes, ASPIRE will install a dynamic charging system at the Utah Inland Port to demonstrate the capabilities of electrified port drayage and short-haul fleets. There will be two dynamic wireless power transfer (DWPT) systems, one co-developed with Purdue, and one utilizing the Electreon DWPT system.

The Electreon DWPT System was first deployed at the Electric Vehicle & Roadway (EVR) research facility in Logan. Following testing at the EVR track, and other Electreon testing sites, a quarter mile of improved and updated system will be deployed within the port boundaries, just outside the highly frequented Union Pacific rail yard.

The USU-Purdue System is being developed to leverage the experience from the ASPIRE team at Purdue University's pilot deployment and demonstration in partnership with the Indiana Department of Transportation, Cummins, and others. Construction is in progress on a quarter-mile test bed on U.S. Highway 231/U.S. Highway 52 in West Lafayette, Indiana where ASPIRE's Purdue engineers will provide power to a heavy-duty electric truck, provided by Cummins, Inc., as it travels at highway speeds up to 65 miles per hour. ASPIRE's Purdue engineers have designed transmitter coils that are installed in the concrete pavement and send power to the truck's wireless receiver as the truck drives over the electrified roadway. The hope is to electrify a segment of Indiana Interstate in the next four to five years. The results from the INDOT pilot in Indiana will inform the USU-Purdue system that will be deployed at the inland port, building on Purdue's coil system with research and technology on power systems developed by ASPIRE's USU engineers.

The results from this pilot will provide valuable data and insights for further electrification planning, including the development of Utah's I-15 corridor project with the DOE, the Utah Intelligent Electrification Action Plan, and other future projects.

What is Drayage?

Drayage is the transportation of shipping containers by truck to its final destination. Drayage is often part of a longer overall move, such as from a ship to a warehouse. Some research defines it specifically as "a truck pickup from or delivery to a seaport, border point, inland port, or intermodal terminal with both the trip origin and destination in the same urban area".

Real-World Deployments

Multi-Modal Planning

I-15 Corridor Project

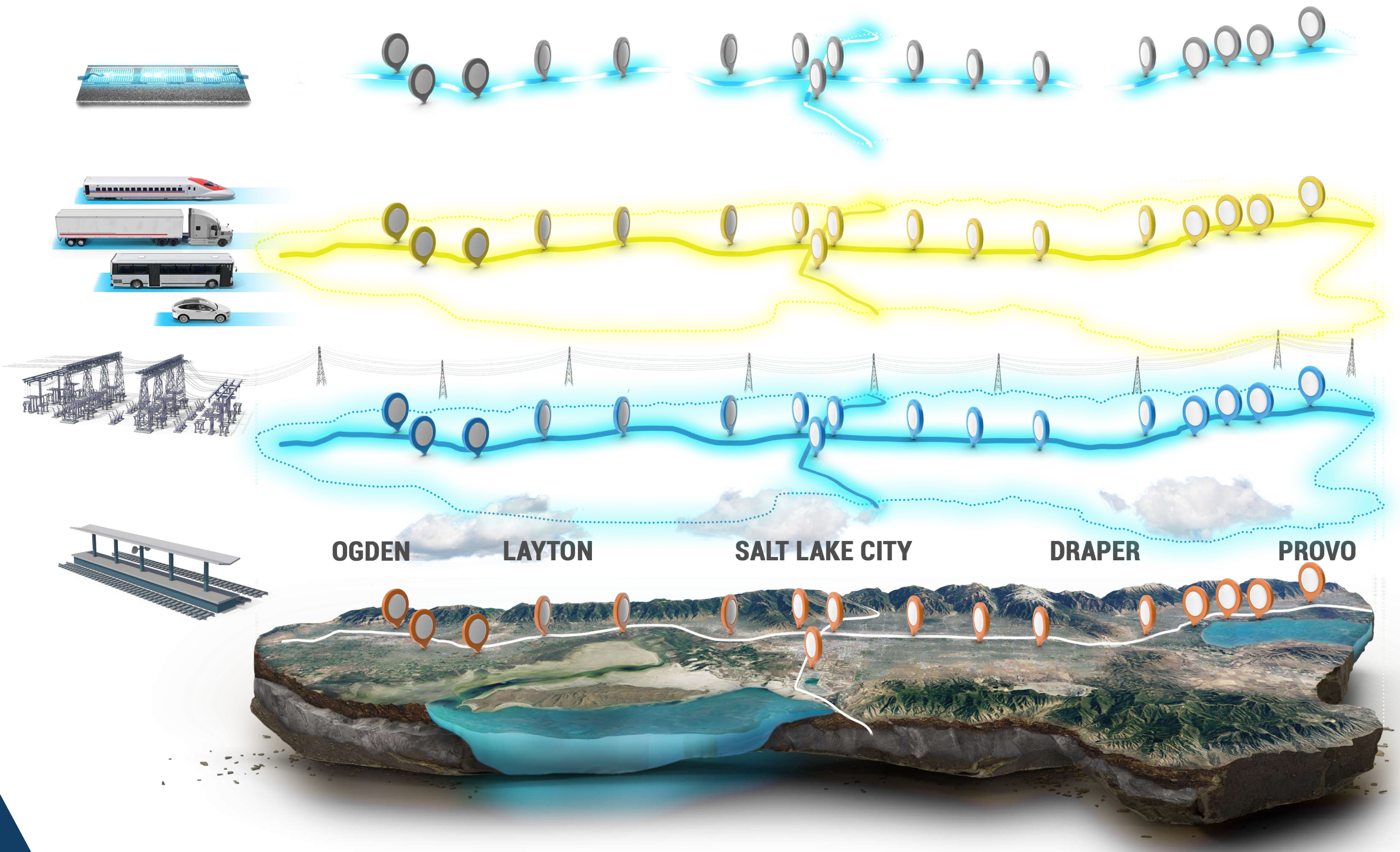
ASPIRE received a grant from the Department of Energy to develop a plan for multi-modal electrification along the Wasatch Front. The project will deliver a 20-year medium- and heavy-duty zero-emission vehicle (MHD ZEV) infrastructure deployment plan — benefitting the communities that experience the most impacts from freight emissions.

The corridor project will demonstrate affordable, energy-efficient transportation planning to benefit all users — from electrified commercial fleets and freight transportation to public transit and private vehicles, and even airspace and drone charging technologies. This project will prioritize community impacts and be maintained by state and industry support, even beyond the 20-year planning period.

We will deliver a plan highlighting opportunities on the I-15 corridor for:

- **Intermodal Charging Hubs:** determined by commuter and light rail roadmaps.
- **Multi-Megawatt Substations:** located at hubs to coordinate with grid loads.
- **Fast Charging Networks & Hydrogen Generation:** to support battery electric and hydrogen fuel cell electric vehicles (BEV/FCEV) of all sizes (trucks for freight, trains, buses, shuttles, and personal vehicles).
- **Electrified Roadways:** leverage shared infrastructure on roads and railways to manage peak load times and grid efficiency.
- **Shared Public Infrastructure:** to reduce costs and emissions related to transportation.

This electrification plan involves a comprehensive network of static and dynamic charging systems, hydrogen generation, intelligent grid management, and multi-modal transportation planning.


OGDEN
LAYTON
SALT LAKE CITY
DRAPER
PROVO


H2
Electric Bus

Our Approach

ASPIRE has long been recognized as a leading authority in the field of electrified transportation, consistently pushing the boundaries of innovation and excellence. Our commitment to advancing knowledge and delivering impactful results is evidenced by our rigorous research, comprehensive analysis, and unwavering dedication to our mission.

Moreover, our work in connecting with and elevating those already addressing societal and economic issues positions us perfectly as facilitators of intelligent electrified transportation planning. As we delve into this year's progress and the outcomes of our latest research endeavors, we reaffirm our position as the experts in our domain, continually striving to inspire collaboration and drive positive change.

Scope & Context

The purpose of this project is to develop and define an action plan for the electrification of transportation infrastructure in Utah, including all major transportation sectors. We categorize the transportation system into six sectors, encompassing both on-road and off-road modes:

Passenger vehicles (light duty):

This includes personal cars and smaller vehicles commonly used for daily commutes and general travel.

Transit (buses & passenger trains):

This encompasses public transportation systems that serve urban and regional travel needs.

Freight rail:

Trains used for transporting goods across significant distances.

Commercial and freight vehicles (light, medium, and heavy duty):

This sector includes vehicles used for goods transport and commercial purposes, from delivery vans to large trucks.

Air transportation:

This includes all aircraft, with a focus on private commercial aircraft and unmanned aircraft systems for electrification potential.

Other off-road transport:

Vehicles and equipment used in industries such as construction, mining, and agriculture that operate off the public roadways.

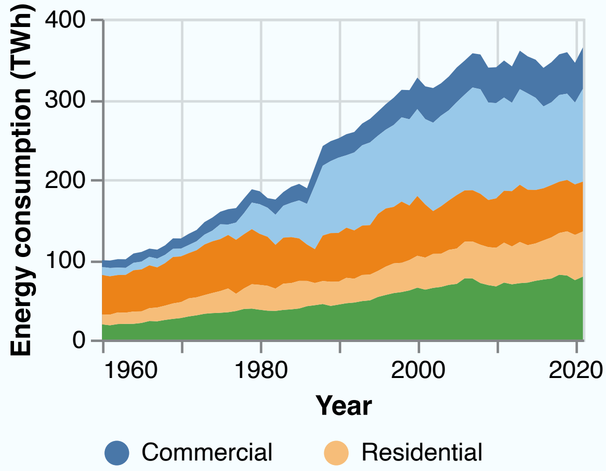


Figure 4: *History of total annual energy consumption in Utah, inclusive of all energy sources, across five sectors. Data from U.S. Energy Information Administration.*

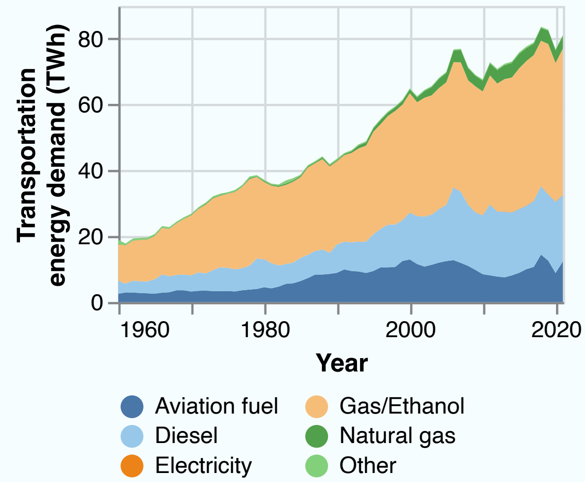


Figure 5: *History of annual transportation fuel sales in Utah, expressed in terawatt-hours (TWh). Data from U.S. Department of Transportation and U.S. Energy Information Administration.*

The first step in developing this action plan is to understand the potential costs and benefits of electrification, focusing on air quality, economic impacts, and job creation. We begin by analyzing each of the six sectors in terms of their current energy consumption and emissions impact. To achieve this, we integrate data from multiple sources:

- **Energy Consumption Data:** Obtained from the Energy Information Administration, this data helps us understand the current energy usage patterns across different transportation sectors (illustrated in Figure 4).
- **Transportation Fuel Sales Data:** Provided by the U.S. Department of Transportation, this data offers insights into the types and amounts of fuel currently consumed by various transportation modes (see Figure 5).
- **Vehicle Miles Traveled (VMT) Data:** Sourced from the Utah Department of Transportation and the Federal Highway Administration, VMT data is crucial for assessing the extent of travel and fuel usage across different vehicle types.
- **Emissions Data:** Collected from the Utah Department of Air Quality, this data allows us to evaluate the impact of current transportation practices in terms of pollutant emissions

As shown in Figure 6, light-duty passenger transportation accounts for the majority of transportation energy consumption, followed closely by commercial and freight transportation.

Harmful air quality can result from direct emissions of particulate matter, such as PM2.5 and PM10, and from the formation of secondary particulate matter derived from precursors like nitrogen oxides (NOx), sulfur oxides (SOx), and volatile organic compounds (VOC).

The transportation sector plays a significant role in contributing to these pollutants, as illustrated in Figure 7, which depicts the relative contribution of transportation to various categories of air pollution.

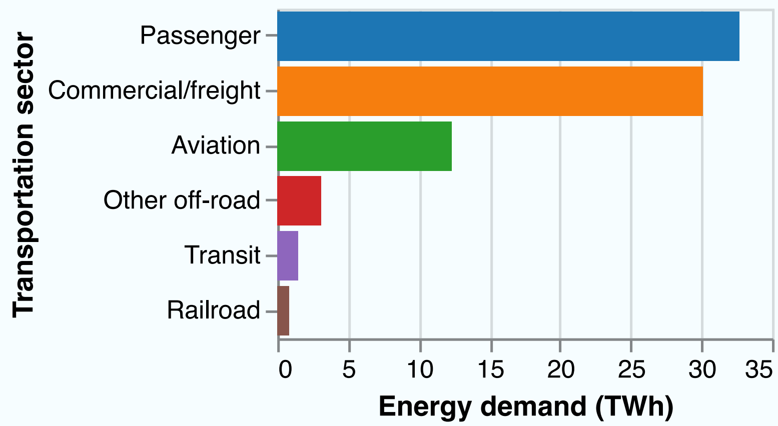
As shown in Figure 8, which provides a detailed breakdown of transportation emissions by sector, commercial and freight transportation are the primary sources of NOx and direct PM2.5 emissions from transport sources. This underscores the critical need to address emissions from these sectors to improve air quality. For a more comprehensive understanding, a detailed breakdown of emissions by source is available in Appendix X: Detailed Emissions Inventory.

Contextualizing the six in-scope sectors in this way establishes a baseline understanding of the transportation system as a whole, the quantity of energy it currently requires, and the significant role it plays in contributing to poor air quality in Utah. It is important to emphasize, however, that these are not the only relevant metrics for understanding what it would mean to electrify transportation in these sectors. Harmful air quality is a localized phenomenon, and the proximity of emissions (and the pollutants they form downstream in the atmosphere) to people and communities is just as crucial to consider as the quantity of emissions.

Further, the costs and logistics of electrifying these sectors vary significantly based on factors such as the types of vehicles, the distances traveled, the weight carried per vehicle, the availability of charging infrastructure, and the time available for recharging. These complexities highlight the necessity of developing and applying robust modeling and data analysis to support decision-making. This approach will help determine which sectors should be prioritized in an electrification action plan and ensure that our efforts are both effective and fairly distributed, ultimately contributing to better air quality and health outcomes for all Utahns.

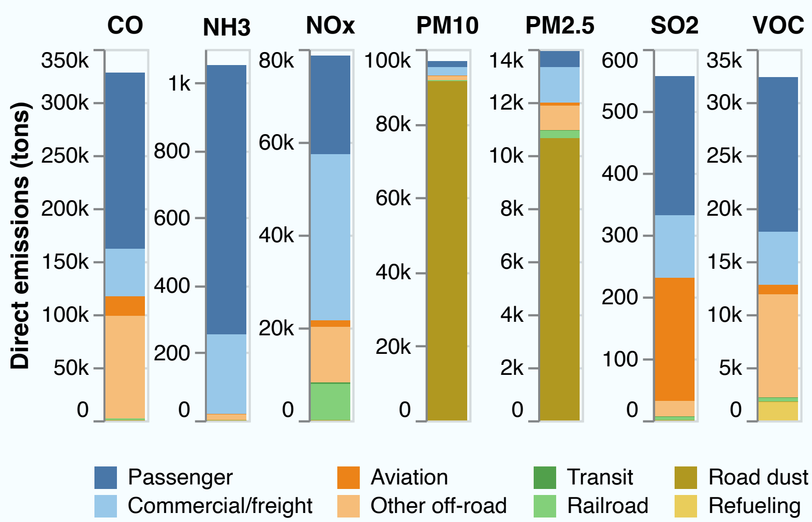
Transportation Sector

Figure 6:
2021 annual energy demand in Utah, split by transportation sectors and inclusive of all fuel types. Passenger and commercial/freight on-road transportation together account for about 75% of total transportation energy demand. Data from U.S. Department of Transportation, Utah Department of Transportation, and U.S. Energy Information Administration.



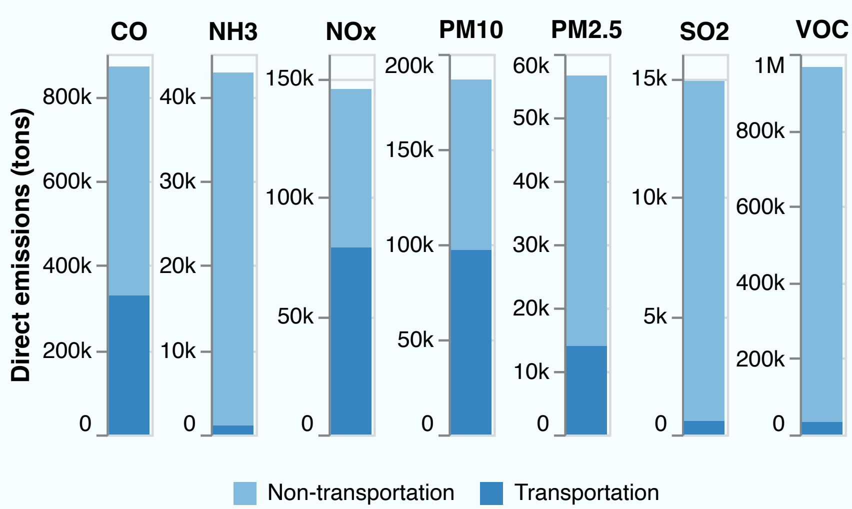
2020 Annual Emissions of Criteria Pollutants from Transporration Sources (tons)

Figure 7:
Breakdown of transportation emissions by source. Data from the Utah Department of Air Quality.



2020 Annual Emissions of Criteria Pollutants (tons)

Figure 8:
Relative contributions of each category of emissions from transportation sources relative to other sources. Data from the Utah Department of Air Quality.



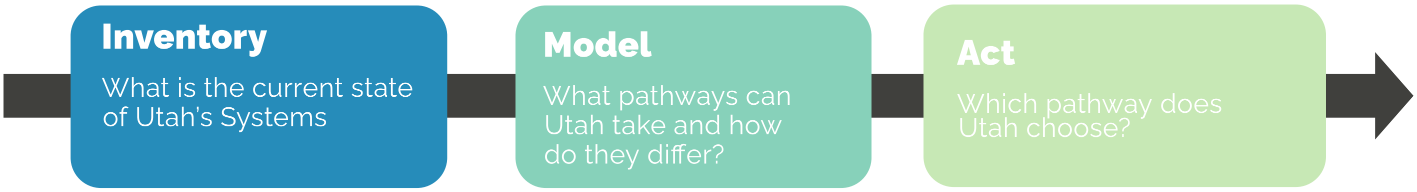


Figure 9: *Top-level diagram of our process to arrive at a data-driven electrification action plan for the State of Utah.*

Methodology

To build an electrification action plan for Utah, we are following the three-step process illustrated in Figure 9. Each step serves an important function toward developing our action plan:

1. **Inventory:** Build a comprehensive data-driven assessment of existing transportation and energy resources and needs in the State of Utah.
2. **Model**: Combine and analyze data resources to assess the implications of a wide array of potential electrification action plans.
3. **Act**: Use the results of inventorying and modeling to develop recommendations and support what will become our definitive action plan.

This process is iterative and will be refined over the course of our five-year initiative. We will continually update and improve our inventories and models, starting with a comprehensive scope and relatively low granularity. As we progress, we will integrate additional data and enhance our modeling resources to increase the detail and accuracy of our analysis.

In the following sections, we provide a summary of the work completed to date ("Work to Date") and outline the anticipated next steps ("Moving Forward"). This ongoing process will ensure that our action plan remains dynamic and responsive to new information and emerging technologies.

Work to Date

The work completed in this initial project year is weighted toward the Inventory and Model steps of our modeling process. (As the initiative proceeds, the Plan will enhance and clarify.) In the next section, we outline and demonstrate the modeling tools we have developed to evaluate potential electrification pathways. Following that section, we summarize some of the key inventorying work that we have undertaken to support our models.

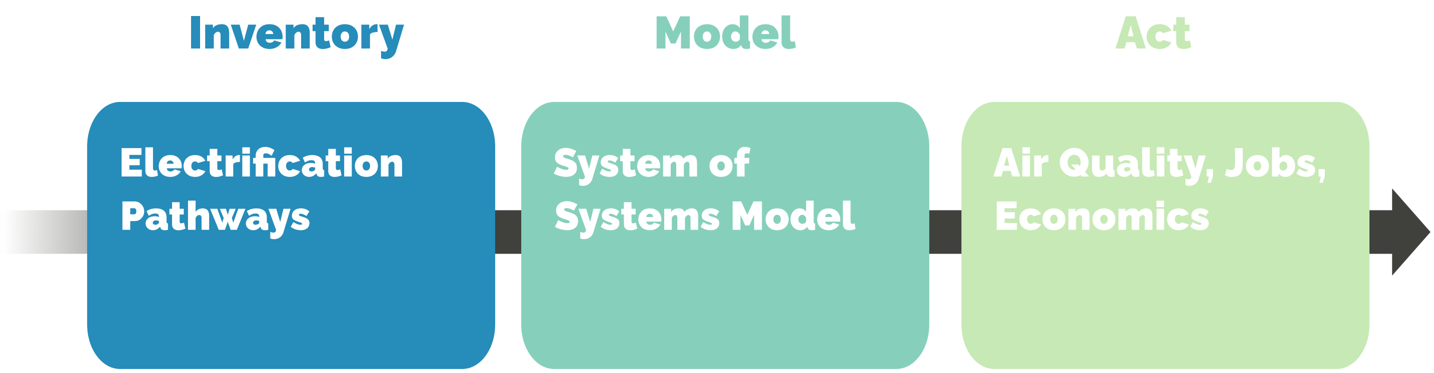


Figure 10: *System-of-systems modeling paradigm. The system-of-systems model is used to model the effects of potential electrification scenarios (e.g. EV adoption trajectories, fuel and electricity prices) on air quality, jobs, and economics in the state of Utah.*

Model: Development & Demonstration of Tools & Approaches

In the Inventory step of our process (as detailed in the next section), we gather, compile, and summarize key data resources. These resources are essential for developing a comprehensive "system-of-systems" model to evaluate potential pathways to transportation electrification. This process involves multiple large-scale systems, primarily the transportation system (including infrastructure, vehicles, and users) and the electric power system (comprising grid infrastructure and power consumers). Additionally, it has significant effects on the atmospheric system (impacting emissions and air quality), as well as state and local economies (influencing jobs and the cost of goods), among other systems.

System-of-systems modeling is a broad paradigm designed to characterize the interactions between these complex systems. It is particularly well-suited for translating potential electrification scenarios into key indicators of air quality, job creation, and economic impacts. This holistic approach enables us to understand how different systems interact and how changes in one can affect the others.

The overall approach is depicted in Figure 10. The system-of-systems model (center block) relies on real-world data and best-practice models to provide an accurate representation of current and potential future states. Electrification pathways (left block) define the

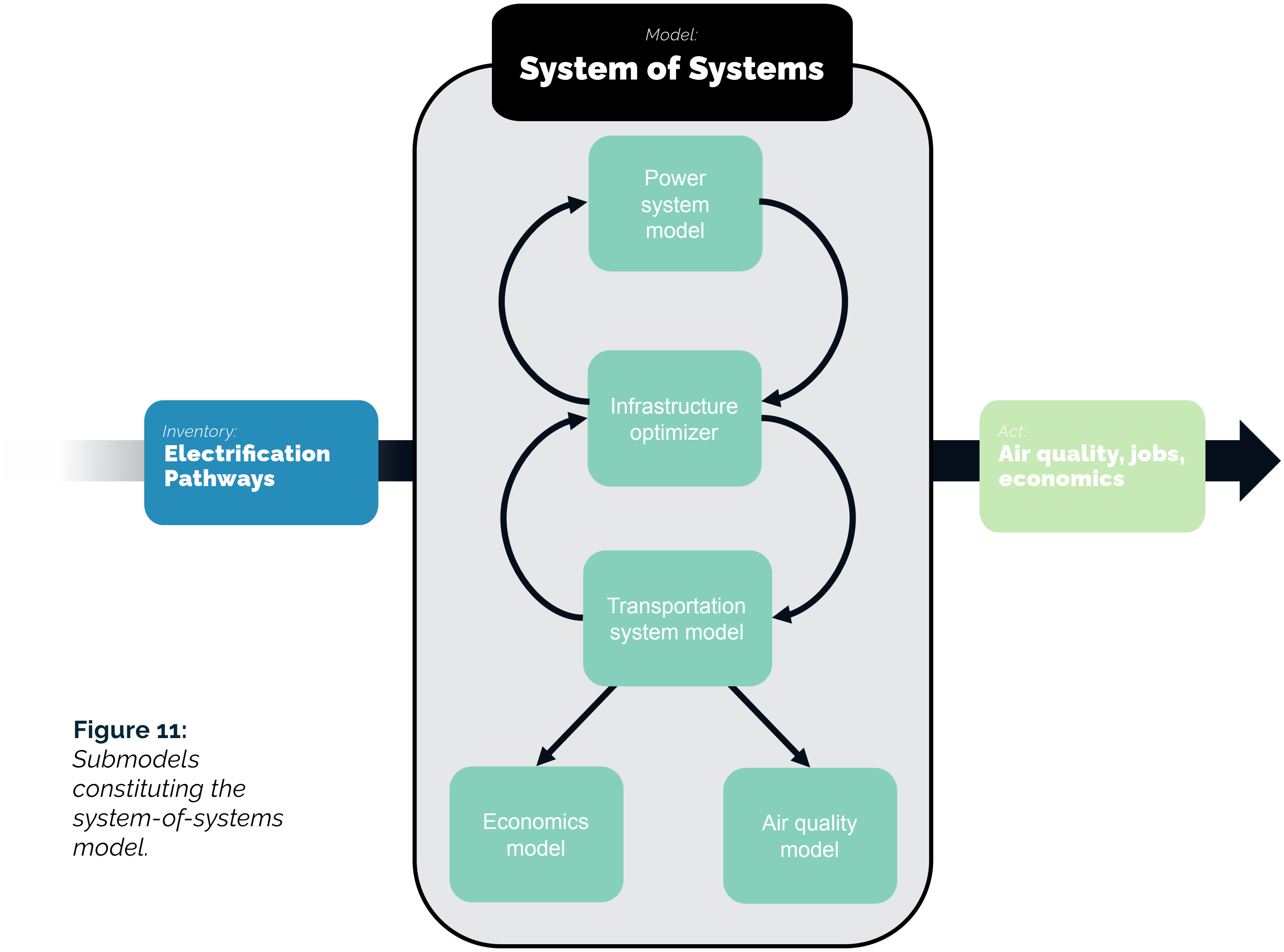


Figure 11: *Submodels constituting the system-of-systems model.*

parameters of the model, representing different strategies for powering the transportation system. Our research evaluates numerous electrification pathways using this model, characterizing how different choices lead to varying outcomes.

The result of this approach is a data-driven understanding of how strategic decisions in transportation and power systems, such as investments and policies, can lead to the most beneficial outcomes for air quality, job creation, and economic growth. Details of the system-of-systems model and its application are provided in the following sections.

Model Configuration

The core systems in the model are the electric power system and the transportation system. Fully characterizing air quality outcomes additionally requires an air quality model; characterizing economic ripple effects including job creation and effects on the cost of goods requires an economics model. The submodels making up the system-of-systems model are depicted in Figure 11.

At the highest level, the electric power system provides the energy needed to move electric vehicles, while the transportation system defines the demand for this energy. Matching the power supply from the grid to the energy demands of vehicles is a crucial task for transportation electrification and presents a highly complex challenge. Delivering the right amount of power at the right time and place for every vehicle in the system, using the most cost-effective configuration of charging and grid infrastructure, is essential to achieving the economic and health benefits of vehicle electrification.

The transportation system incurs operational costs, which feed into our economic model, and generates emissions, which are analyzed by our air quality model. The economic model evaluates how changes in transportation costs, including the construction and installation of new infrastructure, can create jobs and reduce the costs of goods and services, thereby impacting various economic flows. The air quality model uses advanced fluid-dynamic and chemical-reactive simulations to understand how reducing transportation emissions can enhance air quality.

The most significant changes to the transportation system due to electrification stem from the characteristics of electric energy as a transportation fuel. These characteristics include:

- **Infrastructure Dependency:** Electric energy must be sourced from on-site power resources.
- **Cost Efficiency:** Electric energy is generally cheaper than gasoline and diesel.
- **Fueling Speed:** Charging batteries is typically slower than refueling with gasoline or diesel.
- **Energy Efficiency:** Electric vehicles are more efficient in propulsion compared to those using gasoline or diesel.
- **Emission Reduction:** Electric vehicles operate without producing tailpipe emissions.

Initially, we assume that the transportation system remains unchanged by electrification, meaning patterns of driving and vehicle ownership stay consistent. This assumption allows us to understand the high-level costs and benefits of transitioning from gasoline and diesel to electric energy. We will revisit and challenge this assumption in later phases of the project to refine our analysis.

Effective transportation planning requires the coordinated effort of all system users, including roads, highways, and even airspace. The diverse needs of businesses, community groups, environmental organizations, the traveling public, freight operators, and the general public all contribute to the success of our planning efforts.

Dashboard At-a-Glance

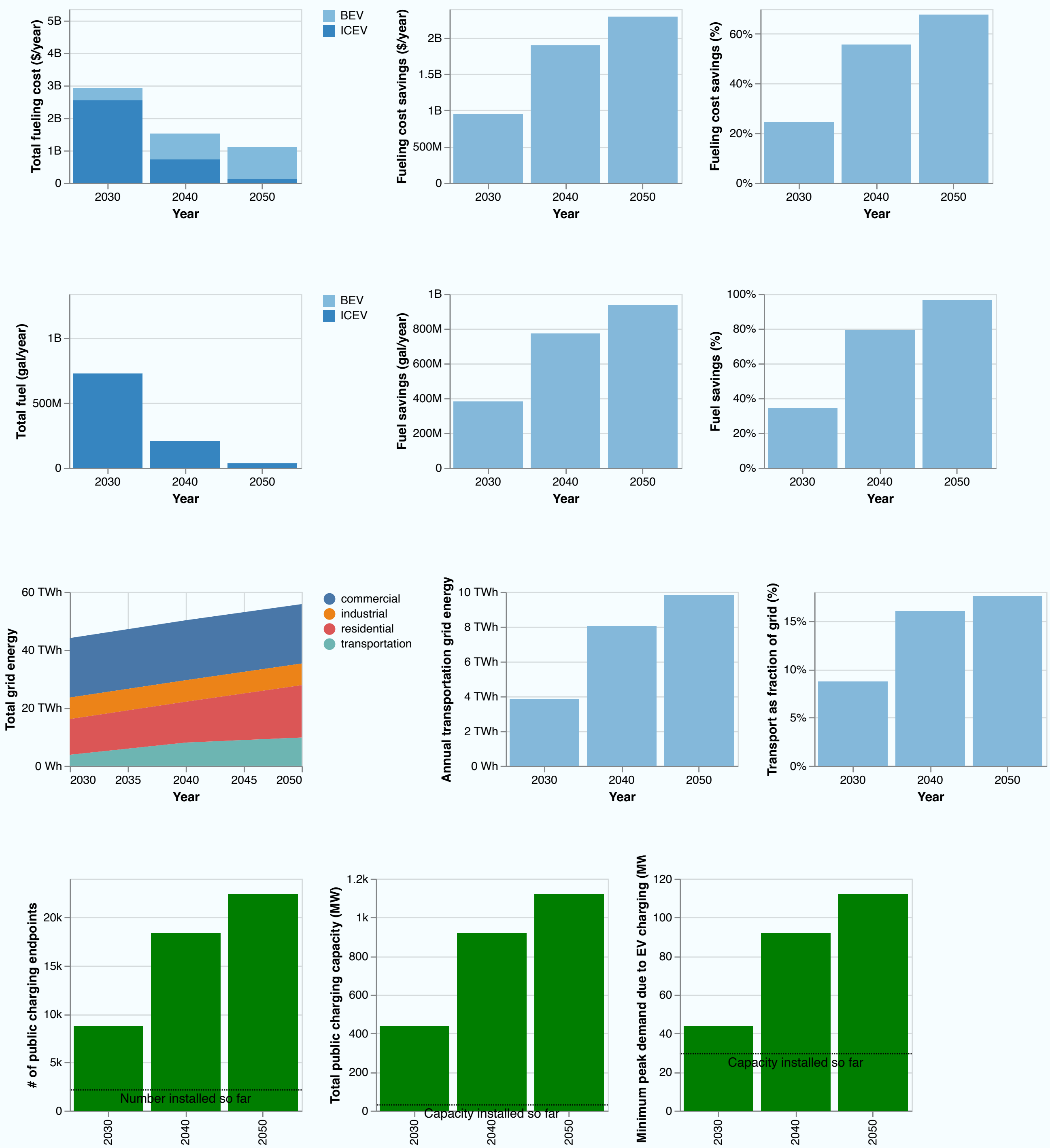


Figure 12: *Example outcome from the data dashboard for passenger vehicles. These figures illustrate the change in fuel demand in Utah due to electrification. The scenario in this example concerns an upper-limit case in which all vehicles sold from 2024 onward are electric; gasoline is sold at $3.50 per gallon; electricity is sold at $0.10 per kilowatt-hour; new combustion vehicles consume 35 miles per gallon on average; new electric vehicles consume 0.3 kilowatt-hours per mile on average; 10% of electric vehicle charging takes place at public endpoints; public chargers supply 20 kilowatts on average; and public chargers are in use 10% of the time on average.*

Transportation System Submodel

In our current demonstration, the transportation system submodel builds upon a data-driven characterization of Utah's on-road transportation sectors to estimate the costs and benefits of various electrification trajectories. The key data sources supporting the model are described in Statewide On-Road Vehicle Activity (section reference). The methods within the model are described in Appendix Y: Transportation model details. Demonstrations are hosted in online dashboards, currently for:

- Passenger vehicles
- Medium- and heavy-duty vehicles

Dashboards representing other sectors will be developed in the future. The dashboards enable the user to modify input assumptions, including EV sales trajectories, future vehicle energy consumption rates (ICEV and EV), fueling costs (gas/diesel and electricity), and parameters pertaining to public charging infrastructure requirements. In Figure 12, results for one of the several scenario configurations are shown, in which all new vehicles sold starting in 2024 are electric. This establishes one kind of upper bound on the impacts of electrification. In this scenario, the cost to fuel light-duty transportation in Utah decreases by $900M (almost 70%) in 2050; for medium- and heavy-duty transportation, the savings exceed $3B (about 60%).

A key insight from the dashboard outputs can be found by comparing the two graphs on the bottom right. Together, they establish boundaries on the maximum total power that can be drawn from the grid for EV charging. The power on the left is what would be drawn if all the charging infrastructure were simultaneously in use; the power on the right is what would be drawn if all EV charging were perfectly spread across all hours of the year. Given the input assumptions, these are absolute bounds.

For simplicity, the information shown in the dashboard is an aggregation of the information tracked within the model. As shown in Figure 13-Figure 14 the model tracks each of the various metrics at county and vehicle model year resolutions, for every year from 2024-2054. Vehicle model year is retained for the purpose of simulating the turnover of the vehicle fleet, where older vehicles have a higher likelihood of retiring, and to incorporate changes in fuel efficiency over time. County is retained as a first step toward higher geographic resolution.

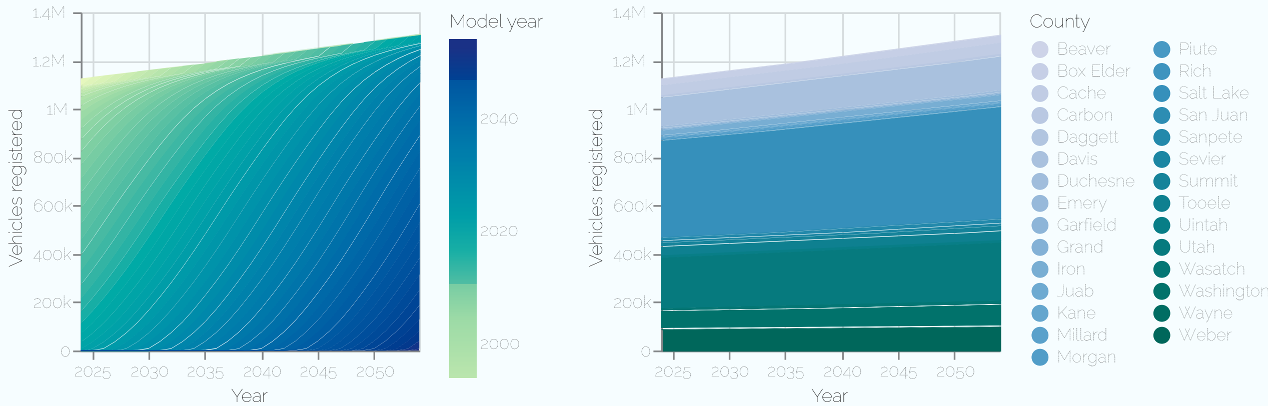


Figure 13: *Passenger vehicle registration counts in the model, disaggregated by vehicle model year (left) and county (right). The scenario in this example concerns an upper-limit case in which all vehicles sold from 2024 onward are electric.*

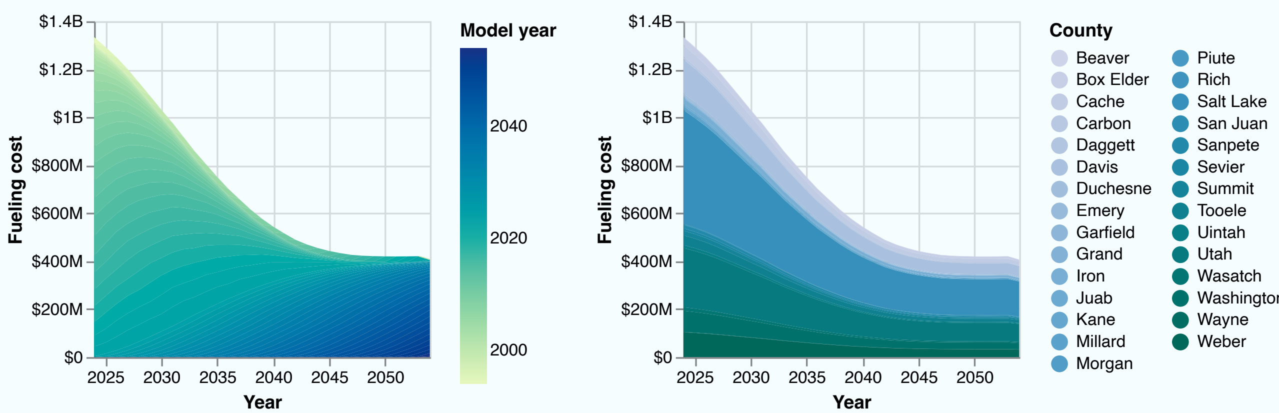


Figure 14: *Total modeled fueling cost for passenger vehicles, disaggregated by vehicle model year (left) and county (right). The scenario in this example concerns an upper-limit case in which all vehicles sold from 2024 onward are electric; gasoline is sold at $3.50 per gallon; electricity is sold at $0.10 per kilowatt-hour; new combustion vehicles consume 35 miles per gallon on average; and new electric vehicles consume 0.3 kilowatt-hours per mile on average.*

Electric Power System Submodel

The high-level goals of the project from a power systems perspective are to ensure that our transportation model can accurately account for the cost and capacity of the electric grid at the locations of concern. To this end, the power systems concept is to create a set of mixed integer linear programming (MILP) compatible cost functions and constraints that define the cost of constructing and operating a multi-modal hub with a given power profile.

Generation of these cost functions is done by using distribution network models for the locations under consideration. The distribution models contain key details about the path power must take to get from the distribution substation to the end load. By building a graph of each element in the network (see Figure 16), we can build cost models that take into account the limits and cost of each element.

Once these individual cost functions are created, they can be integrated into the system optimization MILP. When considered from a single point in the distribution network they will form a composite cost function, Figure 15, which allows the optimization engine to account for the cost of power systems infrastructure operations and upgrades for a given power profile. An additional consideration will be accounting for the time-varying nature of the grid. As the load across the grid is changing constantly in time, the cost functions and constraints are only valid for a specific moment. For example, during peak hours it may be very expensive to pull even a small amount of power from the grid as the existing load may already be pushing the grid to its limits. However, at non-peak hours pulling large amounts of power may be low or even no marginal cost. Considering this varying nature will allow us to maximize the utilization of the grid infrastructure minimize required upgrades, and reduce the cost of electricity and transportation.

Figure 15:
Example Composite Cost Function. As the peak power increases certain elements in the distribution network will need to be upgraded. The composite cost function is time varying and in real applications may exist with different order than shown.

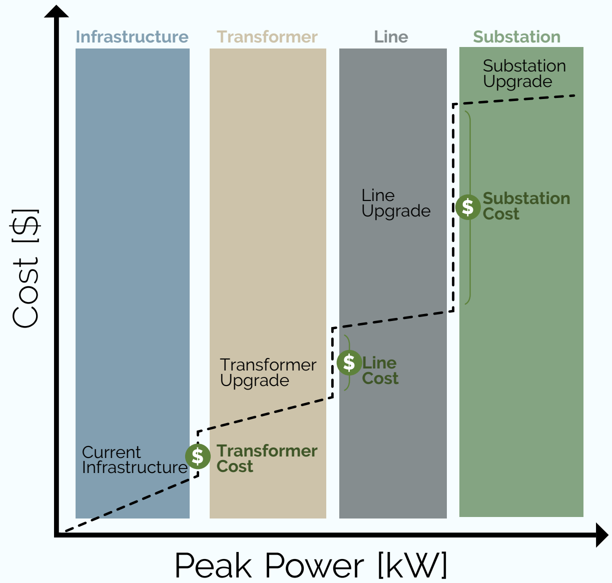
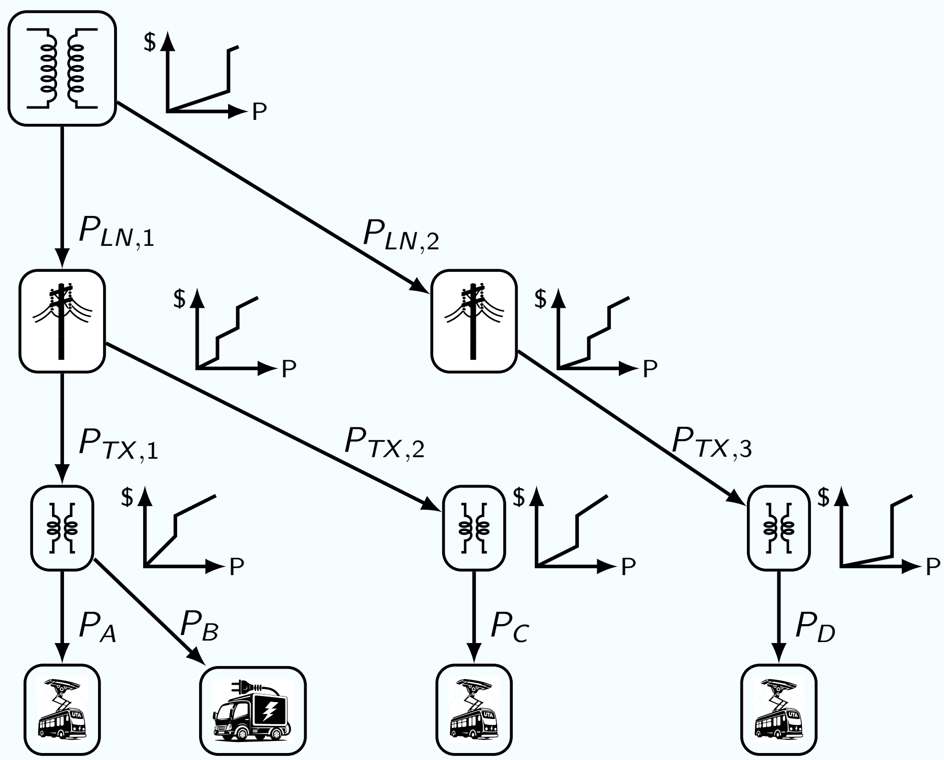


Figure 16:
Example Distribution network. Shows segments that power must flow through to reach the end load. Each element has its own limits and upgrade costs.



Infrastructure Optimization Tool

Linking the transportation system and electric power system submodels necessitates a robust and detailed intermediary model. Electrification introduces a new level of integration between the energy system and the transportation system.

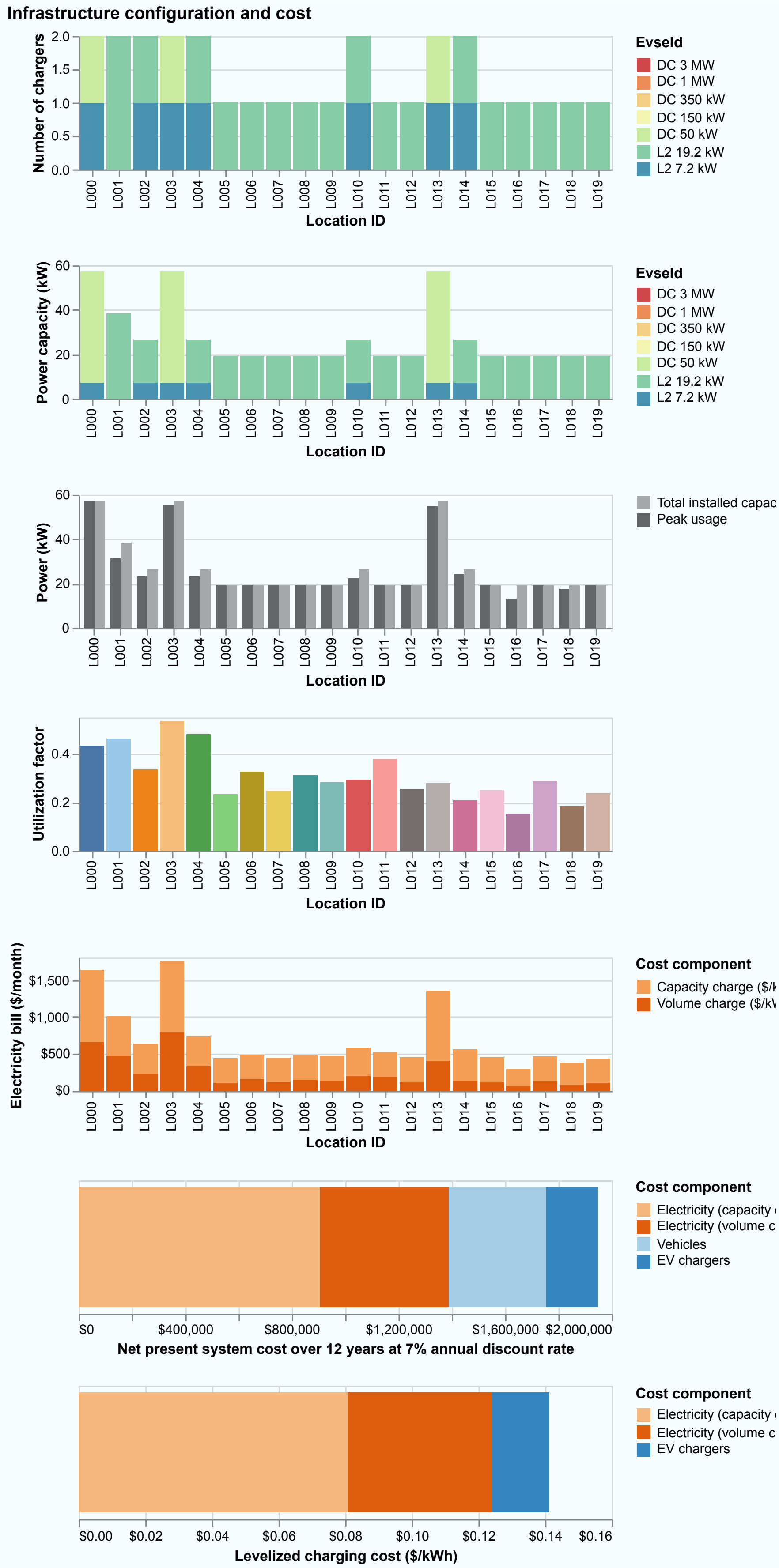
Unlike traditional liquid fuels, which can be stored cheaply and easily at fueling sites, electric grid power must be generated and transmitted almost instantaneously to meet demand. This inherent characteristic of the electric power system poses a unique challenge for the transportation sector, which must adapt to this real-time energy delivery requirement.

Supplying power for electric vehicles (EVs) involves installing charging infrastructure, also known as electric vehicle supply equipment (EVSE), and enhancing grid infrastructure. Upgrades to grid infrastructure can range from localized improvements, such as upgrading transformers, to more extensive projects like adding generation capacity to the bulk grid. Each infrastructure investment must ensure power is delivered precisely where and when it is needed.

To support these crucial infrastructure decisions, we have developed a data analysis and simulation tool that bridges our transportation and power system models. This tool approaches infrastructure design as an optimization problem, defining a design space based on transportation system requirements (such as travel destinations and battery capacities of EVs) and power system constraints (like power delivery capabilities throughout the day at various locations).

Defining this design space requires detailed and comprehensive datasets. Collecting real-world travel patterns can be prohibitively expensive and, for some sectors, such data may not exist. On the power system side, detailed grid capacity information is often sensitive and not readily available (refer to the Rocky Mountain Power Request section). Additionally, future changes in the design space

Figure 17:
Subset of results from infrastructure optimization tool, taken from the linked interactive dashboard. These results are for an example problem with randomized vehicle driving schedules, with 30 vehicles that travel between 20 distinct locations. The goal of the optimization is to minimize the net present cost of the system, which comprises the cost of energy for charging, the cost of converting vehicles to electric, and the cost to install the charging infrastructure.



are uncertain. Therefore, our tool is designed to accommodate a wide range of input precision, allowing for high-fidelity infrastructure design for well-defined travel demands (e.g., individual freight fleets) and for large-scale design under high uncertainty (e.g., passenger cars in Salt Lake City).

Once the design space is defined, finding an optimal solution is achieved using open-source or commercial solvers for standard optimization problem formats, including linear programming (LP) and mixed-integer linear programming (MILP). The tool processes input data—such as travel patterns, assumptions, power capacities, and cost models—into a standard LP problem, which is then solved using an optimization solver. The solutions are interpreted and visualized for practical application. Details of this process can be found in the appendix.

The outputs of our tool, applied to an example problem, is depicted in Figure 17. As shown in the dashboard, one feature of the optimal solution is the specification of the number and type of chargers at each location. This solution must ensure that no vehicle runs out of battery and no charger is over-occupied. This complex task, which would be infeasible to manage manually, highlights the importance of LP in our infrastructure analysis approach.

In the dashboard example, the charging infrastructure is designed for a set of vehicles with predefined travel patterns and battery sizes, aiming to minimize the system's net present cost, which includes both the capital costs for charging infrastructure and the operational costs for electricity, amortized over time. The tool is versatile, capable of optimizing battery sizes for each vehicle, deciding which vehicles to convert to electric within a budget, minimizing peak demand at each location, reducing the levelized cost of charging, limiting the number of chargers installed, or balancing multiple metrics.

Per SB125, a crucial requirement of our action plan is the inclusion of "intelligent coordination for vehicular traffic and charging, both individually and collectively, into a dynamically communicative transportation system that integrates with the electric grid." Our tool is developed with this requirement in mind, harmonizing the energy needs of all types of vehicles with the capabilities of the power system. It is designed to specify the absolute minimum-cost system configuration for any combination of vehicle types and travel demands. This is vital as it establishes a best-case scenario, providing real-world decision-makers with insights to support designs that approach these optimal outcomes. To our knowledge, we have created a unique and groundbreaking resource.


CENTER


W. VALLEY
1115A
UTA

Inventory: Data Gathering & Analysis

This step of the process is to compile, summarize, and leverage the wide variety of data resources ASPIRE has obtained to date pertaining to Utah's transportation and power systems, to define and support the development of our models. Highlighted here are publicly available, statewide datasets summarizing on-road passenger and freight transportation (ref to section); analysis of high-fidelity freight activity data in and around the Utah Inland Port (ref to section); characterization of the existing electric buses operated by the Utah Transit Authority (ref to section); and data characterizing the electric power system (ref to section).

Statewide On-Road Vehicle Activity

Many publicly available datasets exist characterizing on-road transportation as a whole in Utah. The datasets below are of particular value for modeling the impacts of electrification, and specifically support the model described and demonstrated in the Model: Development and Demonstration of Tools and Approaches section.

- **Travel volumes.** Usually given as vehicle miles traveled (VMT), this is the sum of the distance covered by all the vehicles traveling in Utah. For light-duty vehicles, this data is available from UDOT and the FHWA (Figure 18).
- **Vehicle purchasing patterns.** These data support an understanding of how often old vehicles are replaced by new vehicles (a concept often referred to as turnover). For light-duty vehicles, this can be inferred by referencing vehicle sales and registration data, which the State of Utah makes available by county and model year (Figure 19).
- **Vehicle energy consumption rates.** For combustion-powered vehicles, this is usually referred to as fuel economy (miles per gallon); for electric vehicles, it is usually given in terms of kilowatt-hours per mile (kWh/mi). These enable estimating how much energy (in the form of fuel or electric power) is required to power the movement represented in the travel volume data.

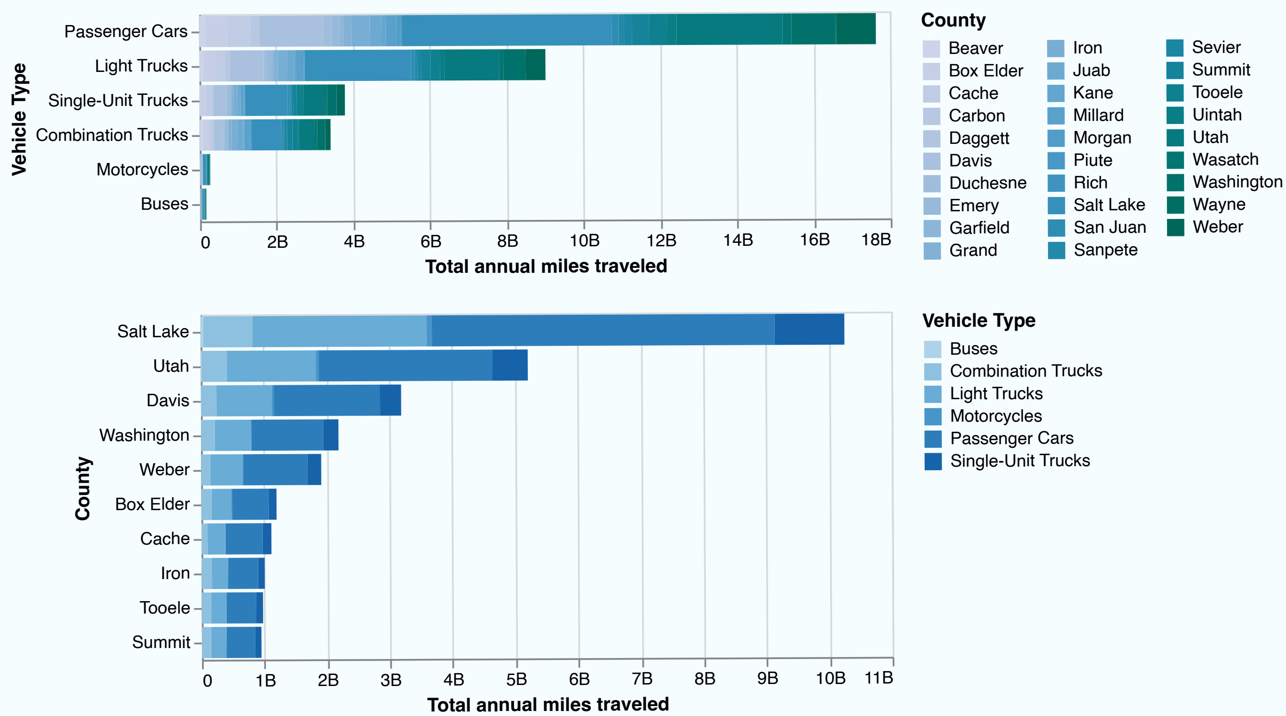


Figure 18: *Vehicle miles traveled (VMT) in 2017 on Utah roads. In the upper figure, the bars represent types of vehicles and are colored to represent counties. In the lower figure, the bars represent counties and are colored to represent vehicle types. The lower figure only shows the ten counties with the most total road travel. Data are from the Federal Highway Administration and the Utah Department of Transportation*

Historical average fuel economy data with a limited temporal scope is available from the Bureau of Transportation Statistics (Figure 20). The GREET modeling tool from Argonne National Laboratory provides fuel economy estimates across a wider span of years (Figure 21). Future vehicle energy consumption rates will depend on choices by policymakers and automakers, so we set them as modifiable model parameters.

- **Transportation system growth.** The amount of vehicle travel is expected to grow alongside population, though estimates vary. Utah has experienced well-above-average population growth in previous decades, and many expect this to continue. We begin with a conservative assumption, using the EIA's average nationwide growth projections. For light-duty transportation, this value is 0.5% annual VMT growth. (We plan to revise this assumption to align with Utah-specific projections.)

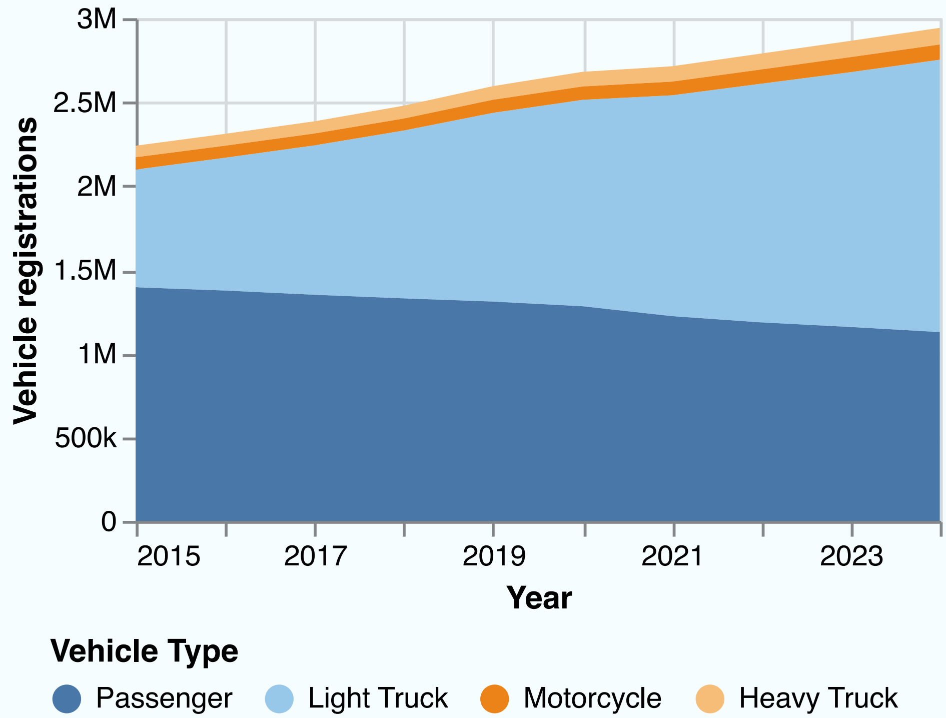
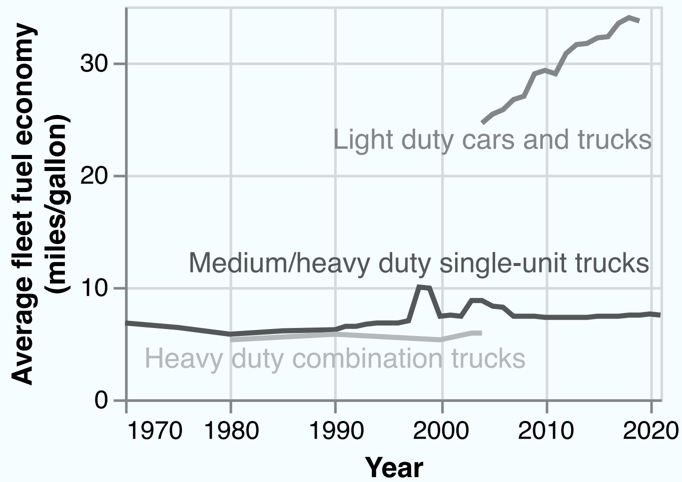


Figure 19: *History of vehicle registrations in Utah since 2015. Registration data are additionally disaggregated by county and by model year. Data provided by the State of Utah.*

Figure 20: *Fleet-average fuel economy for light, medium, and heavy-duty road vehicles. Data from the U.S. Department of Transportation.*



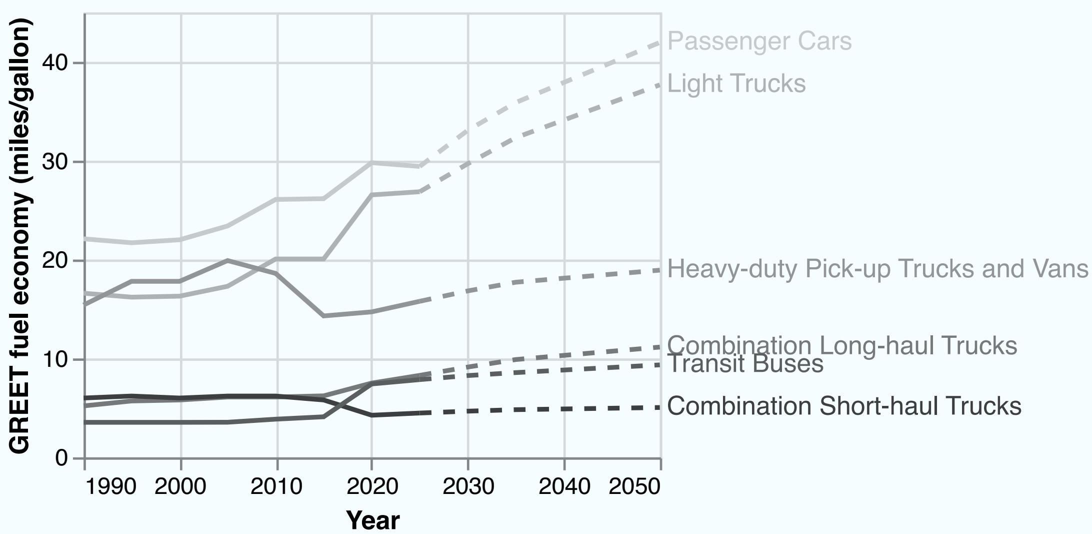


Figure 21:

Fuel economy by vehicle type as modeled in the GREET emissions modeling tool from Argonne National Laboratory.

Corridor Freight Impacts & Recommendations

Through partnerships with local drayage companies, we have been able to analyze large volumes of real-world operation data of freight vehicles. These data are easily combined with many datasets that we use to support detailed modeling of freight electrification using our suite of modeling and data analysis tools. Using these data sources to analyze freight movement at the Utah Inland Port we are able to identify immense potential for enhancing battery-electric freight vehicles by adding charging capabilities along key corridors. These enhancements can be integrated without disrupting most freight operations.

Freight Destinations

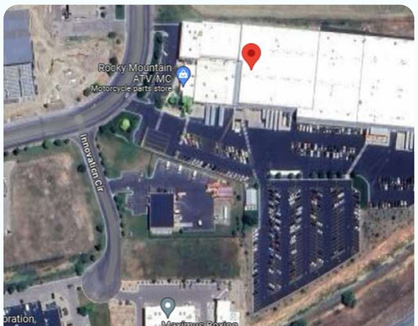
Based on our data analysis, we have observed significant potential for enhancing the adoption of battery-electric freight vehicles in Utah. Key corridors such as I-15 and I-80 are crucial for freight traffic, serving as major arteries for the movement of goods. Data from the Utah Department of Transportation highlights that these highways experience substantial freight traffic, with I-15 being a primary north-south route and I-80 serving as a vital east-west connector. The heavy usage of these corridors by freight operators underscores their importance in the logistics network.

Our analysis revealed that much of the Class 8 freight transportation typically involves stops only at origin or destination locations, but these stops are characterized by operational constraints, leading to relatively short average stop times. Dwell times at destination locations are generally less than 60 minutes, indicating that trucks often do not remain long enough for significant charging sessions. Instead, trucks tend to return to their origin points for overnight dwell periods.

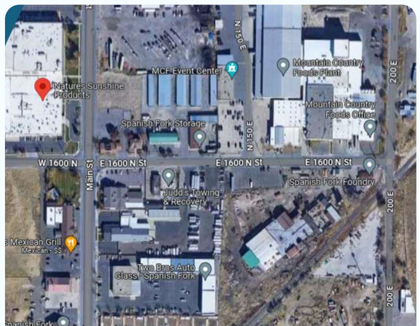
This pattern has important implications for the development of electrified infrastructure. The relatively short dwell times at destination locations suggest that installing charging stations at these sites may not be as critical for range and power delivery. Instead, the focus should shift towards optimizing charging

Destination Locations:

HIgher Capacity Chargers reccomended to reduce operational impact



63min Average Stop



47min Average Stop

157min Average Stop

infrastructure at origin locations and key transit points along I-15 and I-80, where trucks spend longer periods.

Our key finding indicates that incentives for shipping-receiving businesses to install charging stations at destination locations are less impactful. The emphasis should be on creating robust charging hubs at strategic locations along these major corridors and at primary origin points. This approach will better support the operational needs of battery-electric freight vehicles, ensuring they have sufficient range and power to complete their routes efficiently.

Freight Stops En Route

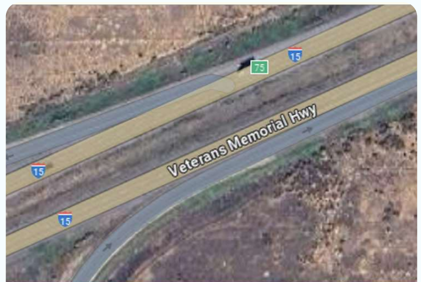
Conversely, en route stops along major corridors often involve longer stop times, making them ideal for charging infrastructure. These stops typically occur at fueling centers, rest stops, and other public facilities with ample freight parking.

En route stops are crucial for long-distance, often interstate, freight that services Utah. These stops tend to be longer, presenting a significant opportunity for charging as many freight vehicles from different organizations can be serviced efficiently. The figure provided illustrates key locations such as Beaver, Utah (71 minutes at a fueling center), Parowan,

In-Route Stops:

Typically longer stops are made at fueling locations.
Free parking is leveraged when available.

Beaver UT: 71min
Fueling Center



Parowan UT: 128min
Fueling Center

Willard UT: 209min
State Parking Lot

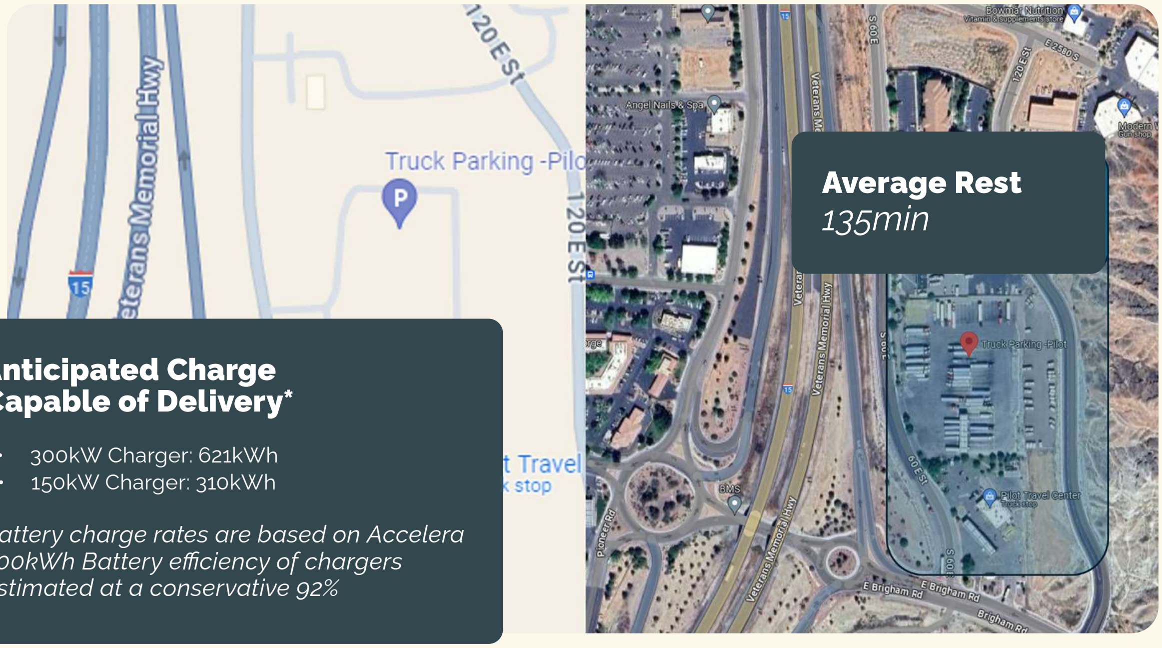
Utah (128 minutes at a fueling center), and Willard, Utah (209 minutes at a state park parking lot). These locations demonstrate how small numbers of chargers can be strategically placed to service electrified freight effectively and inexpensively.

Rest stops and current stop/dwell locations, like those shown in the figure, are ideal for electrification. They offer the advantage of requiring no major logistical or operational adjustments, ensuring that even large vehicles with 500kWh batteries can be charged efficiently. Trucks often stop based on convenience, whether at rest stops or locations like the Willard Bay Park, which offers a conveniently located, large, free parking area next to the highway.

Implementing charging infrastructure at these en route stops leverages existing stop patterns and facilities, ensuring minimal disruption while maximizing the benefit for electrified freight. This strategic approach supports the broader goal of transitioning to sustainable transportation by facilitating the adoption of battery-electric freight vehicles.

Specific Case:

St. George



Average Rest
135min

Anticipated Charge Capable of Delivery*

- 300kW Charger: 621kWh
- 150kW Charger: 310kWh

**Battery charge rates are based on Accelera 500kWh Battery efficiency of chargers estimated at a conservative 92%*

Given the freight volume at this location, installing five 150 kW charging stations would be sufficient to recharge the electrified freight vehicles in our data. Assuming a 10% adoption rate of battery-electric trucks and a 30% or higher state of charge upon arrival, these charging stations could efficiently serve the needs of the freight traffic passing through St. George. As illustrated in the figure, a 300 kW charger can deliver approximately 621 kWh, and a 150 kW charger can deliver about 310 kWh, assuming a 92% DC fast charge efficiency (far lower than the 97% we see in experimental units).

By strategically placing charging stations at this key location, Utah can significantly bolster the infrastructure necessary for freight electrification. This not only reduces emissions but also supports a more sustainable transportation network. St. George, with its high traffic and extended rest stops, represents a model for how targeted infrastructure investments can facilitate the transition to battery-electric freight vehicles.

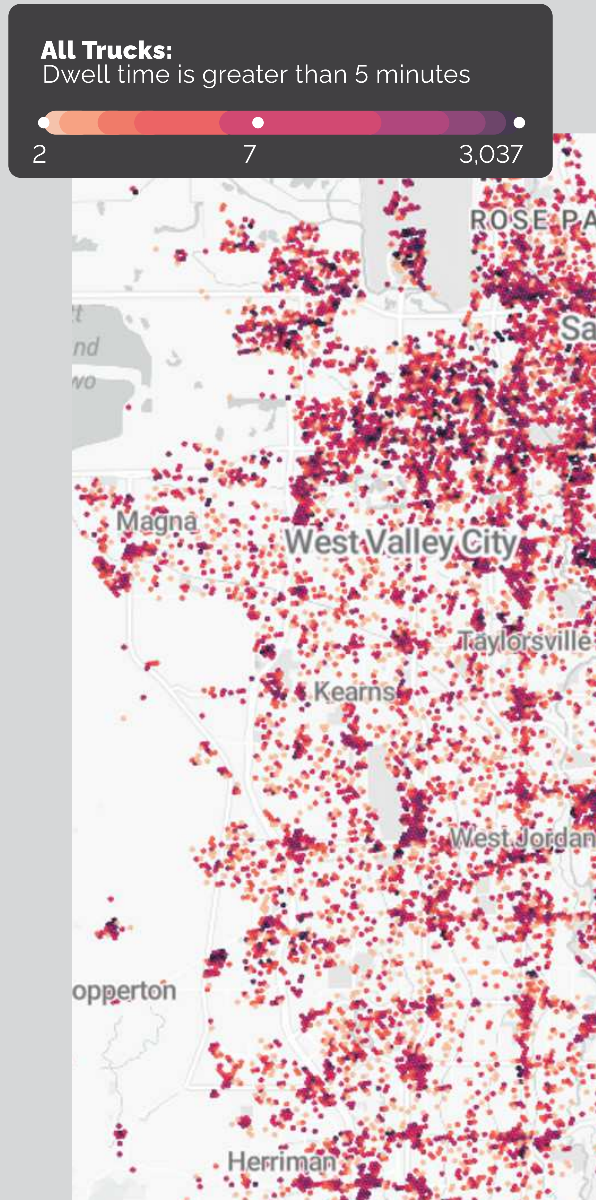
Implementing these charging stations at critical points like the St. George rest stop ensures that trucks can recharge during regular stopovers without disrupting their schedules. This strategic placement leverages existing rest patterns, making it a practical and effective solution for supporting the growing fleet of electric freight vehicles. As Utah continues to develop its transportation infrastructure, such targeted investments will be crucial in fostering a sustainable and efficient freight network.

General Freight & Local Last-Mile Delivery (Class 5-8)

To further understand the needs for electrification of freight transportation in Utah, we analyzed comprehensive data provided by GEOTAB, which encompasses several million data points assessing dwell times for trucks sized Class 5-8. The left side of the figure illustrates all truck stops where dwell times exceed 5 minutes, while the right side focuses specifically on Class 8 freight trucks with dwell times of at least 30 minutes.

The left map (All Dwell) shows a dense network of stop events for all trucks across the Salt Lake City area, with significant concentrations in the industrial and commercial zones. This indicates that a vast number of trucks, including mid-sized Class 5-7 trucks, frequently make stops that are long enough to potentially benefit from charging infrastructure. The high density of these stops suggests that strategic placement of charging stations could cater to a wide range of freight and delivery vehicles, promoting the adoption of electric vehicles across multiple truck classes.

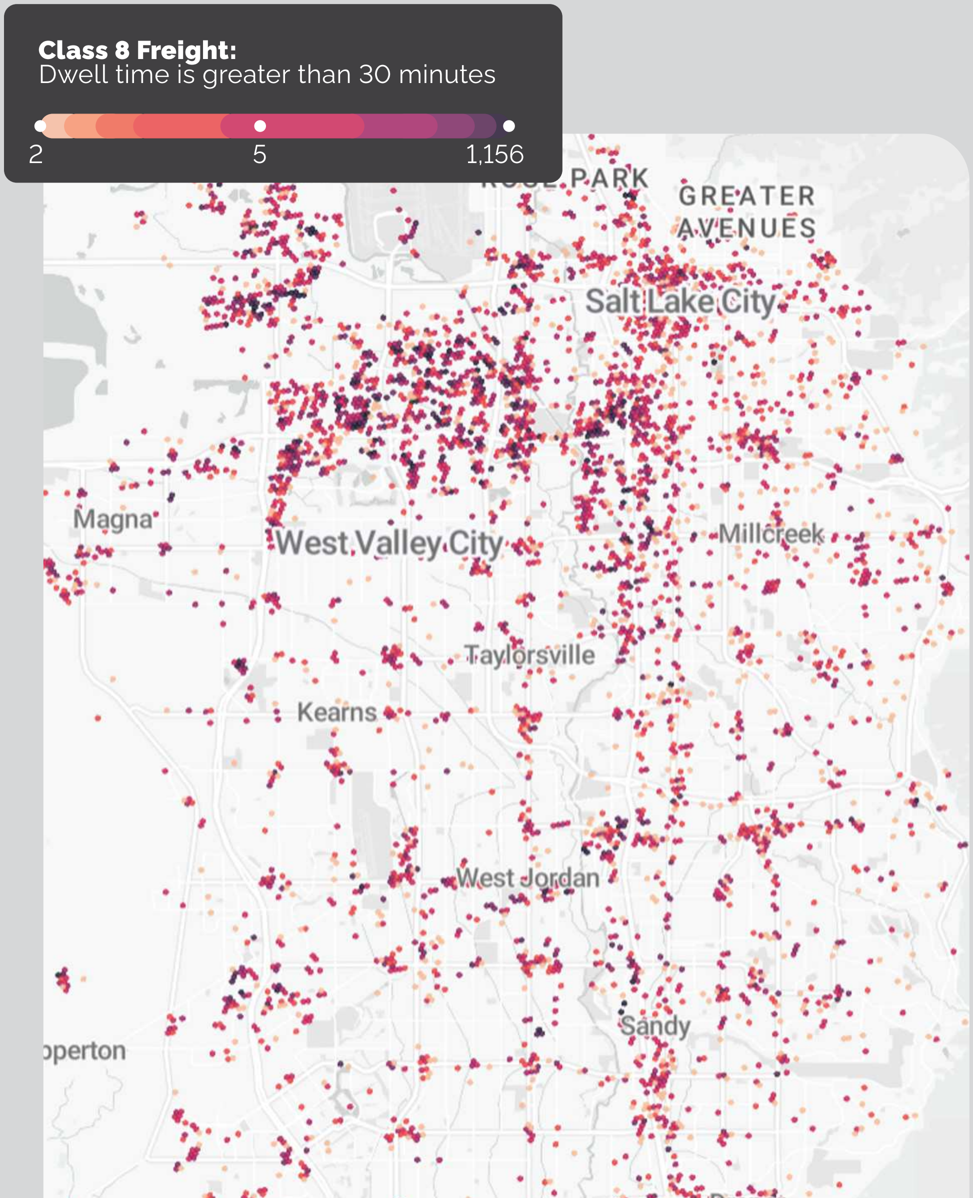
Focusing on the right map, which highlights Class 8 freight trucks with dwell times over 30 minutes, we see critical insights into the specific needs of long-haul and heavy-duty freight operations. These longer stops provide ample opportunity for recharging large battery-electric trucks. Key areas with high concentrations of these stops are ideal candidates for installing high-capacity charging infrastructure.



Vehicle Classes

Class 4
Between 14,000-16,000 lbs.
Examples: box trucks and some delivery trucks.
You can drive these yourself, but be careful!

Class
Betweer
Examples
cherry pic
Lots of f
equiptm



5

n 16,001-19,500 lbs.

: bucket trucks and
kers.

farming
nent.

Class 6

Between 19,501-26,000 lbs.

Examples: beverage trucks, rack trucks and school buses.

You need a CDL to operate this type of vehicle.

Class 7

Between 26,001-33,000 lbs.

Examples: street sweepers, garbage trucks, and city transit bus.

Working trucks you see on a daily basis.

Class 8

Over 33,001 lbs.

Examples: big rigs, cement trucks, and dump trucks.

Heavy isn't enough of an adjective. These trucks are called *severe-duty.*

The data underscores that en route stops at fueling centers, rest stops, and other public facilities with ample freight parking are ideal for placing charging infrastructure. Longer dwell times at these locations mean trucks can recharge without disrupting their schedules. The figure shows that stops are spread across various locations, including rest stops and convenient free parking areas such as Willard Bay Park, highlighting the importance of strategically placed chargers to maximize coverage and utility.

By leveraging these insights from GEOTAB data, Utah can strategically enhance its electric vehicle charging infrastructure to support a more sustainable and efficient freight transportation network. The high density of stops in the Salt Lake City area, combined with critical long-duration stops for Class 8 trucks, provides a clear roadmap for prioritizing charging station placements. This will not only facilitate the adoption of battery-electric freight vehicles but also contribute to reducing emissions and improving air quality across the state.

Electric Transit Buses & Trains

The shift towards electric bus (EB) fleets is a pivotal component of Utah's electrification efforts. This movement aligns with broader sustainability goals and reflects the commitment of the State to move away from fossil fuel-dependent transportation models. The switch from traditional diesel buses to electric variants introduces several significant challenges. Key among these are the issues of charger ecosystem reliability and charging resource allocation, which have become more pronounced as EBs are integrated into existing fleets and new infrastructure is installed. Any issues that impact charging infrastructure availability often causes operational challenges, leading to lengthy queues at charging stations and potential service delays.

The Utah Transit Authority (UTA) has transitioned part of its fleet to include 34 electric buses, manufactured by Gillig and New Flyer, to service routes in Ogden and Salt Lake City. Through partnership with UTA, data has been collected to focus on the operational data to analyze reliability, energy consumption, and costs. Using this data, analysis of existing systems is conducted along with a simple model to understand the costs of implementing new routes, considering factors such as distance, road gradient, traffic conditions, ridership, and weather. While infrastructure installation costs are not directly included, bus charger use and billing contracts, based on Rocky Mountain Power's rate schedule, are incorporated into the analysis.

Data from onboard telematics is transmitted through Viriciti and ingested via API to a local database. Viriciti is a commercial cloud-based telematic service tailored explicitly


CAUTION
Do not walk in front of the bus
Stand behind the yellow line
Priority seating area
CLEARANCE HEIGHT
UTA

to electric trucks and city buses. Operational data is obtained in real-time at a relatively high frequency (1-second interval), and analysis is conducted based on collection period in 2023 to the present. We note that some data, such as GPS, publishes updates slower (typically every 7-20 seconds), while others on the OBD can be obtained faster. The choice of collection at 1s intervals was to give sufficient fidelity to high-speed information without undue burden on the collection databases. We note that the delivery and integration of the pilot e-bus into the operational fleet at these locations was started on February.

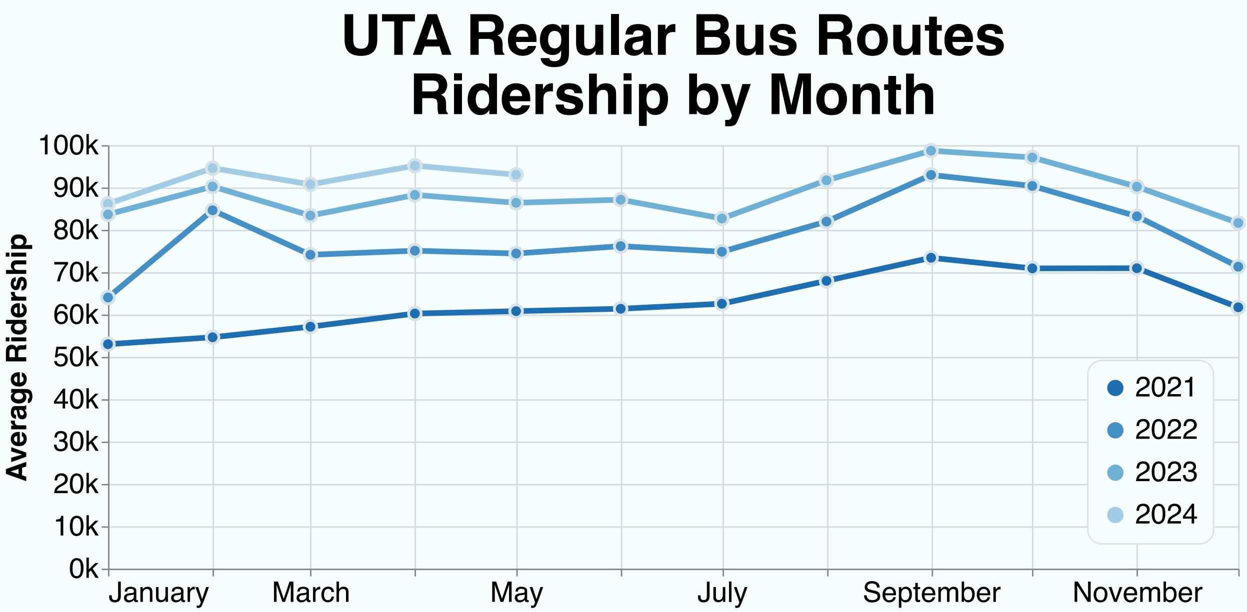
While data cleaning and synchronization posed challenges due to varied sensor transmission rates and occasional failures, these technical aspects were managed to ensure data integrity. Data anomalies, including outliers and gaps, were identified and rectified through methods such as interpolation and cross-validation. Despite the complexity of data handling, the process allowed for a precise and reliable analysis of the UTA EB operational data.

Routes & Ridership

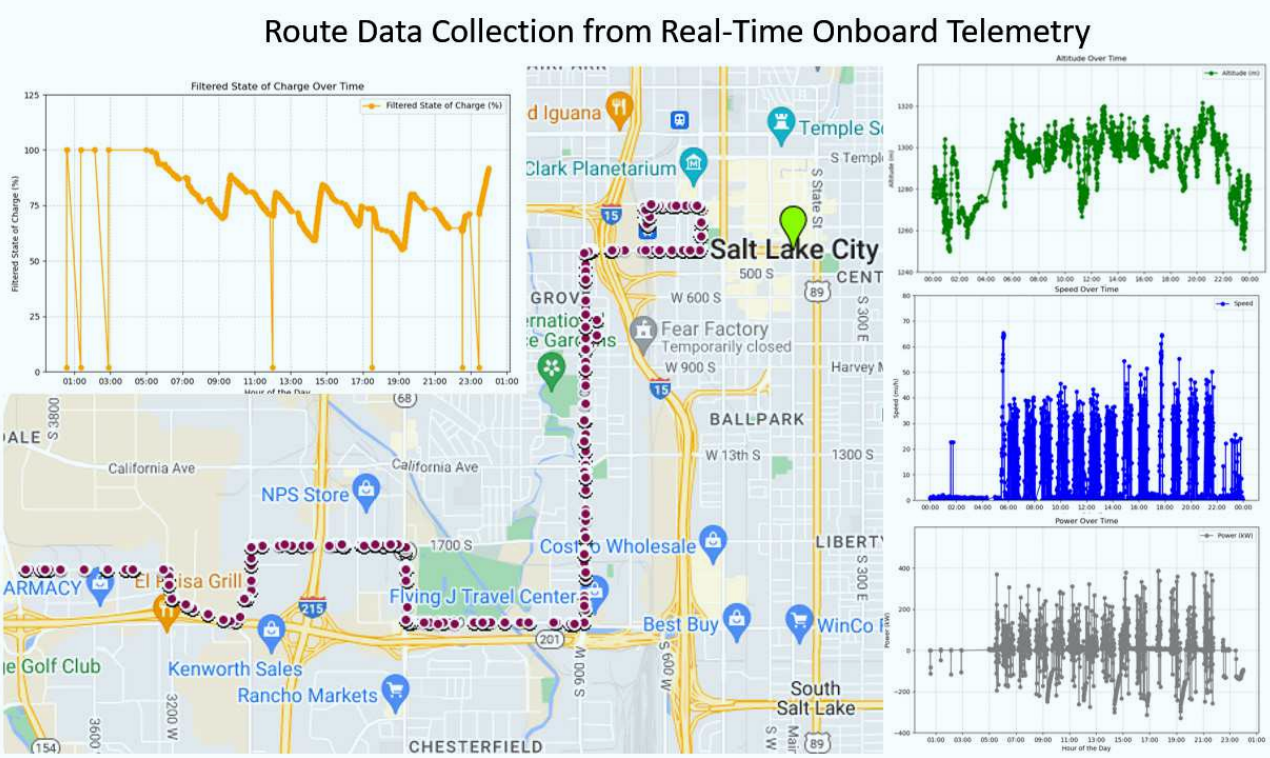
Since 2021, public transit bus ridership in Utah has been steadily rising, driven by an increased need for urban mobility solutions. This resurgence in ridership has significant implications for electric bus fleets (Figure 22). Higher demand for public transit translates to more frequent service and expanded routes, necessitating the deployment of more electric buses to meet these needs. Additionally, increased ridership amplifies the environmental benefits of electric buses, as more passengers reduce the per capita carbon footprint. The growing usage also highlights the importance of reliable charging infrastructure and efficient energy management systems to ensure that electric bus fleets can operate seamlessly and sustainably, catering to the evolving transportation demands of urban populations.

The Utah Transit Authority (UTA) has strategically electrified a few key bus routes, chosen for their high ridership, significant impact on reducing roadside pollution in densely populated areas, and their vital connections to Frontrunner commuter rail stations. These routes, primarily in Ogden and Salt Lake City, are pivotal in providing efficient and sustainable transit solutions. By targeting routes with high ridership, UTA maximizes the environmental and economic benefits of electrification, reducing emissions in areas where pollution has the greatest adverse effects on public health. Additionally, servicing connections from Frontrunner stations ensures seamless integration with the broader transit network, promoting the use of public transportation and enhancing the overall efficiency and appeal of UTA's services. This strategic approach not only supports cleaner air in urban centers but also encourages more commuters to opt for public transit, thereby contributing to a

Figure 22: *UTA Ridership and Route Data Collection*



	Route 602	Route 2	Route 209	Route 509
Weekdays	7:08am-11:03pm	4:33am-12:35am	4:16am-12:03am	5:28am-12:30am
Weekend	–	Saturday 4:35am-12:19am Sunday 67:36 am-10:00pm	Saturday 6:13am-10:18pm Sunday 6:13am-9:18pm	Saturday 6:00am-9:50pm Sunday : –
Run	Every 10 minutes in Avg	Every 44 minutes in Avg	Every 67 minutes in Avg	Every 55 minutes in Avg
Distance driven by day	58.027 mi	155.998 mi	166.453 mi	187.334 mi
Energy consumption by day	156.784 kWh	519.955 kWh	454.791 kWh	478.407 kWh



more sustainable transportation system. We also note that while the total average bus usage in the Salt Lake County area stands at 41,222 rides, nearly half of this ridership (average of 20,617 rides), is concentrated in Justice 40 designated communities. This high usage rate underscores the vital role that buses play as a primary mode of transportation for residents in these areas. Moreover, of the total 52 bus routes servicing the county, only 12 are dedicated to servicing Justice 40 communities, where other routes do not have high usage. This disproportionate reliance on bus transportation in Justice 40 communities reflects their dependence on public transit for daily commutes and emphasizes the broader impact of bus fleet electrification in these areas. By catering to a significant portion of the city's bus ridership, the transition to electric buses in these communities plays a crucial role in reducing exposure to harmful emissions and improving the overall quality of life for the residents.

Charging Capabilities

Electric buses necessitate specific charging technologies and substantial energy capacities. Charging an EB typically requires connecting the bus to a power source that can deliver anywhere from 50 kW to 150 kW for standard charging, and up to 450 kW for high-speed charging systems to maintain operational efficiency throughout service schedules. The high power demand is essential to quickly recharge the large batteries installed on the UTA bus fleet.

The current electric bus (EB) fleet of the Utah Transit Authority (UTA) demonstrates impressive energy efficiency, operating at approximately 2.3 kWh per mile. On an average weekday, the fleet collectively travels around 2,500 miles, translating to a total daily energy consumption of about 5,750 kWh. This level of efficiency not only highlights the operational viability of electric buses but also underscores their potential for substantial cost savings and environmental benefits compared to traditional diesel buses. The calculated power consumption allows UTA to plan and optimize their energy usage, ensuring that the electric bus fleet can sustain its daily operations reliably while contributing to a reduction in greenhouse gas emissions and improving air quality in urban areas.

Electric Power System

During FY23 the power systems team has been focused on conceptualization, data gathering, and visualization that will inform future power planning efforts.

Data Gathering

Data is key to developing project outcomes that are based in the reality of the Utah grid. The use of high quality, up-to-date data on Utah's grid will allow us to make recommendations that are realistic and implementable. To ensure that we have access to this high-quality data a major effort of this year has been data collection. The data collection effort is broken into two distinct segments, publicly available data and private utility data.

Rocky Mountain Power Request

Most data pertaining to the power grid is stringently regulated by utility providers due to security implications, and it is therefore inaccessible to the public. To procure this information, we are required to provide a justification for its use and formally request it from the respective utility provider. The Inland Port, along with all but three of the other multi-modal sites currently under evaluation, falls within the jurisdiction of Rocky Mountain Power (RMP). Given this, our efforts to collect utility data are focused on RMP.

As part of our efforts to secure this data from RMP, the technical team has put together a detailed request containing information on the reasons we are seeking this data and the specific items we are looking for. This information has been communicated to RMP through a series of regular meetings that are part of ASPIRE's close relationship with RMP. The request is broken into eight categories of data:

1. Integrated Resource Plan
2. Distribution models
3. Time series loads
4. Infrastructure Costs
5. Substations
6. Transformers
7. Electricity Cost
8. Import / Export

Integrated Resource Plan

In Utah, the Integrated Resource Plan is a biannual document developed by Rocky Mountain Power that contains a wide array of tables and charts describing the future of the grid in Utah. By requesting this information in formats that can be more easily structured to be used in our models we can synchronize our plans with RMP's.

Distribution Models

Distribution models are key to the analysis of Utah's grid and electrified transportations impact on it. These models will allow us to build cost functions that accurately capture the state of the grid and will ensure that the loads we project under different scenarios are compatible with the grid. We will also be able to inject our loads onto the grid to verify that elements are within their limits and the grid remains stable.

Time Series Loads

The grid is constantly changing and designing a transportation network that assumes a steady fixed load will either be unrealistic or excessively conservative. By obtaining time-varying load measurements we can account for changes in the grid throughout the day instead of at only a fixed time or worst-case scenario.

Infrastructure Costs

Transportation is one of the largest uses of energy in Utah and if a significant portion of that transportation is electrified the current grid infrastructure will require upgrades. To ensure that we are strategic in placing these upgrades we need to accurately model the cost of replacing elements in the grid. By using estimates and real-world data from the utility we will be able to build accurate and reliable models for cost.

Substations

Substation data will allow us to determine for any location in RMP's territory what substation serves that location. This will help us with our modeling and planning efforts.

Transformers

Data on transformers will help us connect publicly available data on transmission lines with the provided distribution models. This will enable us to ensure that for a given distribution network the generation and transmission infrastructure is capable of handling the new loads.

Electricity Cost

To ensure that we are accurately reporting on the cost of electrified transportation we will need accurate models of the cost of electricity under various scenarios. Information from the utility on these costs will enhance our models and help to ensure that we are accurately predicting the costs associated with a change in the transportation system.

Import / Export

Utah is an electrical energy importer and exporter and this will not change in the future as we have considerable infrastructure in place that enables this movement of electrical power. To ensure that we are accounting for this movement we have asked the utility for information it has on this aspect of Utah's electricity landscape.

Utah Electrical Energy Consumption

The EIA reports electrical consumption on a monthly basis for all states. Figure 23 represents the aggregation of this data by year up to 2023 for Utah. Additionally, the RMP IRP forecasts the loads by sector for their service area from 2024 to 2050. The data in Figure 25 adjusts those totals to account for the entire state by scaling the 2023 data by the rates of increase forecast in the IRP. Solid areas are past and transparent areas are forecast. There is no data for 2024 as the IRP does not publish an estimated increase from 2023 to 2024, and complete EIA data for 2024 is not yet available.

Power Generation Capacity in Utah

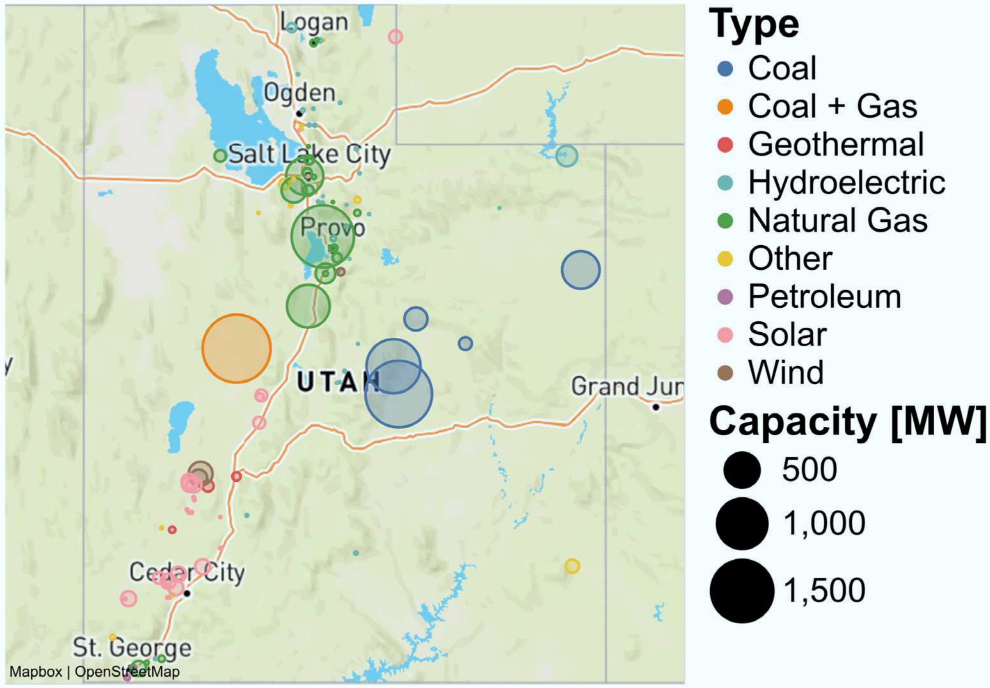


Figure 23: *Data from the US Department of Homeland Security. Shows the location, type, and operating capacity of each power plant in the state. It does not include distributed energy resources such as residential solar.Comments restricted to single page*

Figure 24:

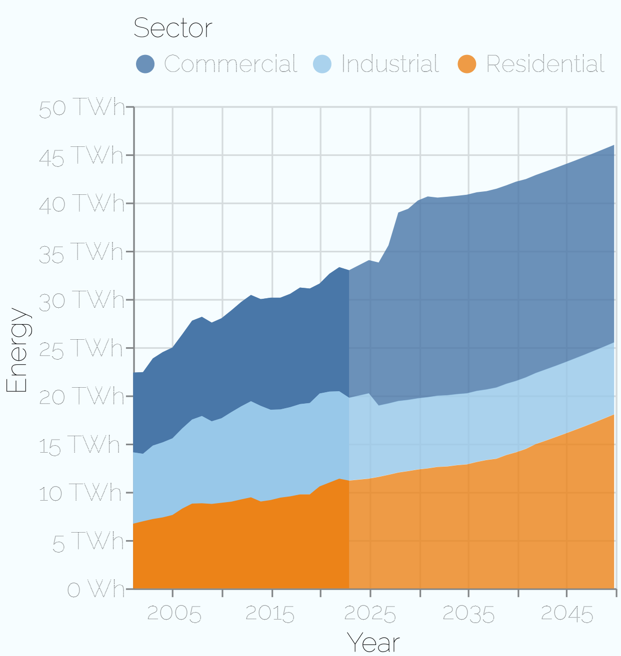
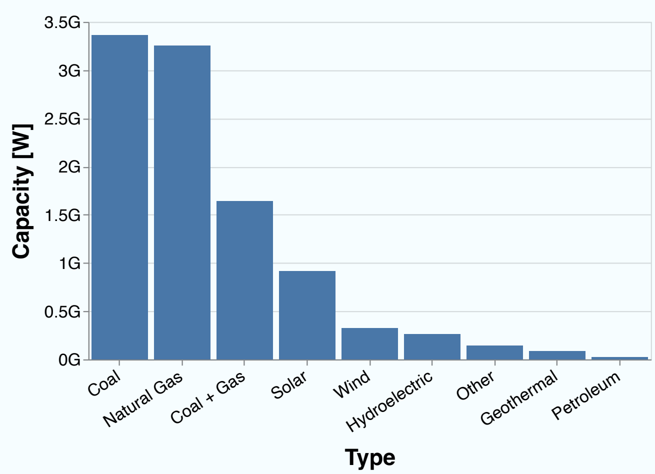


Figure 25:



Potential Geothermal Generation in Utah

Figure 26: Data from the UGRC. Sites are theoretical locations where geothermal energy could be utilized.

Electric Charging Stations in Utah

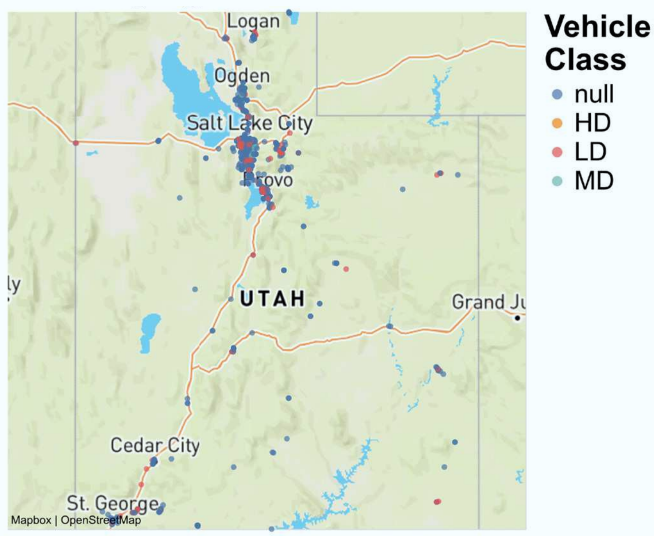


Figure 27: This data is from NREL. Shows existing EV chargers in Utah. Colored by maximum vehicle class where data is available.

Transmission Lines in Utah

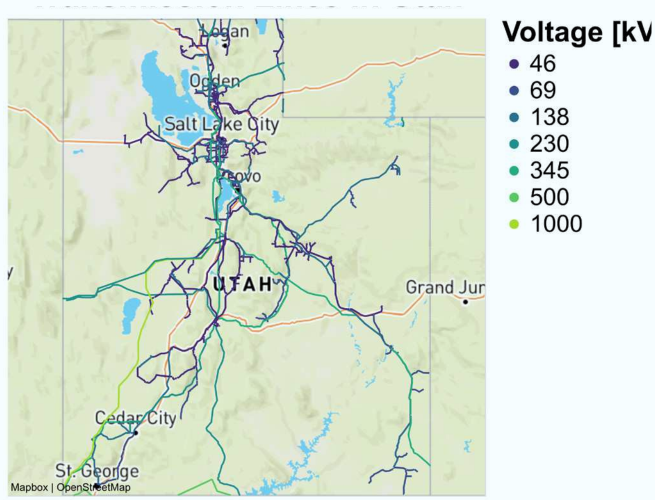


Figure 28: Transmission line data comes from the UGRC. Data is colored by the line voltage.

Geospatially Referenced Electrical Provider Data

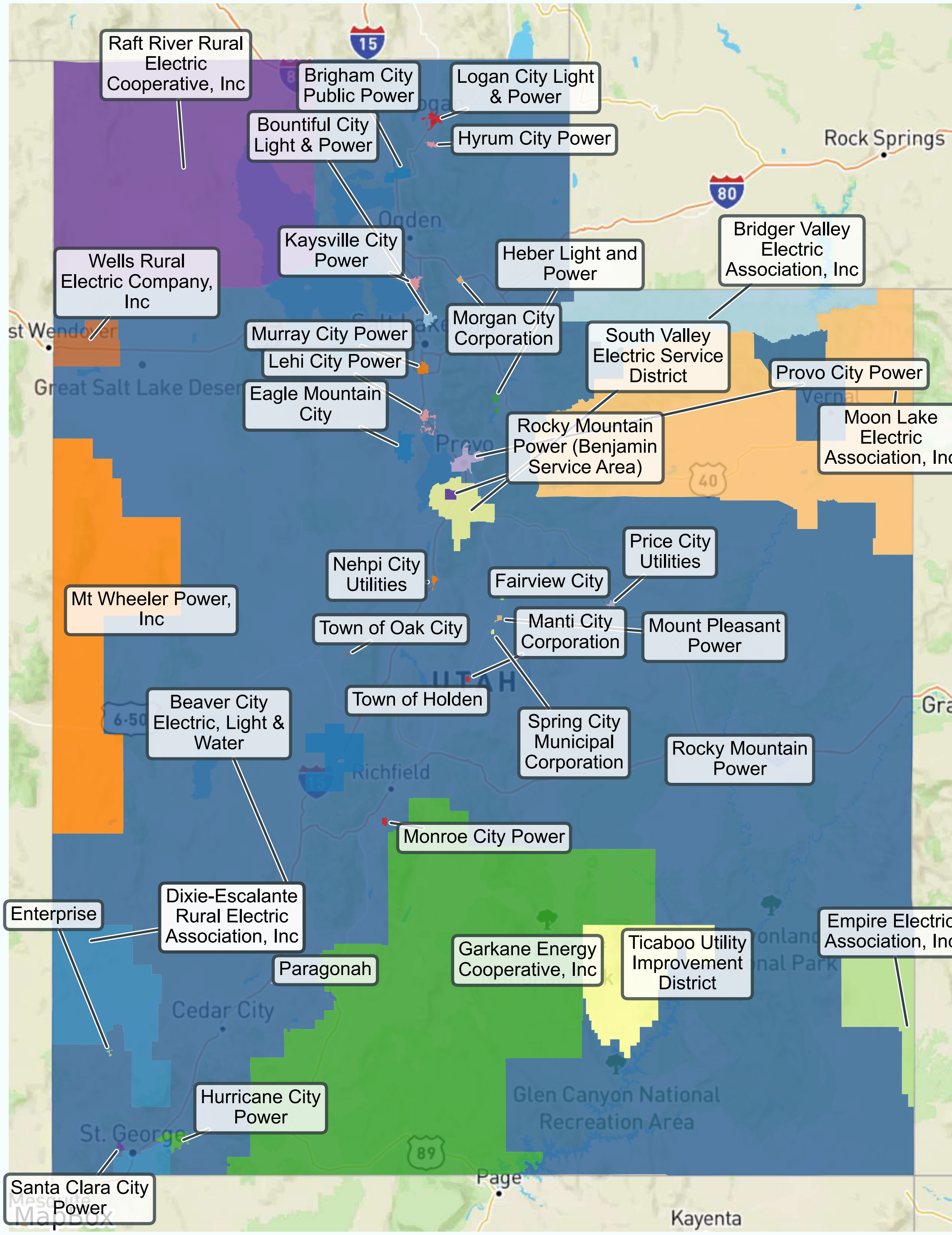


Figure 29: This data is from the UGRC and shows the locations of all of the electric service providers in Utah. *Map generated from as of 06/31/2024*

Moving Forward

The focus of our work thus far has been to inventory data on the current state of Utah's transportation system and to develop generalized modeling tools and methodologies. This foundational work sets the stage for successively more comprehensive and detailed analyses in the future. Initially, we demonstrated our methods by applying them to assess scenarios for statewide on-road transportation, as this data was the most accessible.

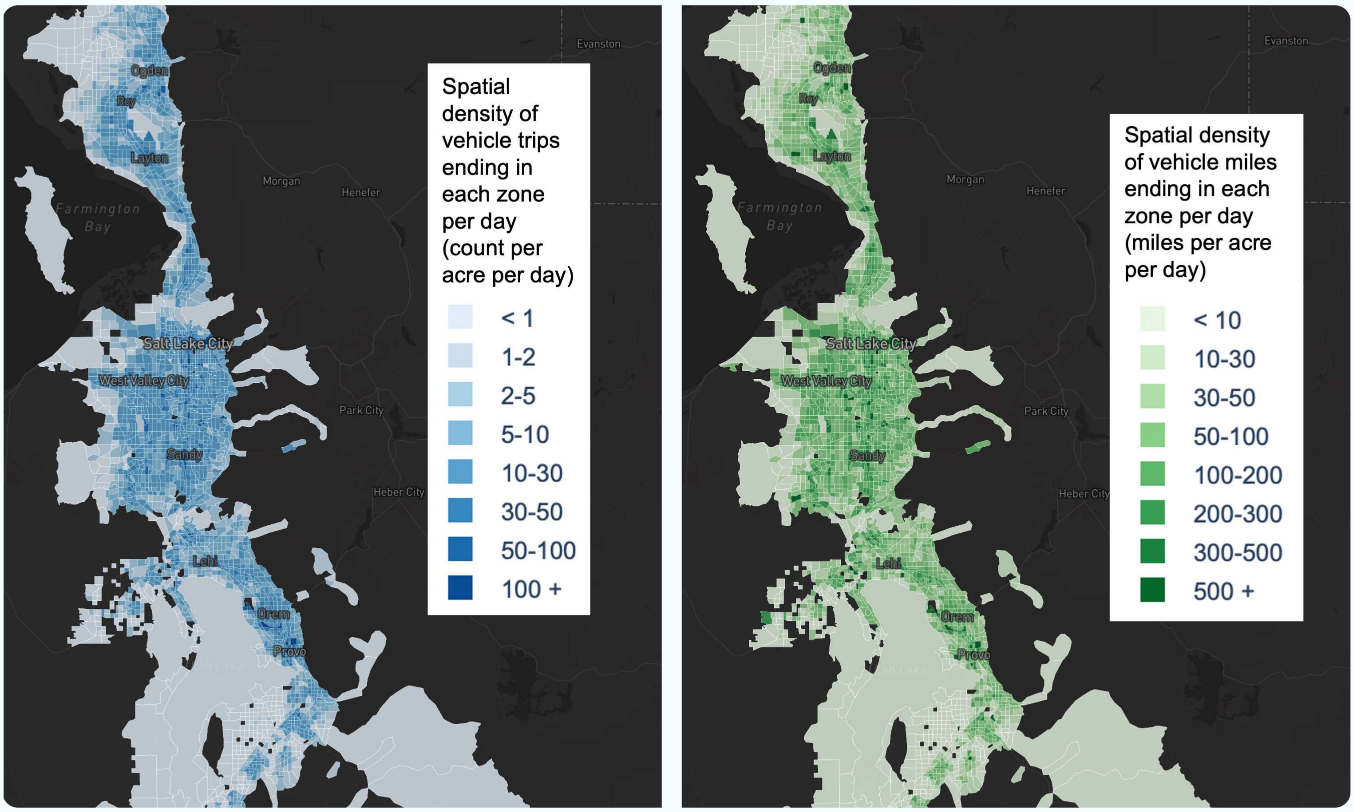
Moving forward, our goal is to apply these approaches to enhanced datasets, enabling us to conduct a more thorough and nuanced analysis. This involves compiling and synthesizing data with greater spatial, temporal, and sectoral detail. In essence, we will be 'zooming in' while retaining our comprehensive statewide scope, and integrating all six in-scope transportation sectors along with the electric power system into our modeling efforts.

Modeling

The models we have demonstrated are designed with the entire five-year project trajectory in mind. Enhancing the details of these models will not require modifications to the models themselves but will involve applying the same models with more detailed datasets. To complete the system-of-systems model as proposed, we will integrate additional modeling resources, including air quality, jobs, and economic growth, areas in which ASPIRE has significant expertise.

- **Power system constraints & costs:** Enhancing our analysis with the infrastructure optimization tool will involve incorporating detailed power system data. This will allow us to factor in the costs of upgrading utility infrastructure, which is crucial for planning effective charging infrastructure projects. By considering these costs in our optimization models, we can ensure more accurate and practical planning for future developments.
- **Statewide transportation detail:** To increase the resolution of our statewide transportation model, we will integrate higher-resolution datasets such as the Wasatch Front Travel Demand Model (WF TDM) and data from Geotab. Currently, our model operates at a county-level spatial resolution, but these

Figure 30: *Summary of data obtained from the Wasatch Front Travel Demand Model. The WF TDM characterizes all on-highway transportation in the domain shown in the maps. These maps illustrate one day of passenger vehicle activity, shown as a sum of vehicle stops (left) and vehicle-miles (right) ending in each analysis zone.*



new resources will allow us to zoom in to traffic analysis zones (TAZ), road segments, and individual charging points. Additionally, incorporating data for off-road sectors will enhance the comprehensiveness of our model, enabling us to better understand and plan for all aspects of transportation.

- **Air quality modeling:** The transportation and power system models provide detailed profiles of emissions that contribute to air pollution. To understand the impact of these emissions, we will employ air quality modeling, which uses advanced fluid-dynamical and chemical-reactive simulations to assess the impacts of our modeled emissions. ASPIRE has experts in this field who will help us develop these top-priority outputs, ensuring that our action plan addresses transportation needs while improving air quality.
- **Jobs & economic growth:** Understanding the workforce requirements for the transition to electrification is essential. We have partnered with economics experts who will assess these requirements, identify potential barriers, and provide recommendations. Their work will ensure that our plans contribute to job creation and economic growth, aligning with the broader goals of the state.

Data Gathering

The key next step for enhancing our understanding of Utah's transportation and power systems is to gather and integrate additional datasets. We are already making significant progress in this area:

- **Electric power system data:** We have submitted a detailed request for data from Rocky Mountain Power, the primary utility serving the largest area of Utah. This request is part of our effort to gather comprehensive power system data. Additionally, we are developing data partnerships with electric cooperatives in other parts of Utah to ensure a thorough statewide analysis.
- **Detailed on-road transportation data:** We have partnered with the Wasatch Front Regional Council to access data from the Wasatch Front Travel Demand Model (WF TDM). This partnership will significantly enhance our understanding of on-road transportation, especially in Utah's most heavily trafficked areas. (Figure 30) We have also acquired fleet activity data from individual fleets and from Geotab, a data aggregator. These resources will further refine the detail and accuracy of our transportation modeling.
- **Air transportation data:** Building on previous work with the Utah Department of Transportation, we are integrating air transportation data into our statewide analysis. This includes data on routes and aircraft specifications.
- **Remaining sectors:** We are additionally working to characterize the demands and requirements of off-road, non-aviation sectors including freight rail, construction, mining, and agriculture. Data for these sectors is relatively scarce, and we are exploring novel solutions and partnerships to fill these gaps.
- **Other fuels:** While the primary focus of this initiative is on electrification, we recognize the importance of a diverse energy mix. Our infrastructure optimization tool is designed to identify optimal configurations that complement electricity with other fuels. To support this, we are gathering data on the costs, benefits, and characteristics of alternative fuels like hydrogen and renewable natural gas.

Summary

The data analysis and modeling we have completed in this initial year lay a robust foundation for developing Utah's electrification action plan. All of our work has been fundamentally guided by the requirements set out by the legislature:

1. **Intelligent Coordination:** Provides intelligent coordination for vehicular traffic and charging individually and collectively into a dynamically communicative transportation system that links to and coordinates with the electric grid.
2. **Integration Across Modes:** Integrates across and supports all modes of transportation and vehicle classes in complementary ways
3. **Integration with Alternative Fuels:** Integrates with hydrogen and renewable natural gas generation, storage, grid support, and fuel cell vehicles in complementary ways
4. **Critical Outcomes:** Provides improved air quality, reduced cost to move people and goods, and new jobs and economic growth in the state

Requirements 1, 2, and 3 emphasize the need for a holistic approach, assessing all systems in an integrated manner. To achieve this, we have developed a novel infrastructure optimization tool that specifies an ideal system configuration, incorporating the needs of all transportation sectors, power system assets, and fueling resources. Requirement 4 mandates that our action plan be evaluated based on air quality improvements, cost efficiency in transportation, and contributions to job growth and economic development. Our statewide transportation model is designed to assess critical metrics for these outcomes, including emissions of pollutants, the costs associated with building and operating the transportation system, and the necessary infrastructure investments.

Together, these efforts and tools provide a comprehensive framework that not only fulfills the legislative requirements but also positions Utah as a leader in sustainable transportation innovation. By building on this solid foundation, we are confident that our action plan will enable a seamless transition to an electrified and integrated transportation system, delivering long-term economic, social, and health benefits to the state. We aim not only to meet but to surpass legislative expectations, setting a new benchmark for intelligent transportation systems across the nation.

Outreach & Communication

Transportation infrastructure decisions impact everyone in the state, from individuals to organizations, and should be shaped by the needs and wants of localized communities. Civil infrastructure should fill the purpose of spurring and supporting communities' long-term growth and well-being.

With this collaborative, community-first purpose in mind, ASPIRE is at the forefront of rural/diverse perspectives. We are actively working to earn Utahns' trust and candid input through clear, transparent, and timely communication throughout the entirety of the state's intelligent electrified transportation action planning process.


ASPIRE
NSF Engineering Research Center

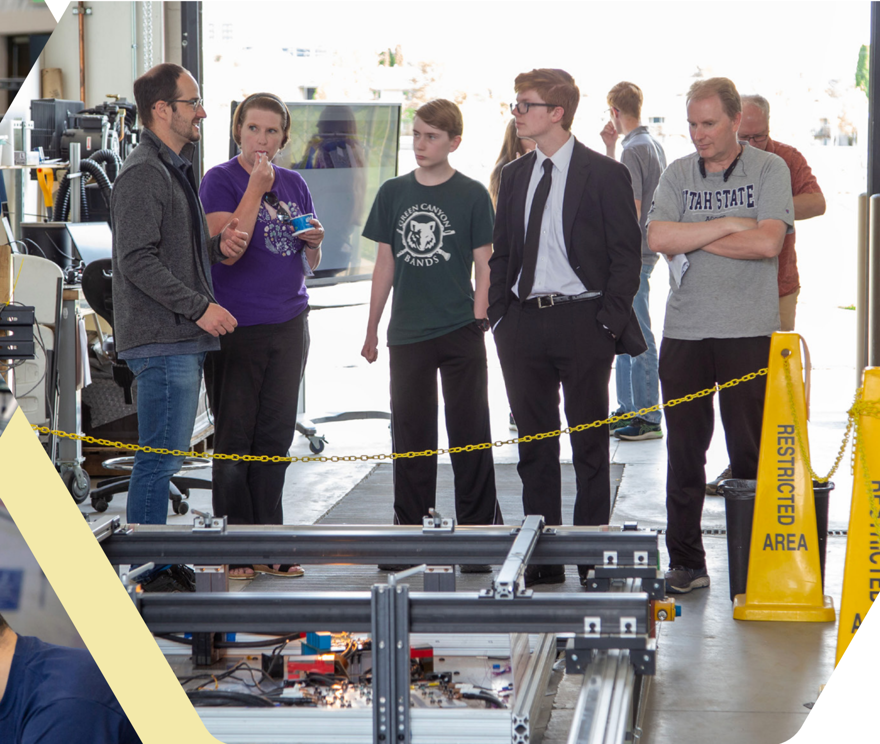
Statewide Communication & Public Collaboration

The key to this initiative's success lies in creating transparent and two-way, open communication avenues between ASPIRE, the State of Utah's legislature and administration, advisory board members, and the state's constituents across all societal levels, and addressing a diverse array of interests, concerns, stakes, points of view, and benefits.

We deeply value Utahns' input for the rich context that their experience provides in shaping the vision as it evolves throughout this process. The mutual exchange of ideas and experiences will better inform all who participate in developing the initiative, making clear the reasoning supporting its intent, scope, and expected benefits. The diverse array of shared interests, concerns, and points of view from various geographies, settlement types, and demographics will enhance our avenues of respectful and collaborative communication. This also will lead to practical solutions that best fit our collective state and local needs.

ASPIRE is as interested and committed to strengthening the workforce in the skilled trades as we are in the theoretical research space, and all levels in between. We recognize the crucial role that skilled trades play in driving economic growth and community resilience. By fostering partnerships with technical schools, industry leaders, local businesses, and beyond, we aim to provide robust training and development opportunities. This ensures that Utah's workforce is not only prepared for the demands of today but is also adaptable and innovative for the challenges of tomorrow.

To build trust, it is critical to communicate the intent and scope of this initiative in clear terms, breaking down complex concepts as well as capturing and addressing evolving perceptions of this topic — informing the public while simultaneously


UTAH STATE
RESTRICTED AREA


18153
DANGER HIGH VOLTAGE KEEP OUT
SHOP

Outreach & Communication

Through intentional engagement and strategic collaboration, ASPIRE is committed to addressing the unique needs and aspirations of each community we serve.

inviting the state's residents to help shape the vision for Utah's future and inform practical applications and solutions that best fit local needs. This will be achieved through a combination of digital and analog communication tools that serve key principles to ASPIRE's public and stake-holder engagement success:

- **Long-lasting:** Similar to the long-term impact of the infrastructure investments that may emerge from this action plan, the outreach and communication strategy associated with it should be thought of and structured as an ongoing public education and information program of equal length. A strong foundation of communication materials outlining the purpose, scope, and desired outcomes and benefits of the action plan will be complemented with timely updates, developments, and achievements in the planning process, helping us broaden and deepen the public's understanding of the electrified transportation field in general and its particular potential applications in Utah.
- **Respectful:** Honoring the diversity of lived experiences and points of view of individuals in every corner of the state, our communication strategy is to present research-backed statements in a people-focused manner by embracing objectivity and transparency, and by breaking down complexity for the many audience layers impacted by this topic.
- **Open:** A truly community-informed planning effort allows for ongoing public input and perception sharing through one-on-one interviews with community leaders and liaisons, public focus groups, policymaker & resident surveys, website feedback, and suggestion forms. Such feedback

has led to peer-reviewed contributions to academic journals and feedback from both reviewers and community members that our thoughtful approach to teaching and learning is refreshing. On the horizon, we aim to further strengthen our engagement and interaction via social media, including direct messaging, polls, and comment sections. Our goal is to anticipate and provide timely answers to questions, address concerns as they arise, and display thoughtfulness, consideration, and continuity in our actions, so that people may feel comfortable sharing the candid feedback our team needs to make the best electrified transportation planning recommendations.

Audiences & Communication Channels

In addition to Utah's general public needs for topical education and information, there are several specialized audiences which will require additional or different information in order to successfully support the action planning process. These audiences include:

- **Experts, community stakeholders, & industry advisory board members:** Ranging from industry experts, state agencies, universities and educators, and citizens of Utah from all regions of the state, we're expecting hundreds, if not thousands, of individuals to engage in this collaborative, multi-year planning initiative to electrify Utah's transportation infrastructure. Close collaboration with these various groups will enable ASPIRE to collect, contextualize, and process information and feedback to shape our electrification recommendations. The result will be an expression of Utah communities' collective voice in this unprecedented and visionary endeavor to develop a strategic action plan that is indeed actionable and provides a higher quality of life to all Utah citizens while offering inspiration for our nation and global community. Using this approach, we will continue to achieve breakthrough advancements across multiple disciplines, broadening advancements by targeting gaps and barriers identified through continuous stakeholder engagement.
- **Policymakers & industry leaders:** The desires of this one Utah community are translated into state economy decisions and legislation with the help of industry leaders and policymakers. ASPIRE's communication will therefore include recommendations on potential legislation to implement the action plan for policy makers will help clear paths forward that drive transformative innovation rather than rebuild the past.
- **Workforce development, education, & training:** The state's economic vision comes to fruition with the help of qualified and informed workers. ASPIRE aims to support the

creation and coordination of education programs and the recruitment marketing required by this immense opportunity to develop a skilled and diverse workforce ready for future electrified transportation challenges across urban and rural landscapes alike. (More details on this topic are included in the Workforce-dedicated section of this report.)

Among the communication tools we intend to use are various media campaigns that span multiple digital and traditional analog communication channels including a dedicated website, social media accounts, videos, infographics, data visualizations and interactive maps, news articles, press releases, print and digital advertising, participation in existing events or creating new ones to fit the purpose, conducting surveys, and holding focus groups to gather important observations. We're also keen to engage with various civic organizations, such as community associations, service clubs (Rotary, for example), hobbyist groups, etc. who may be natural collaborators to our statewide communication and education program.

Our efforts will collaboratively coordinate with the online presence of various state agencies, electric utilities, and transportation, energy, and air quality organizations to build momentum around the initiative of intelligent and electrified transportation while allowing the initiative's brand and messaging to focus exclusively on informing and communicating with the public. In fact, at this point, we envision the Utah intelligent electrified transportation action plan's communication building on and tying into other existing long-range infrastructure plans, such as UDOT's Utah's Transportation Vision and the Unified Transportation Plan (UTP).

Community-Focused Collaboration

Our Utah leadership plus communication and outreach team have actively participated in numerous community-focused events to build a foundation of meaningful relationships within key communities, raise awareness about electrification, highlight local opportunities, and learn from community members' personal and professional wisdom. These events have provided invaluable platforms for engaging directly with residents, listening to their concerns and insights, and sharing information about the benefits and career prospects associated with electrification. We viscerally recognize that our outreach and involvement with communities can help or hinder future and current efforts for government and private sector engagement with the public on a variety of issues, and we approach these interactions with respect, accountability, and appreciation.

By actively participating in community-organized gatherings, local fairs, and educational workshops, we have gained understanding and appreciation for the large and small challenges that communities navigate as well as their skill and resourcefulness in managing them. Our face-to-face engagement with individuals and organizations has fostered a more comprehensive grasp of both the transformative potential of electrified transport and the communal ecosystems that safeguard community well-being.

Through formal and informal interaction, we have been able to not only disseminate key technical information but also strengthen valuable trust and collaboration between ASPIRE and the communities we are dedicated to serving. As we continue into the coming year, our ongoing initiatives focus on maintaining relationships, expanding engagement with new communities, and supporting community well-being through development of low-barrier workforce pathways.

Accessibility Through A Web-First Approach

Given the complexity of electrified transportation as a topic, we will label the many efforts and elements of the endeavor at hand under an unambiguous title: "Utah Intelligent Electrified Transportation Action Plan." For this electrifying purpose, the ASPIRE team has created a Utah-inspired brand combining two well-known symbols: the electric plug and the bee:

Utah Intelligent Electrified
Transportation Action Plan

This logo and complementary brand elements offer a modern and approachable take on key concepts and will debut on the **utahelectrifiedplan.org** website, equipped with all of the necessary information and features for the attraction and smooth coordination of advisory board members. This web-first approach is intrinsically accessible, as it allows anyone across the state to easily and immediately find or offer information pertinent to this planning endeavor.

Project updates or news relevant to the topic also have a home on this website, along with a digital copy of this annual report and an interactive map showing existing electrified transportation deployments in the state of Utah. This website will also include contact information for the collection of public input and links to other communication channels and social media as they are built.

Strategic Workforce Partnerships & Outreach

ASPIRE's mission to foster community connections, workforce partnerships, and career development is central to our efforts in empowering local communities.

Through intentional engagement and strategic collaboration, ASPIRE is committed to addressing the unique needs and aspirations of each community we serve. Our approach is rooted in building trust, understanding local dynamics, and creating pathways for sustainable economic and social growth.

By connecting Utahns with relevant training programs and employment opportunities, we aim to enhance the quality of life and economic resilience within these communities. The following sections will detail specific initiatives and outcomes of our workforce development efforts, highlighting our collaborative endeavors in the WestSmart EV@Scale (WSEV) project and beyond.

Workforce Development Strategy

Workforce development efforts within ASPIRE have concentrated on building strong relationships with local labor unions and related groups to determine current program gaps, assess future needs, and create robust pathways for training and employment in the electrification sectors.

Collaborations with organizations such as the International Brotherhood of Electrical Workers (IBEW), Laborers' International Union of North America (LiUNA), and other organizations have been pivotal in determining where apprenticeship programs exist and disseminating this information to interested parties. These relationships promote training opportunities aligned with the needs of the community and industry standards and showcase the unique challenges.

ASPIRE aims to leverage these relationships to facilitate access to high-quality, hands-on training, ensuring that community members are well prepared for careers in electrified transportation — from automotive technology and design to utility and power careers — and related fields.

Credentials for these career paths vary, ranging from technical certificates and training programs to associate, bachelor's, or graduate degrees. This demonstrates the need to establish pathways where individuals — no matter their age or experience levels — can access the

Event Count	Event	Start Date	End Date	City	State
1	Westside Community Council/Coalition Meeting	Recurring on first Wed. of month		Salt Lake City	UT
2	Westside Special Meeting	Recurring as needed		Salt Lake City	UT
3	Westside Community Steering Committee Meeting	Recurring quarterly		Salt Lake City	UT
4	AFL-CIO "Labor" Day EVR Tour + Workforce-focused disscussions	12-Sep-23	12-Sep-23	Logan	UT
5	LiUNA laborers' union site visit	13-Sep-23	13-Sep-23	West Jordan	UT
6	Rocky Mountain Power EV Car Show	28-Sep-23	28-Sep-23	Salt Lake City	UT
7	CED Logan High School EVR Tour	27-Nov-23	27-Nov-23	Logan	UT
8	Utah Asphalt Association Conference	27-Feb-24	28-Feb-24	Sandy	UT
9	Wilson Elementary STEM Night	14-Mar-24	14-Mar-24	Logan	UT
10	SAMPE & UAMMI 2024 Wasatch Front Materials Expo	20-Mar-24	20-Mar-24	Sandy	UT
11	Logan Rotary Club Guest Presenters	4-Apr-24	4-Apr-24	Logan	UT
12	Utah State University Student Research Symposium	9-Apr-24	10-Apr-24	Logan	UT
13	Utah Association of Counties Building Utah Conference	10-Apr-24	11-Apr-24	Richfield	UT
14	One Utah Summit Spring Conference	12-Apr-24	12-Apr-24	Salt Lake City	UT
15	Utah League of Cities & Towns - Midyear Conference	17-Apr-24	19-Apr-24	St. George	UT
16	Utah Inland Port Authority Open House	18-Apr-24	18-Apr-24	Salt Lake City	UT
17	Westside Coalition Annual Meeting	23-Apr-24	23-Apr-24	Salt Lake City	UT
18	Greater Cache Valley Economic and Business Summit	24-Apr-24	24-Apr-24	Logan	UT
19	2024 Salt Lake County Climate and Health Symposium	30-Apr-24	30-Apr-24	Salt Lake City	UT
20	Utah Association of Counties Management Conference	30-Apr-24	1-May-24	Dixie	UT
21	American Planning Association Utah Chapter (APA UT) Spring Conference	8-May-24	10-May-24	Cedar City	UT
22	Utah Rural Electric Cooperatives Association (URECA) Tour of ASPIRE	22-May-24	22-May-24	Logan	UT
23	ASPIRE Leadership Retreat & SB125 Partners & Deployment Sites Tour	29-May-24	30-May-24	Salt Lake City	UT
24	ASPIRE Visit to USU Bastian Agricultural Center	6-Jun-24	6-Jun-24	South Jordan	UT
25	47G Logan City Council EVR Tour	7-Jun-24	7-Jun-24	Logan	UT
26	Neighborhood House Summer Celebration	14-Jun-24	14-Jun-24	Salt Lake City	UT

development they need to both provide for themselves and their families, and ensure Utah's workforce is prepared for the infrastructure and technological advancements of the future.

By working closely with labor unions, technical colleges, universities, community organizations, and industry partners, ASPIRE is not only enhancing the skill sets of the local workforce but also ensuring sustainable economic development through well-paying, future-oriented jobs.

Government Partnerships

ASPIRE's efforts to collaborate with government partners are crucial in bridging the gaps between market-driven solutions, data-driven strategies, and Utah's regional, economic, and societal needs. By working alongside local, state, and tribal branches of government, agencies, associations, and elected officials, ASPIRE aims to ensure that the benefits of electrification and technological advancements are mindful of and responsive to all regions across Utah and accessible to all community members. We acknowledge that these needs will vary greatly among the different geographies and regions within the state.

Our team has made concerted efforts at events and meetings throughout the state to build relationships, learn from existing planning efforts, assess needs, and strengthen new and existing connections. These partnerships facilitate the alignment of public policies with market and data insights, fostering an environment where innovative solutions can thrive.

Additionally, we've focused effort and energy in learning from existing planning vision documents. Community members and public servants have worked hard to develop these guiding efforts in manners that honor the gifts, graces, and common visions in their areas; we want to learn from and develop strategies that complement current plans. This collaborative approach supports the development of infrastructure and workforce initiatives and ensures that economic growth is accessible.

By integrating government resources and community input, ASPIRE is dedicated to creating sustainable, data-informed strategies that drive both economic vitality and societal well-being in the regions we serve.

Industry Insights

ASPIRE was one of the select partners to be invited to the White House Roundtable on Zero Emissions Freight Infrastructure on May 24, 2024, in Washington, D.C. We were among approximately 100 attendees, including representatives from truck OEMs, Charging-as-a-Service (CaaS) providers, utilities, seaports, A&E firms, travel centers, logistics and distribution, as well as federal government offices such as the Department of Transportation, the EPA, the White House Climate Policy Office, the Joint Office, and the FHWA.

In a breakout session moderated by Rachael Nealer, the deputy director of the Joint Office, ASPIRE shared the Utah Electrification model for a unified electrified transportation effort. We suggested that Electrified Roadway Systems (ERS) should be included in the updated master plan, especially considering ASPIRE has nine commercial demonstrations in with $60M in funding: four in Utah; one in Indiana with the DOT; two in Florida, one with the Central Florida Expressway and the other with the DOT; one in Detroit with the Michigan DOT; and one in Pennsylvania with the Pennsylvania Turnpike.

In May 2024, ASPIRE attended the ACT Conference & Expo in Las Vegas. It is the largest advanced commercial vehicle technology show with more than 15,000 attendees where all major OEMs are represented. For the first time, Tesla demonstrated their Semi truck at the Ride & Drive event. The wait to test drive the vehicle was about two hours, compared to approximately 30 other OEMs who had little or no wait to test drive their vehicles. Nikola and Volvo are currently delivering vehicles to key customers, and Tesla mentioned another upcoming order from PepsiCo, in addition to the 50 Class-8 Tesla Semi trucks they already have in operation. General deliveries to other clients are slated for 2026. This is the first time that Tesla exhibited at the ACT Conference & Expo as a supplier with real-world vehicles present to experience. In contrast, DTNA Freightliner unofficially quoted deliveries that are only about two months out. They reportedly have about 55 fleets operating their eCascadia semi-truck.

Another notable trend is the emergence of Charging-as-a-Service

(CaaS) companies for Class 8 battery-electric trucks. Six of these companies were at the White House Roundtable and all exhibited plus participated on panels at the ACT Conference & Expo. One provider mentioned that utilization of Class-8 charging infrastructure is only 4%. To increase utilization and raise visibility of the viability of Class-8 battery-electric trucks, they decided to purchase trucks, hire drivers, and begin operating their own battery-electric fleet.

ASPIRE participated in the National Renewable Energy Laboratory (NREL) Sustainable Freight Futures Workshop from May 29-30. We learned crucial insights from keynote presentations by Austin Brown, the director of the DOE Vehicle Technologies Office, and Alex Schroeder, the director of the Joint Office of Energy & Transportation. There were also breakout sessions on trucking (both long-haul and local/regional), intermodal freight, freight rail, maritime freight, aviation, and freight resilience. Notably, the breakout session on Disruptive Technologies and Business Models facilitated discussions of ASPIRE's work on electrified roadways and charging stations of the future, which support the CaaS efforts mentioned above.

Outreach Milestones

Several key milestones in the first year of the Utah Intelligent Electrification Action Plan have been or will be completed by the end of 2024:

- **Electrification Workforce Brochure:** Our team is working with academic institutions, labor and trade unions, and industry partners to produce a comprehensive communication tool sharing information on apprenticeships related to electrification. This will discuss career opportunities related to EVs, including credentials needed, trade options (such as technical, service, engineering, or research), and which institutions offer paid and unpaid apprenticeships. This will then be disseminated to the public, starting in September.
- **Research Publications:** Based on community research related to the Utah Intelligent Electrified Transportation Action Plan, our team has published the following papers:
    i. "Community Perceptions of Procedural and Distributive Justice in Engineered Systems: A Case Study of Community-Engaged Vehicular Electrification"

This case study was published June 25, 2023 by the American Society of Engineering Education. It observed a near-port community experiencing numerous health and economic impacts associated with excessive port emissions. For example, one local study found that air pollution levels in the near-port community were associated with increased school absences, and estimated that reducing pollution by 50% would save $426,000 per year in a school district that was already under-resourced.

This estimate did not account for the economic impacts on working caregivers who took time off to watch children, or who incurred medical costs from pollution-related illnesses themselves. Additionally, excessive exposure to PM2.5 has been repeatedly linked with adverse consequences in children's brain development.

- **"Designing Electric Vehicle Charging Infrastructure to Benefit Historically Marginalized Communities":** Article emphasizes the importance of integrating socioeconomic and factors into electric vehicle (EV) adoption strategies to address transportation needs holistically. The research highlights that effective EV adoption must consider multifaceted human needs, particularly in historically marginalized communities. By engaging residents in the planning process, the study developed a template for EV charging stations that promotes mobility justice and benefits the entire community, emphasizing the need for infrastructure that supports lower-income households.
- **Policymaker Survey:** aims to gather insights from Utah policymakers on electrified transportation infrastructure. Participants are asked to assess the importance and readiness of various subjects like community and economic development, power generation, air quality, and transportation infrastructure. The survey seeks feedback on transportation improvements, EV awareness, and perceived barriers to EV adoption, such as cost, charging infrastructure, and reliability concerns. It also gauges support for initiatives like tax credits and public charging stations to increase EV adoption. Policymakers' responses will inform strategic planning for Utah's electrified transportation future. (More on this survey in the Regional Adaptability section.)

A Voice For Regional Adaptability

The Utah Policymaker Survey invites elected officials and individuals who work in state and local government to share their perspectives regarding various aspects of electrifying our transportation system – from sharing their perceptions of electric infrastructure readiness to the potential barriers of implementing a fully integrated electrified transportation system. It is a crucial aspect of our planning process that is guiding the initiative in a balanced effort for an electrified future by tailoring the action plan to fill various regional and local needs throughout the state.

Importantly, the survey provides an opportunity for rural representatives to share their feedback. This approach allows rural community members to proactively express their perspectives and concerns at the forefront of the planning process rather than being left to react to government policies that may be unfavorable to them.

The survey results are informing the annual report and policy briefs that the ASPIRE publishes related to the Utah Electrification initiative.

These publications include phased actionable goals for policymakers to implement while outlining needed innovations across various industries and organizations that will accelerate realization of the vision, ensuring a comprehensive approach to the transition.

To date, we have conducted the survey among policymakers in the Six County Association of Governments (AOG) and Bear River Association of Governments (BRAG) organizations. This approach is providing valuable regional context to the planning effort as we recognize each of the seven Association of Governments (AOG) regions across Utah have different perspectives on the topic of electrified transportation based on their lived experiences, demographics, communities, geographies, climates, infrastructure, economies, and resources. Please consider a few insights from the May 2024 Six County AOG policymaker survey taken in Richfield by 120 respondents from all six central Utah counties (Juab, Millard, Piute, Sanpete, Sevier, and Wayne) located within the AOG.

Next Steps

Analysis of these results is underway and no conclusions can be drawn at this point. Please know that the collaboration and feedback from these rural central Utah policymakers are crucial to developing sustainable, intelligent, and economically viable electrified transportation infrastructure throughout the state while ensuring regional adaptability for each community's needs.

ASPIRE will continue surveying the remaining five AOGs throughout Utah along with other policymakers and the general public to ensure that all who would like to express an opinion have an opportunity to share their feedback, concerns, and hopes for the future of transportation electrification in Utah.

Stackable Credentials

Moving forward, our team's focus will be on furthering workforce development in typically underserved, rural areas of Utah. The Utah System of Higher Education (USHE) has prioritized increasing access to and awareness of "Stackable Credentials".

Stackable credentials enable individuals to earn a sequence of qualifications that build upon one another — such as credits and training programs at technical colleges, or skills badges

ASPIRE recognizes stackable credentials as a key workforce development tactic, from their potential to enhance career pathways to continuous improvement options to meet evolving iindustry needs. ASPIRE aims to seek out partners to further the state's initiative while providing flexible, accessible education to support lifelong learning and career development, ultimately fostering a skilled and adaptable workforce equipped to thrive in high-wage, high-demand sectors.

For example, under USHE's direction, Southern Utah University, Utah Tech University, Utah Valley University and Weber State University are coordinating pathway development in career and technical education in their respective regions. At USU, there is a mobile unit deployment that takes electrical training on the road. This unit showcases training and certification options to rural high schools throughout southeastern Utah. ASPIRE aims to support this program and collaborate with other institutions to expand opportunities throughout the state.

Women in STEM & Trades

Additional workforce development focus will be placed on strengthening connections with the Utah Women in Trades' Pre-Apprenticeship Program. Similar to stackable credit programs, the pre-apprenticeship program offers flexibility with weekend classroom instruction around typical family and work commitments. Upon successful completion, students (typically, low-income women, though the program is open to others) receive mentorship to navigate the application process for various construction trade apprenticeship programs. This guidance helps them determine if a career in the trades suits their interests and identifies specific trades to pursue.

Other partners, such as Neighborhood House, offer family care support to help women access this and other career-building training programs. ASPIRE is committed to finding solutions to benefit typically underserved communities in the state, and we recognize the important work that other organizations are doing to boost access to life-changing career and educational pathways. By fostering these connections, ASPIRE supports creating pathways to high-wage, high-demand careers in the trades for Utahns of all ages and from all regions.

For more details on the achievements and work completed toward SB125, Contact **marcom@aggies.usu.edu**.

Regional Priorities:

At least 82% of respondents rated community, economic, and workforce development as moderately to extremely important for their communities.