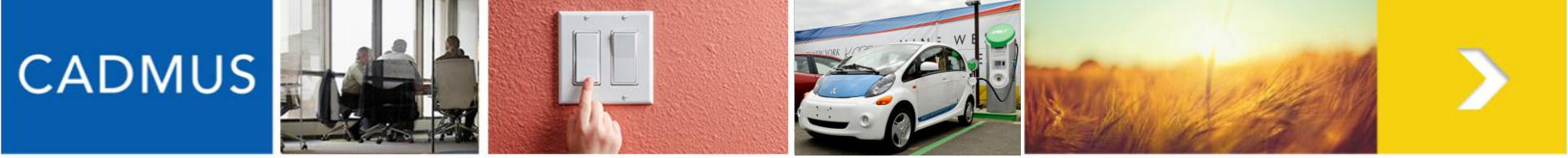
CADMUS

Electric Vehicle Corridor Planning in the Western US

Monday, January 22, 2018

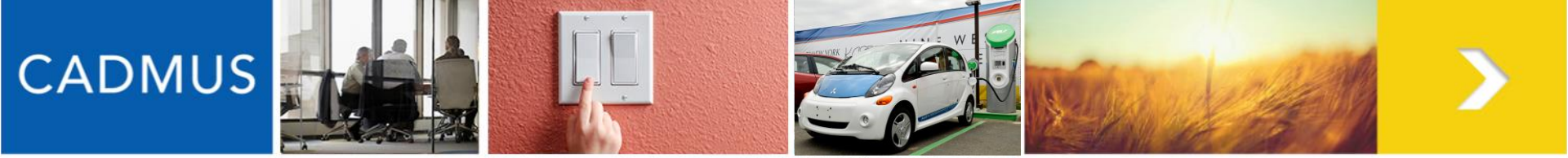
U.S. Department of Transportation
Federal Highway Administration

Oregon Department of Transportation

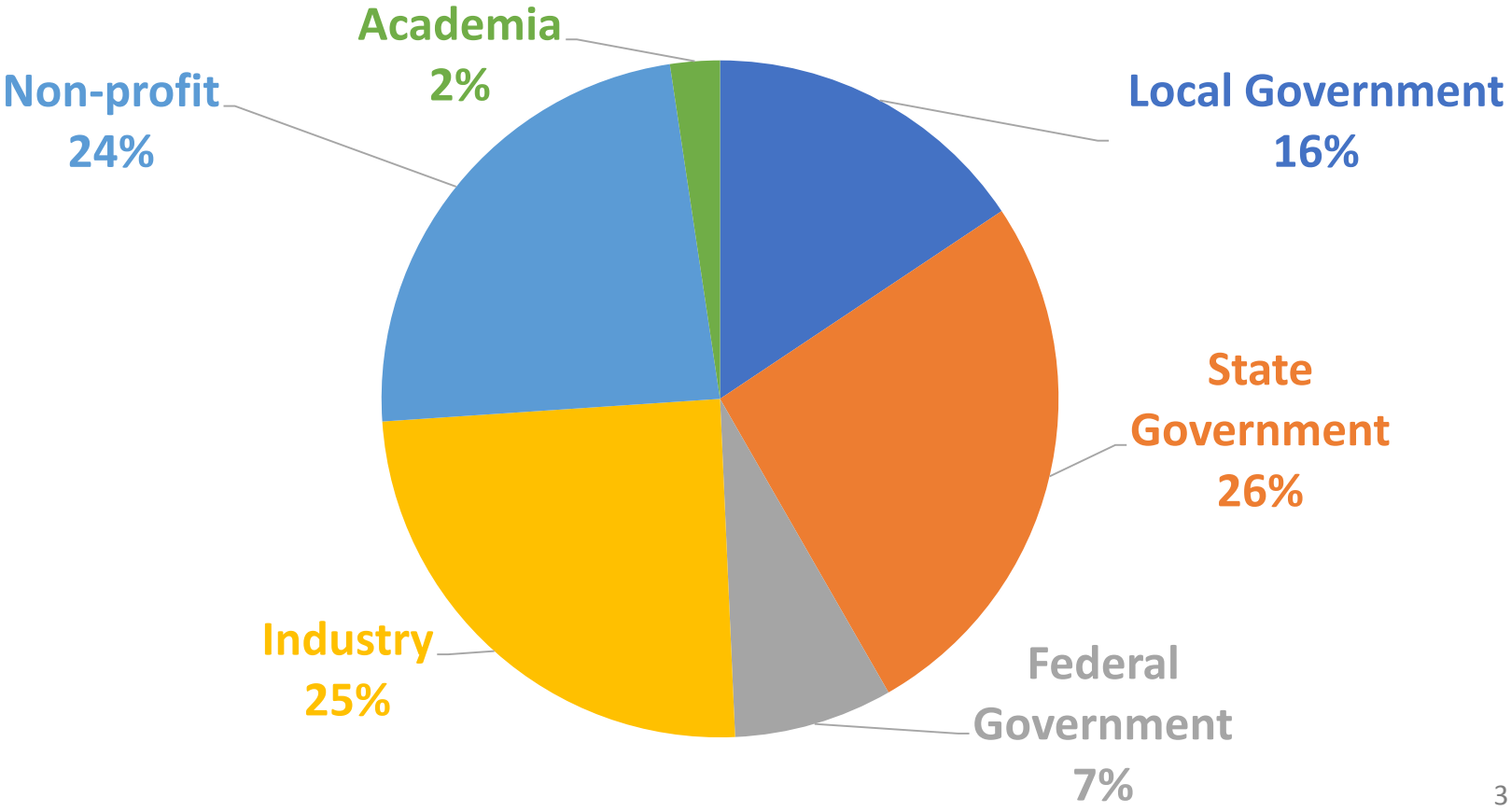


Agenda

- **Diane Turchetta, FHWA** - National Alternative Fuels Corridor designations
- **Tonia Buell, WSDOT** - West Coast Electric Highway
- **Zach Owens and Maria Eisemann, Colorado Energy Office** - Rev West MOU
- **James Campbell, Pacificorp** - EV Corridor Planning in UT, ID, WY
- **Geoff Morrison, Cadmus** – Web tool: altfueltoolkit.org
- **Q & A**
  - Use chat box to the right of your screen to submit questions
  - Questions may be submitted at any time during the panel
  - They will be answered by speakers during the final Q&A



Webinar Registrants (231 total)



Who is Cadmus?

Expertise in transportation:

- Alternative fuel strategies
- Connected and shared mobility
- Vehicle emissions analysis
- Low carbon fuel standards
- Fleet management
- Emergency preparedness, climate resilience, and business continuity
- Clean energy financing
- Grant and loan application support
- Policy analysis
- Lifecycle assessment
- Benefit-cost analysis

Contact:

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CADMUS

Vermont Energy Investment Corporation

ATLAS PUBLIC POLICY

Electric Vehicle Corridor Planning in the Western United States

Diane Turchetta – USDOT - FHWA

U.S. Department of Transportation
Federal Highway Administration

Alternative Fuels Corridor Designations

- The Secretary is required to designate corridors to improve mobility of passenger and commercial vehicles that employ electric vehicle charging, hydrogen, propane, and natural gas fueling technologies across the U.S. within one year of enactment (Dec. 2016):
  - Identify near and long-term need for infrastructure;
  - At strategic locations along major national highways;
- Solicit nominations from state and local officials;
- Incorporate existing infrastructure (demand and location)
- Stakeholder involvement (on a voluntary basis)
- **No funding authorized**

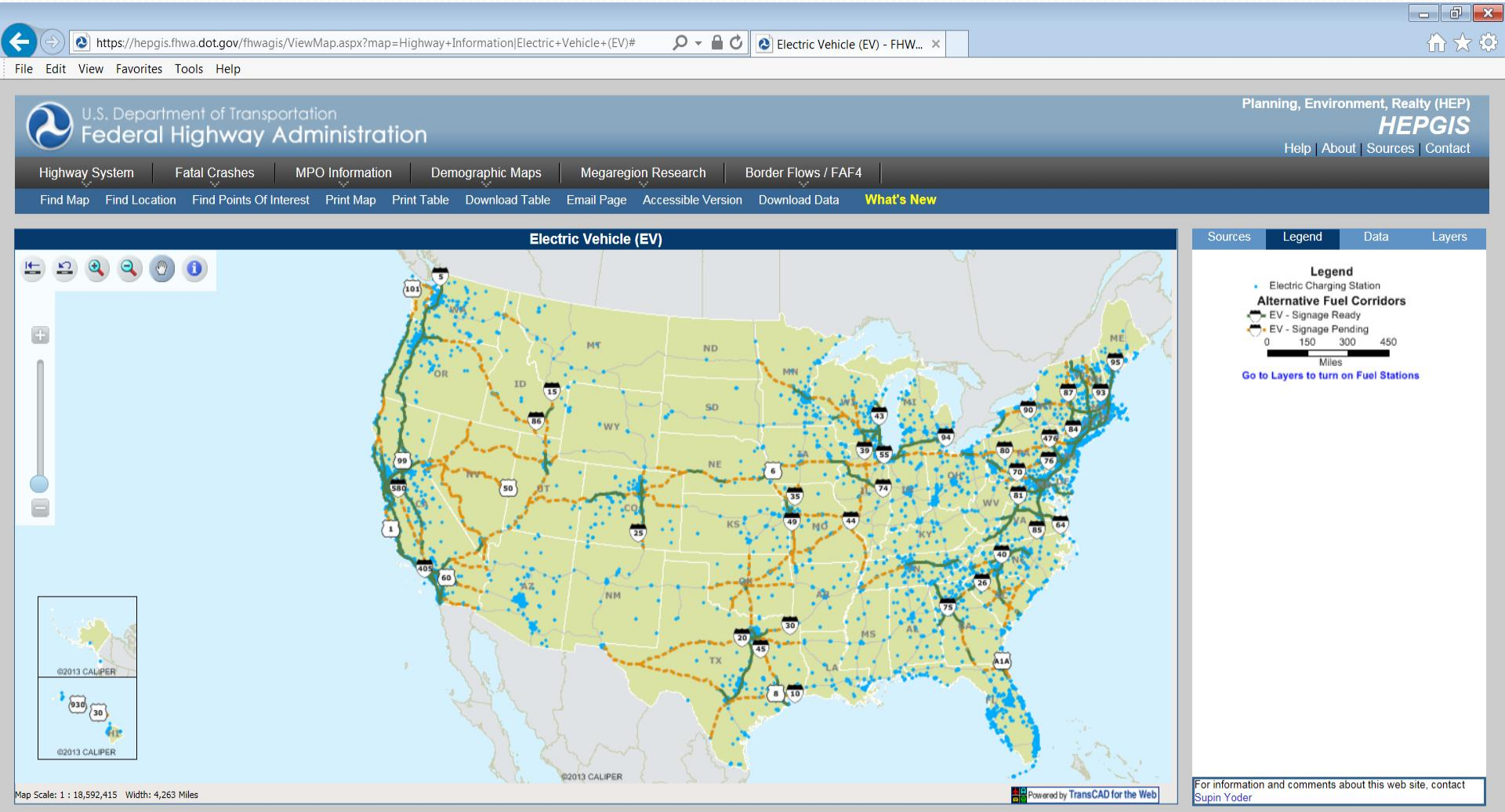
FY 2016 Nomination Results

- 34 nomination packages received, with nominated corridors separated into two designation categories:
  - **Signage/Corridor-complete** – sufficient facilities on the corridor to warrant highway signage;
  - **Signage/Corridor-pending** – currently insufficient facilities on the corridor to warrant highway signage.
- Designations….
  - Include portions/segments of 55 Interstates and a few state roads/highways
  - Comprise 36 states plus D.C.
  - Cover ~85,000 miles of the National Highway System
- This initial phase focused on interstate highway designations (many state highways and roads were nominated)
- Decisions based on DOE's ***Alternative Fuel Station Locator*** database

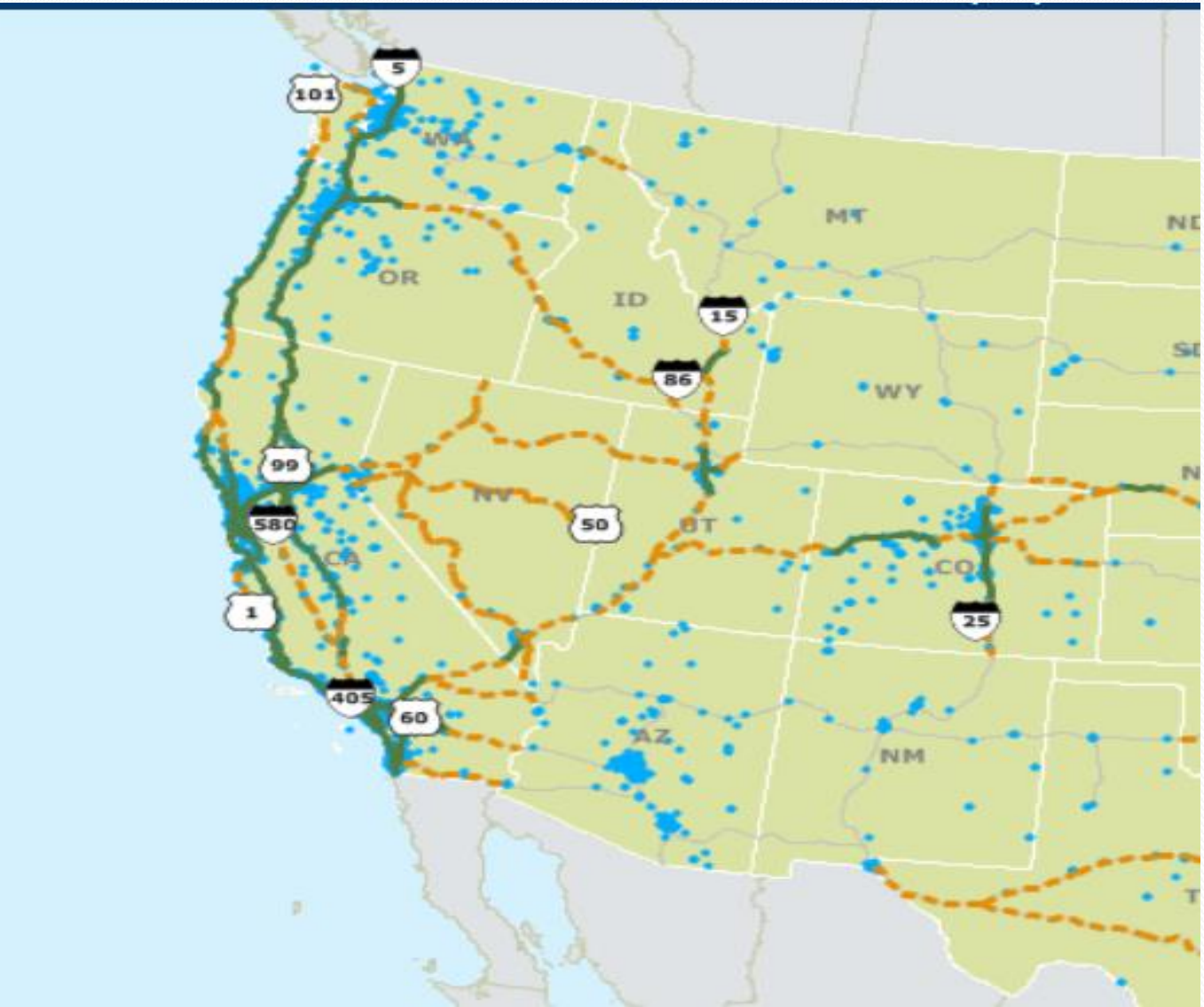
"Signage/Corridor-Complete" Criteria for 2017 Nominations

EV	CNG	LNG	Hydrogen	Propane
DCFC only	150 miles between stations	200 miles between stations	100 miles between stations	150 miles between stations
50 miles between stations	5 miles from highway	5 miles from highway	5 miles from highway	5 miles from highway
5 miles from highway	Public stations only	Public stations only	Public stations only	Public stations only
Public stations only *(no Tesla)*	Fast fill, 3,600 psi			Primary stations only

FHWA GIS EV Corridors



EV Corridors in Western States



Legend

Electric Charging Station

Alternative Fuel Corridors

EV - Signage Ready

EV - Signage Pending

0 150 300 450

Miles

Go to Layers to turn on Fuel Stations

2017 Request for Nominations

- **Process**
  - Defined in FHWA Request for Nominations (RFN) notice (released Sept. 22, 2017)
  - Distributed through **FHWA Division Offices**
  - Provides ability to nominate new corridors or add fuel types to existing corridors
  - Due date was **November 30, 2017**

2017 Request for Nominations (con't.)

- Can be submitted by **ANY state or local official**.
- Focus is on **Interstate highways** but allows for a compelling case to be made for other highways.
- **State DOT** with jurisdiction over corridor must be aware and supportive of nomination.
- **Multi-state and regional** applications/approaches are encouraged.
- A **plan for signage** on the corridor is required.
- **GIS Shapefile** information:
  - Should be available from your State DOT
  - Additional guidance in RFN

2017 Request for Nominations (con't.)

- **Signage/Corridor-ready** corridors should have 2-3 stations and be at least 150 miles in length – or entire length of corridor in a State, if less (final classifications will be made on a case-by-case basis).

- **Signage/Corridor-pending** corridors – if no facilities, then must submit a plan/timeline for build-out.

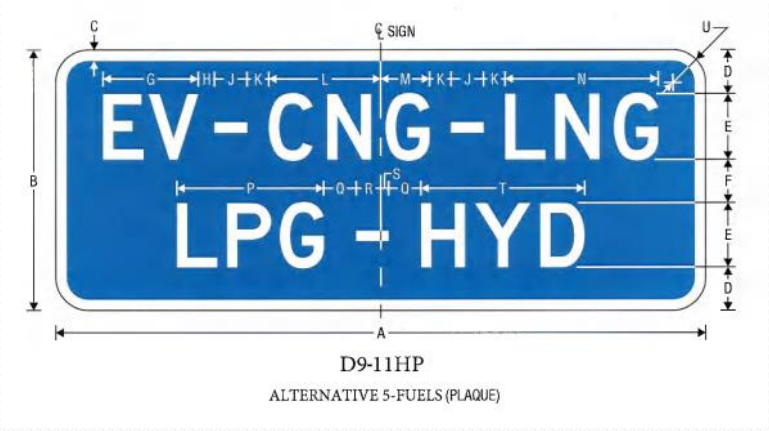
- EV corridor nominations – encourages coordination with **Electrify America** on targeted Interstates.

- **Public and private sector coordination** – working with state and local agencies, Clean Cities Coordinators, and other stakeholders.

- Coordinate with state **freight plans and/or long-range transportation plans.**

Highway Signage

- MUTCD Memorandum – Signing for Designated Corridors
  - Provides guidance to State DOTs
  - First Corridor signs installed on I-94 and I-26
  - Some questions remain on General Service & Specific Service exit signage
  - FHWA is developing additional guidance (FAQs)



First Corridor Signs Installed

I-26 (South Carolina)

I-94 (Minnesota)

2017 – Preliminary Information

- **24** nominations received – mostly from State DOT's (others from state environmental and energy agencies, MPO's, 1 Governor's Office and 1 Economic development Authority

- **14 new lead applicants**: AL, AR, AZ, DE, IA, KY, LA, MI, ND, NJ, OH, RI, WI and WY
- **10 repeat states:** CA, GA, HI, MD, NC, NY, OK, PA, TN and TX

- **8 new states**: AL, AR, AZ, KS, KY, LA, ND and WY

- FY 2016 and FY 2017 nominations represent **44 states plus the District**

FHWA Alternative Fuel Corridors

- **Next Steps**
  - Reviewing and analyzing the 24 nomination proposals
    - FHWA/Volpe team, along with NREL
  - Selections announced in early 2018
  - Meetings with industry groups/key stakeholders (Feb/on-going)
  - 5 Regional/Local convening's during 2018
  - Working with stakeholders in priority areas to prepare for future round of nominations
    - Florida, Indiana, Western/Mountain EV Corridor MOU States, and remaining states with no corridors

For More Information

DOT Alt Fuel Corridor Team Contact Information

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Volpe Center
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stephen.costa@dot.gov

Resources

FHWA Alternative Fuel Corridor website:
http://www.fhwa.dot.gov/environment/alternative_fuel_corridors/

MUTCD Memorandum – Signing for Designated Alternative Fuel Corridors:
https://mutcd.fhwa.dot.gov/resources/policy/alt_fuel_corridors/index.htm

DOE/NREL Alternative Fueling Station Locator:
https://www.afdc.energy.gov/locator/stations/

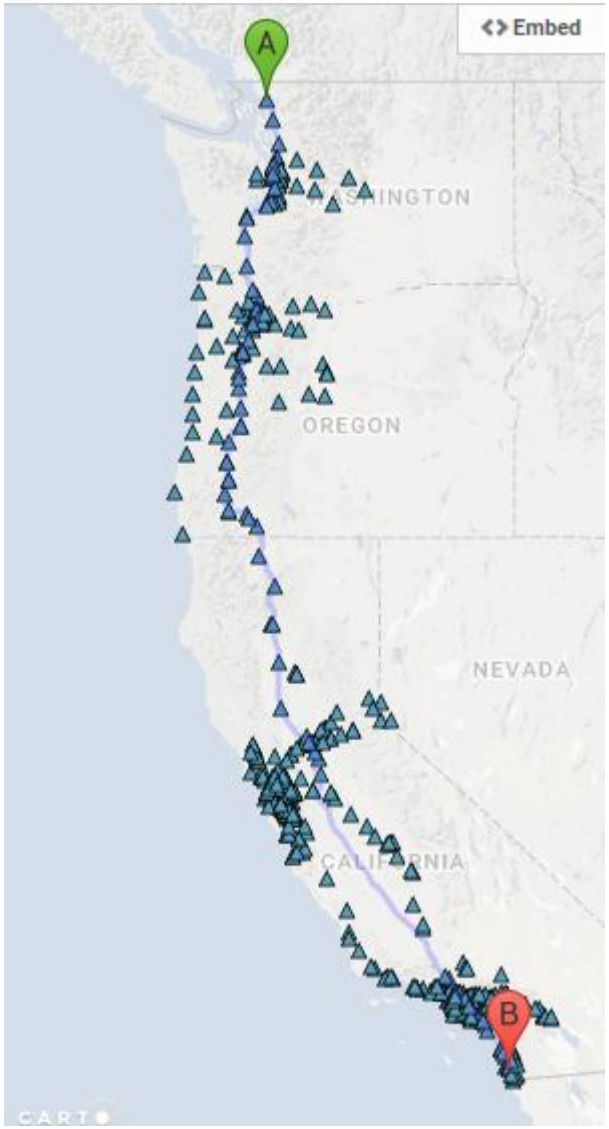
West Coast Electric Highway

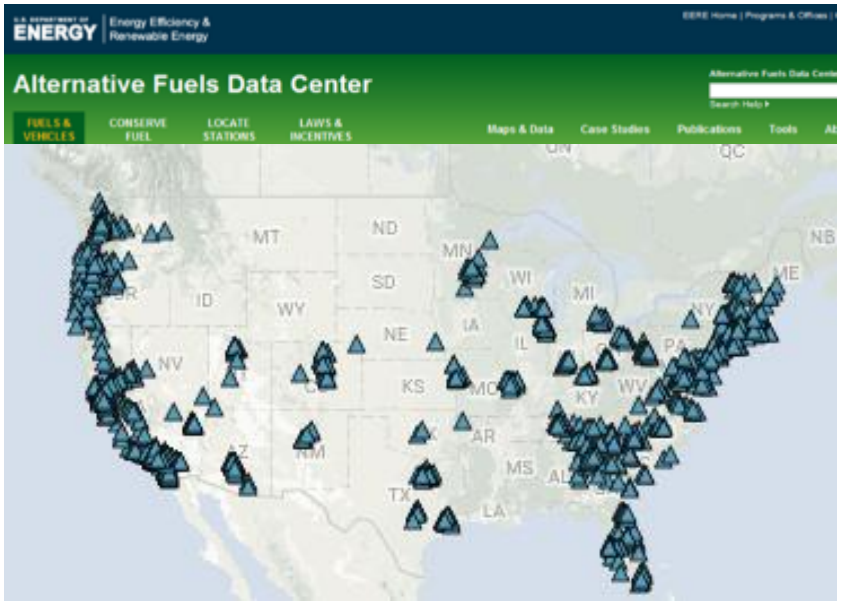
Webinar: Electric Vehicle Corridor Planning in the Western United States

TONIA BUELL
PROJECT DEVELOPMENT MANAGER
WSDOT INNOVATIVE PARTNERSHIPS

January 22, 2018

Electric Vehicle fast charging locations





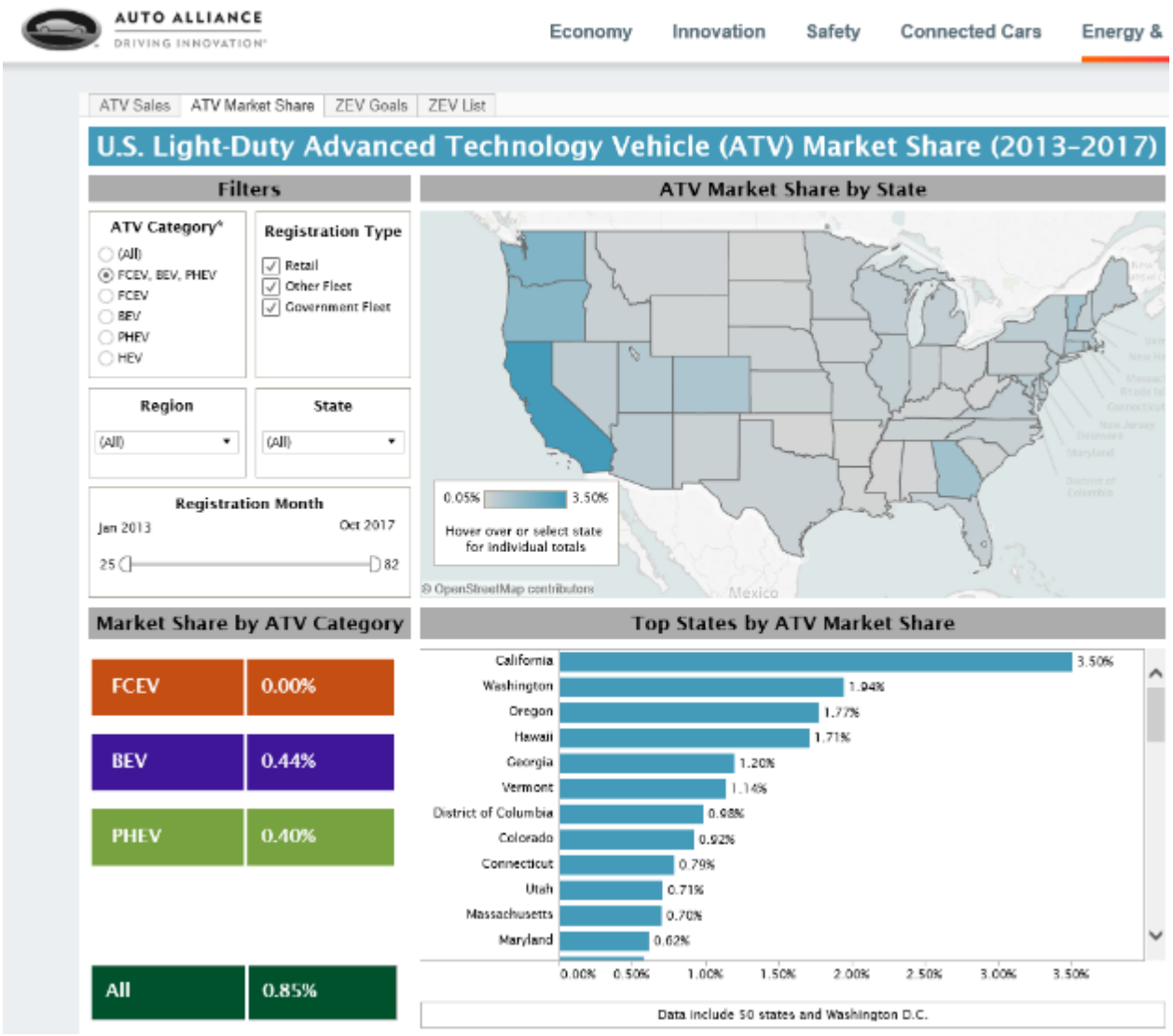
www.afdc.energy.gov/fuels/electricity_locations.html 1/21/18

West Coast is home to 41% of Nation's 1,405 DC Fast Charge Sites*

Washington	60
Oregon	88
California	427
Tri-state total	**575**

** Not including Tesla Superchargers*

Electric Vehicle Market Share

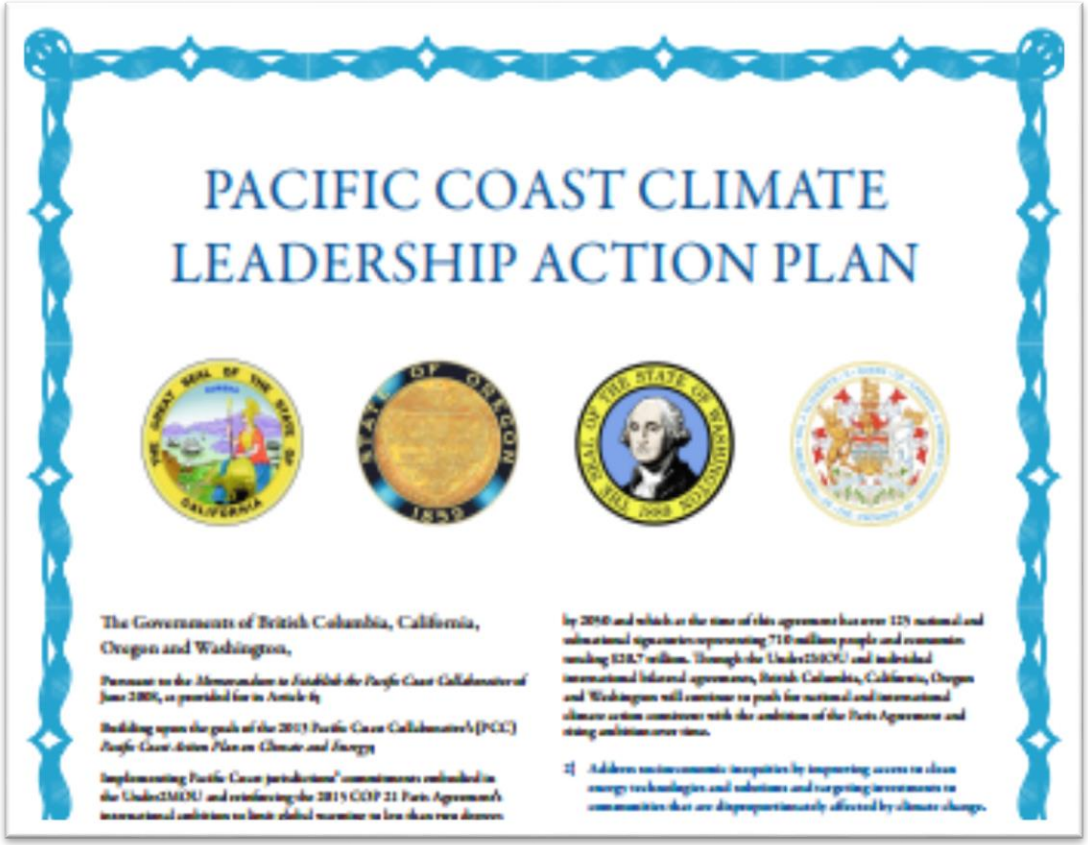


Today’s presentation

West Coast Electric Highway

- Overview
- Regional collaboration
- Best practices and lessons learned

Leaders of Pacific Coast Collaborative reach 2008 agreement for regional action



PACIFIC COAST CLIMATE LEADERSHIP ACTION PLAN

The Governments of British Columbia, California, Oregon and Washington,

Promoting clean fuels from BC to BC

West Coast Partnerships:

- Promotes petroleum reduction and sustainable transportation solutions on I-5 / Hwy 99 corridor
- Provides travelers with alternative fuel infrastructure
  - CNG
  - Hydrogen
  - Biodiesel
  - Electricity
- Green Highway from British Columbia, Canada to Baja California, Mexico “BC to BC”
- West Coast States, Province, and Cities

Hydrogen fuel cell vehicles in Olympia, Washington on the Hydrogen Road Tour.

June 1, 2009

West Coast Electric Highway

Accelerating EV adoption by promoting robust charging corridors.

Connecting Communities and Enabling Long Distance Travel

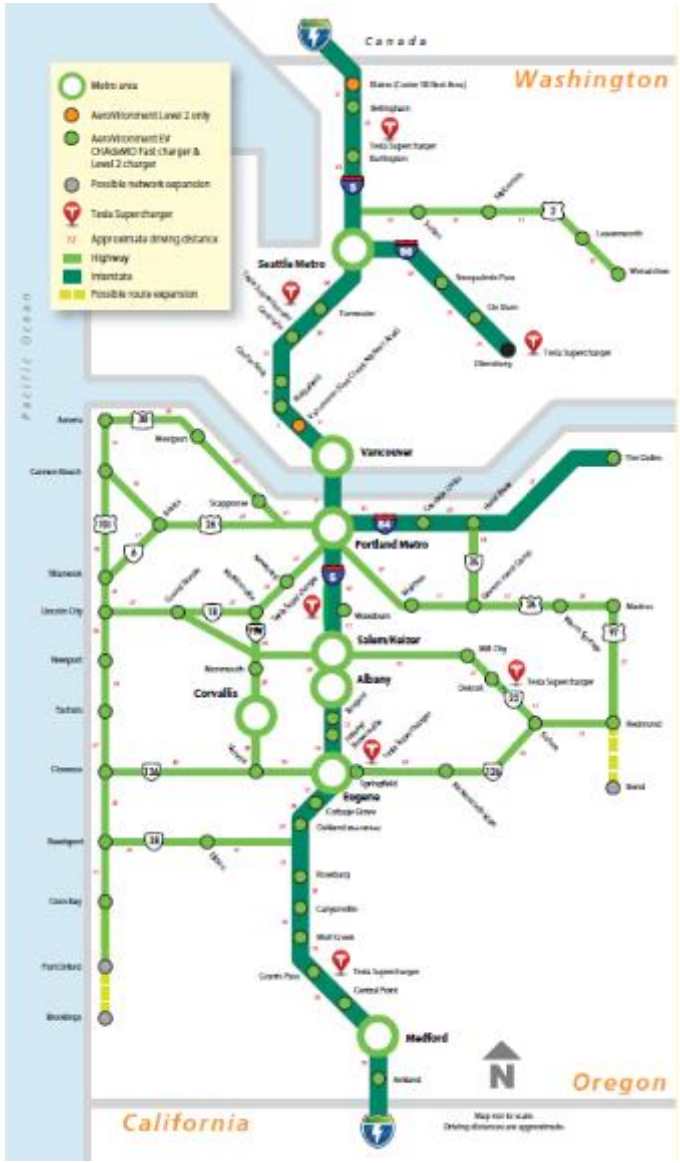
Seamless EV Driver Experience

- Equipment Specifications
- Highway Signs
- Branding and Marketing

I-5, Hwy 99, US 101, and other major highway corridors

Common vision, patchwork of funding and projects

West Coast Electric Highway



EV Charging Locations
Fast charging stations at retail sites every 35-50 miles along I-5.

Charging Equipment: AeroVironment
50kw DC fast charger (CHAdeMO)
Level 2 EVSE (J1772)

Federal Funding: 3 Grants
Washington: $1.6M USDOE ARRA
Oregon: $1M+ USDOE
$3M+ FHWA TIGER II

Partners:
- WSDOT/ODOT
- AeroVironment
- 22 Electric Utilities
- 57 Host sites
- EV Drivers

Opened for public: 2012

EV highway charging networks enable long-distance travel

Bellingham, Exit 252
Sehome Village

Tumwater, Exit 102
Shell Station and Deli Mart

Centralia, Exit 82
Wendy's

Burlington, Exit 229
Outlet Shoppes at Burlington

Castle Rock, Exit 49
Cascade Select Market

Ridgefield, Exit 14
Country Café

EV charging networks promote economic development and tourism

Sultan Visitor Information Center

Skykomish Sky Deli

Snoqualmie Pass Chevron

Leavenworth City Hall

Wenatchee Convention Center

Cle Elum Suncadia Resort

Best Practices and Lessons Learned

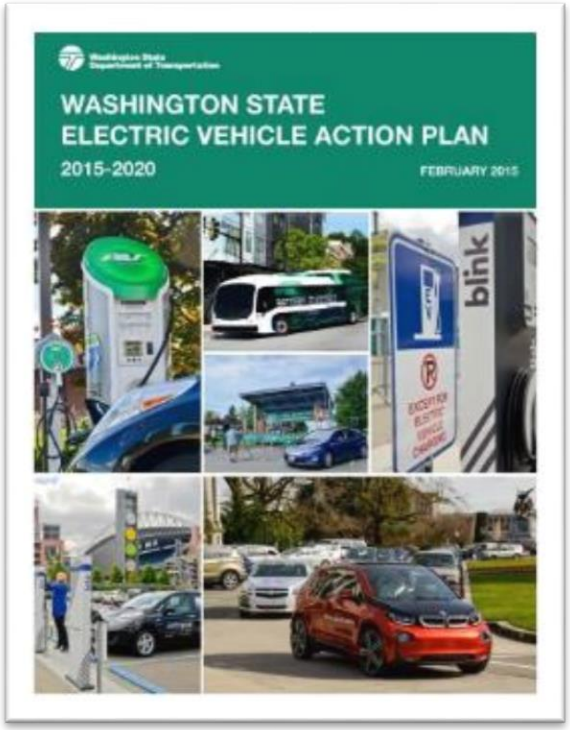
“Tonia’s Top Ten”

1. Create clear vision and purpose
2. Collaborate with partners
3. Engage electric utilities
4. Carefully select sites
5. Account for weather and terrain
6. Promote charging network
7. Encourage EV sales
8. Use public-private partnerships
9. Provide consistent signage
10. Plan for the future

1. Create clear vision and purpose

The EV driver's experience should be paramount

- Make network streamlined, convenient, and straightforward, and reliable



When developing EV charging corridors:

- Have an EV readiness or deployment plan.
- Anchor corridor with at least 1 EV-ready metro area.
- Target urbanized areas (cities/towns) along route.
- Begin by deploying within regions, then expand to connect regions over time.
- Easiest corridors are about 200 miles or less, so they could be travelled w/ only 2 fast charges.
- Find retail centers where 3-phase power exists.
- Have overlapping EVSE coverage.

2. Collaborate with partners

Establish partnerships among electric utilities, businesses, federal/state/city governments, transportation industry, community based organizations, car manufacturers and dealers, researchers, associations and EVSE providers.

3. Engage electric utilities early and often

Identify your target areas for charging along the corridor and work with electric utilities to:

- Find potential sites, transformers
- Determine electrical upgrades needed
- Provide customer information and outreach
- Offer incentives/rebates
- Consider electric utility vehicles

Considerations:

- Understand unique, location-specific issues and timelines.
- Beware of expensive electric utility demand charges and negotiate for lower rates, time of use rates

4. Carefully select sites

Fast-Charge Site Criteria:

- Within ½ mile of highway interchange
- Safe and convenient access
- Parking spaces
- Restrooms and drinking water
- Shelter and lighting
- 480V 3-phase electric power supply
- Customer amenities (food, traveler info)
- 24-7 Access

Use data for investment decisions:

- University of Washington
- Idaho National Labs

Host Site Partners:

- Plan for long lead time for host site agreements: negotiating leases, utility easements and operating agreements.
- Work with a regional store chains with multiple locations along the corridor (Fred Meyer, IKEA, Walmart).
- Install chargers near transformers to keep costs to a minimum (trenching, cutting concrete).

5. Account for weather conditions & terrain

Prepare for:

- Cold, wet or mountainous locations effect installation costs and scheduling, operations, and driver experience.
- Have agreements in place for snow removal.
- Don’t place EVSE under rookery trees.

6. Promote your charging corridor

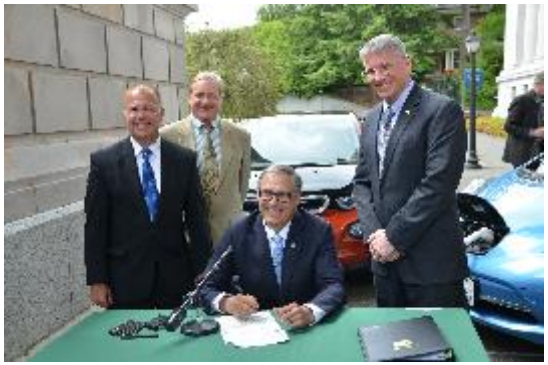
Work with partners to host:

- Community meetings
- Groundbreaking events
- Media press conferences
- Ribbon cuttings
- Special events
- All electric road rallies

7. Encourage EV sales and incentives

Work with partners to:

- Encourage legislators to provide **incentives** such as **rebates** and **sales tax exemption** on the purchase price of new clean cars.
- Create an **EV infrastructure pilot program** to provide financial assistance for EVSE.
- Require urban cities and counties to adopt incentive programs to encourage **EVSE-ready installation in new buildings** and renovations.
- Encourage investor-owned, municipal and public utility district **leadership in EV charging** infrastructure.
- Transition public and private **fleets to electric**. Aim for 10% of new vehicle purchases.



WEST COAST ELECTRIC FLEETS

8. Install highway, street & on-site signs

Roadway Directional Signs

State Highways, Local Roads, City Streets

D9-11b (alternate) EV Charging Station Symbol

British Columbia

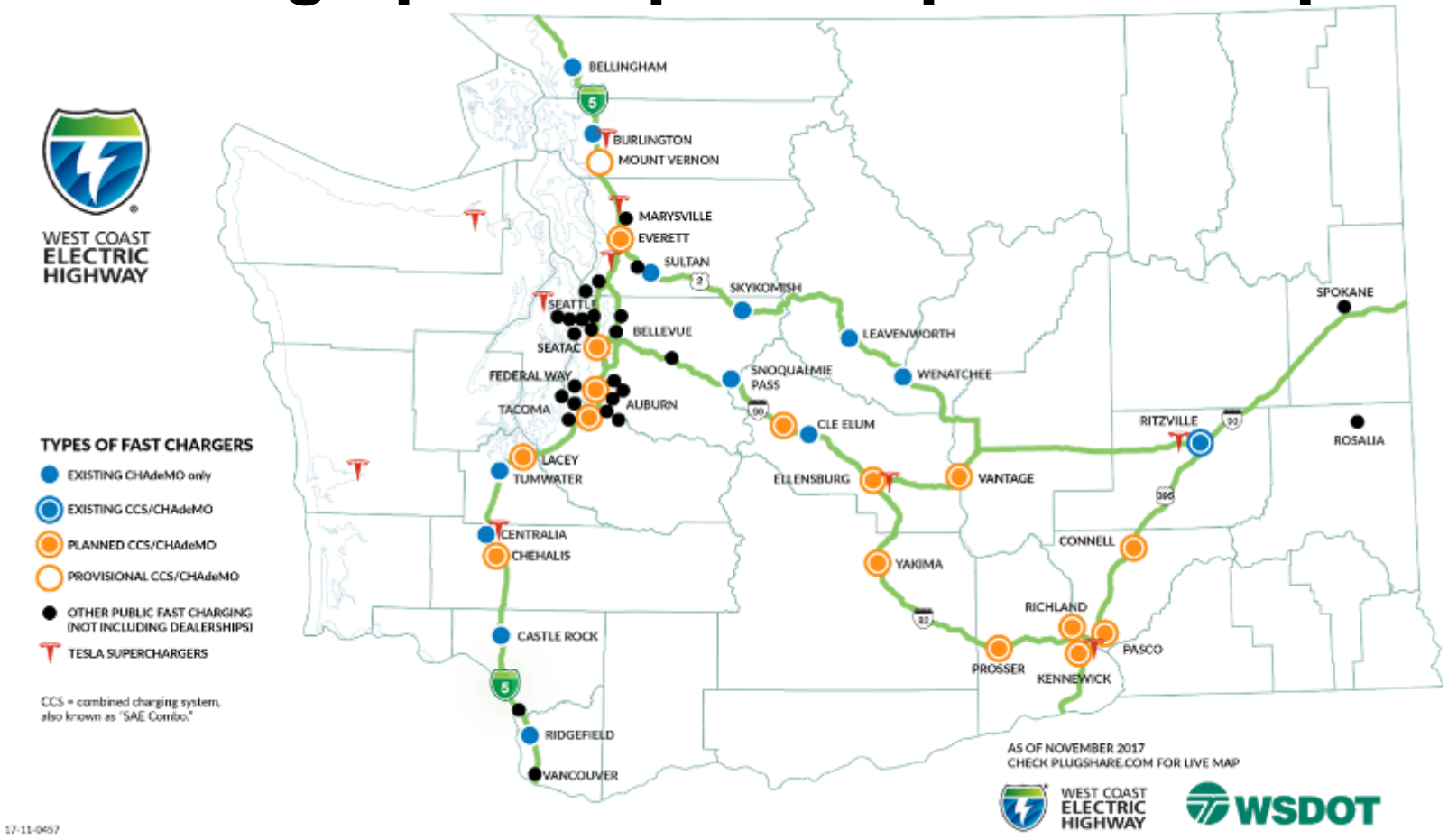
Regulatory Signs & Striping

"No Parking Except Electric Vehicle Charging"

Washington state law "de-ICEing bill" (SB 5849)

www.westcoastgreenhighway.com/evsigns.htm

9. Leverage public-private partnerships



- Washington's Electric Vehicle Infrastructure Pilot Program uses a portion of the annual electric vehicle registration fee to provide matching grants.
- $1M in state funding used to encourage private sector investment for 15 new locations totaling $2.5M in investments.

10. Plan for the future

Extreme Fast Charging (XFC)

Electric Vehicles

- More variety (makes and models)
- More pricing options (low to luxury subscription)
- More driving range (FF91 375 Miles)
- Bigger battery packs (FF91 130 kWh)
- More shared EVs (TNCs)
- More autonomous driving features
- More sales

Highway Charging

- More interstate coverage needed
- More investment needed
- Improved technology
- More charging plazas
- Farther DCFC spacing on corridors (70 miles)
- Faster DCFC charge time (20 minutes or less)
- Higher DCFC power levels (120 kW to 400 kW)
- Higher electricity demand charges
- Multiple fast charging standards

Thank you

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Electric Vehicle Corridor Planning in the Western US

REV West MOU

Maria Eisemann and Zach Owens

Colorado Energy Office

January 22, 2018

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Colorado Planning

Colorado Energy Office

Policy and Planning – Maria Eisemann

- Regional Electric Vehicle Plan for the West (REV West)
- Colorado Electric Vehicle Plan

Programming and Planning – Zach Owens

- Request for Applications for EV Fast Charging Corridors in Colorado

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Joint Action Regional EV Corridor

- Dec. 19, 2016, began as a joint action agreement between the Governors of Colorado, Utah and Nevada
    - over the next year develop complementary plans for building an electric vehicle charging network across key highway corridors in their states – 2000 miles of highway (70, 80, 15, 25, 76)
    - Shared information on VW settlement developments, studies, corridor station best practices and current progress
    - Decision to develop an MOU and reach out to other western states to join

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REV West MOU

- **Regional Electric Vehicle Plan for the West (REV West) October 12, 2017**
  - 8 states CO, UT, NV, WY, NM, AZ, ID, MT
  - Purpose: Provide a framework for creating an Intermountain West EV Corridor that will make it possible to seamlessly drive an EV across the Signatory States' major transportation corridors
  - Recognizes EV infrastructure will increase access to state's highways, promote tourism and recreation in our rural communities and support our economies

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REV West MOU

Activities

- Create best practices and procedures to address “range anxiety”; coordinate on EV charging station locations
- Create voluntary minimum standards for EV charging stations
- Identify and develop opportunities to incorporate EV charging station infrastructure into planning processes, such as building codes, metering policies, and renewable energy generation projects
- Encourage EV manufacturers to stock and market a wide variety of EVs with the MOU states
- Collaborate on funding opportunities

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REV West MOU

Status

- States have begun to meet
  - How to collaborate
  - Determine baselines
  - Summary of best practices
- MOU calls for a progress report on April 1
  - Collaboration will continue beyond this date

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Colorado Electric Vehicle Plan

Directs the development of a statewide Electric Vehicle plan

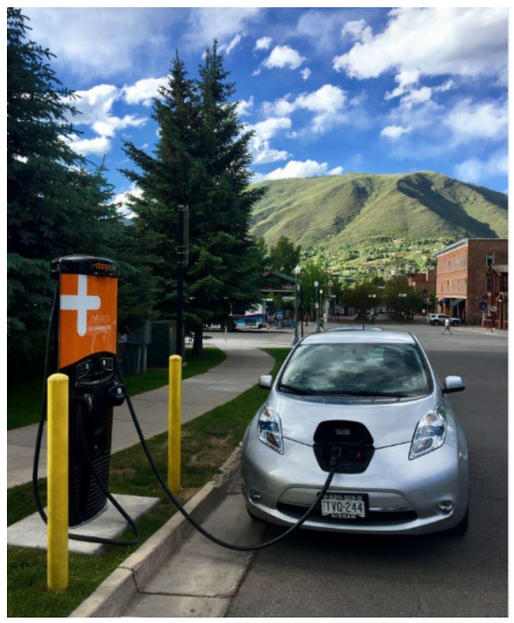
-To build out key charging corridors that will:

-facilitate economic development and

-boost tourism while reducing harmful air pollution

-Stakeholders saw opportunity and incorporated goals to also accelerate the adoption EVS

-Release end of January 2018



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Scenario Mapping and Modeling

- National Renewable Energy Lab (NREL) Study: *Electric Vehicles in Colorado: Anticipating Consumer Demand for Direct Current Fast Charging* used a Battery Lifetime Analysis Simulation Tool for Vehicles (BLAST-V) to model various scenarios for placement of DCFC along corridors.

Table 2. Hypothetical DCFC Networks Developed for BLAST-V Simulation-Based Evaluations

Name	Total DCFC Stations	Notes
Baseline	0	No stations
Existing	18	Existing (per Alternative Fuels Data Center)
Scenario 1	68	Existing plus 50 "traffic-based" stations
Scenario 2	49	Existing plus 31 interstate stations (based on CDOT FAST Act proposal)
Scenario 3	99	Existing plus 31 interstate stations (based on CDOT FAST Act proposal) plus 50 "traffic-based stations"
Scenario 4	96	Existing plus 31 interstate stations plus 47 highway stations (based on CDOT FAST Act proposal)
Scenario 5	146	Existing plus 31 interstate stations plus 47 highway stations (based on CDOT FAST Act proposal) plus 50 "traffic-based stations"

- Study available at https://www.nrel.gov/docs/fy17osti/68447.pdf

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NREL Scenario #4

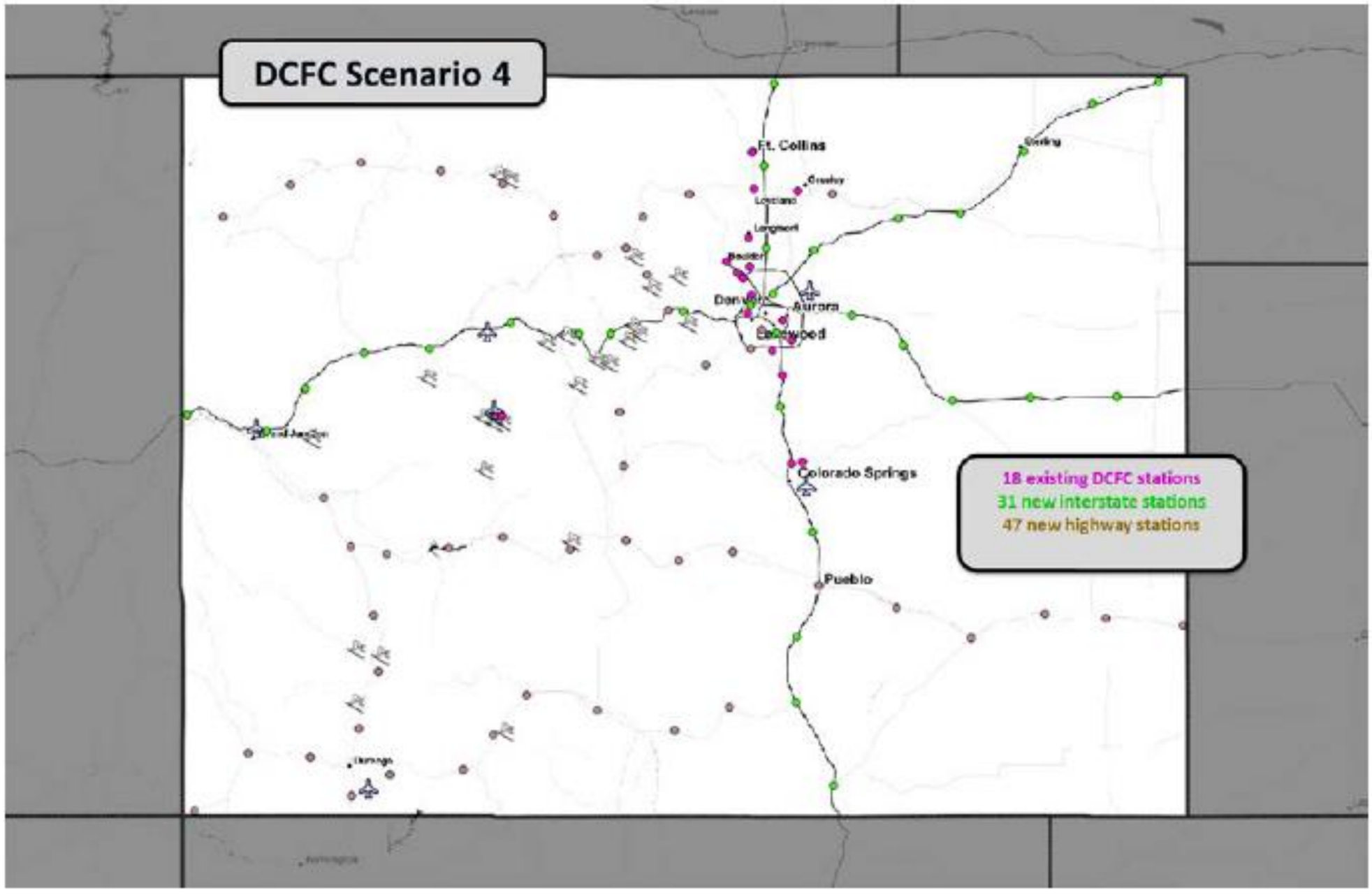

Figure 10. Scenario 4: Colorado's existing 18 DCFC stations plus 31 Interstate stations plus 47 highway stations (96 total stations)

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Scenario Mapping and Modeling

- Graduate Students at the University of Colorado Boulder modeled placement of stations every 30-50 miles while taking into account elevation, adverse conditions, daily traffic, and proximity to cities and towns. Modeled after California approach.
- Scenario 1 modeled placement every 30 miles in or near population centers which are likely to have amenities for EV charging customers. The average distance between stations is 32 miles.
- Scenario 2 assumed a greater range for EV batteries and the average distance between stations expanded to 46 miles.

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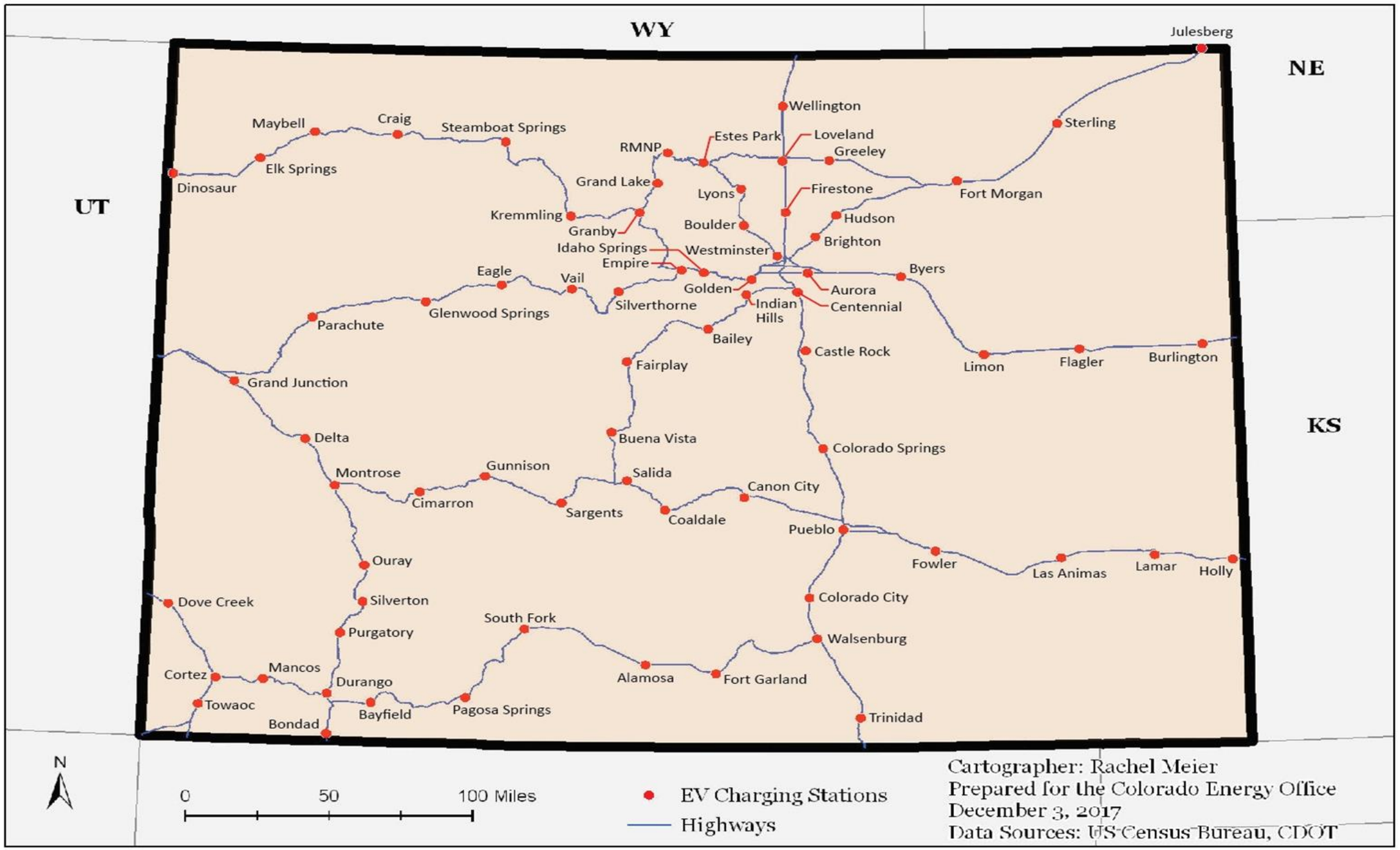
CU Boulder Scenario 1 Cities



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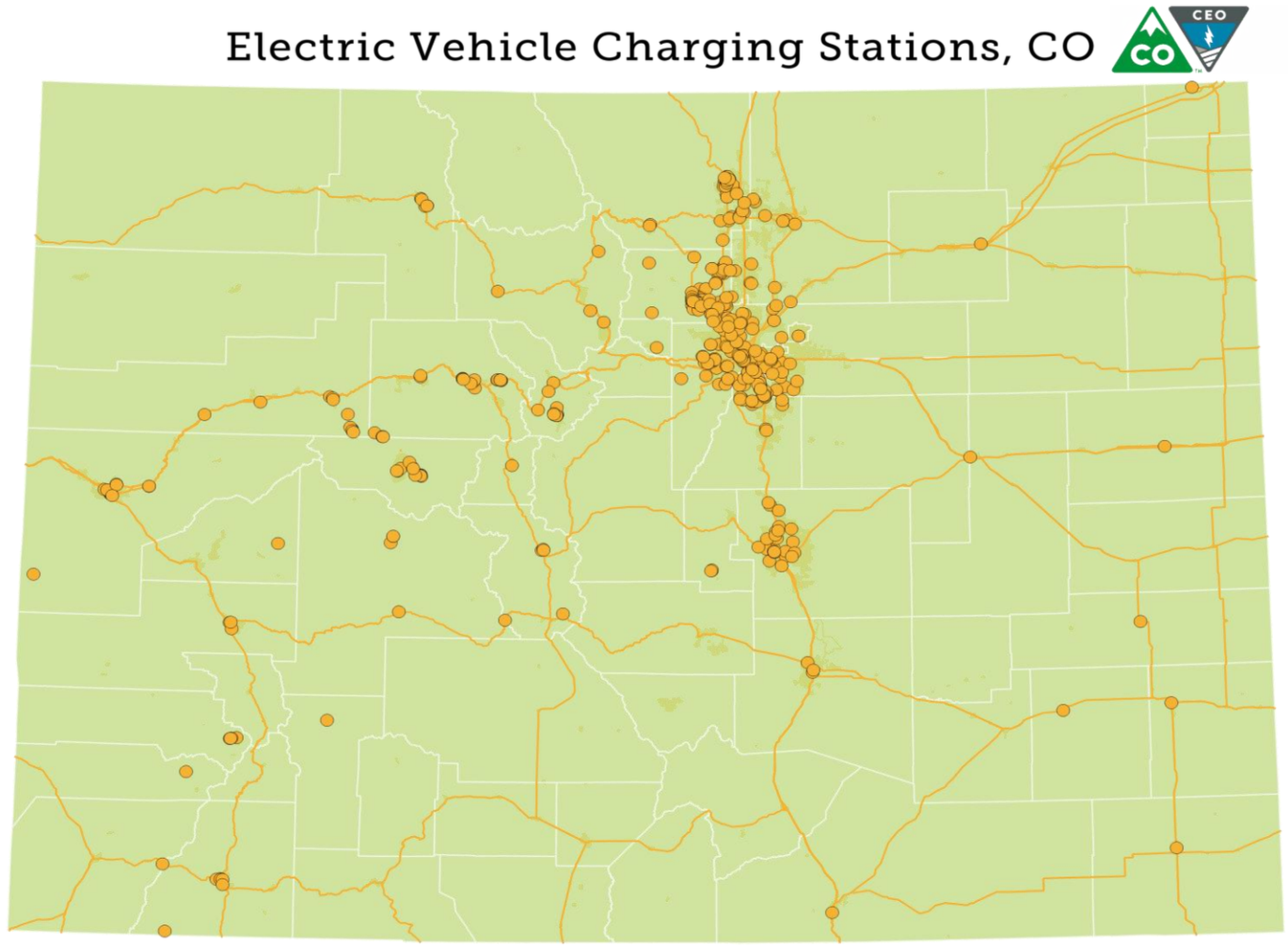
Charge Ahead Colorado - Community Charging

- Charge Ahead Colorado is a partnership between the Regional Air Quality Council (RAQC) and the Colorado Energy Office (CEO).
- Provides grants for Level II and DC fast-charging stations across the state and assists with purchase of EVs in the 7-county metro area.
- Visit http://cleanairfleets.org/programs/charge-ahead-colorado for more info



Map Source: CEO

CEO CO COLORADO Energy Office

CHARGE AHEAD COLORADO

REGIONAL AIR QUALITY COUNCIL

CEO's Next Steps

- Continued due diligence with technical experts, utilities, EV industry (equipment manufacturers), and other stakeholders to develop a Request for Applications (RFA) to provide grants to build DC fast-charging stations along Colorado's highways.
- Development of program framework and incentive levels is in progress.
- CEO Anticipates releasing the RFA by the end of Q1 2018.
- CEO is interested in speaking with utilities, industry experts, and other interested stakeholders to discuss DC Fast Charging policy and program development. Please contact zachary.owens@state.co.us to set up a discussion.

COLORADO
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The Colorado Energy Office

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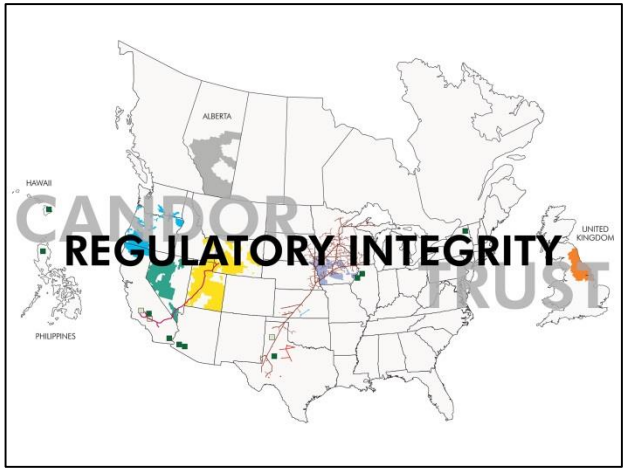


Electric Vehicles Corridor

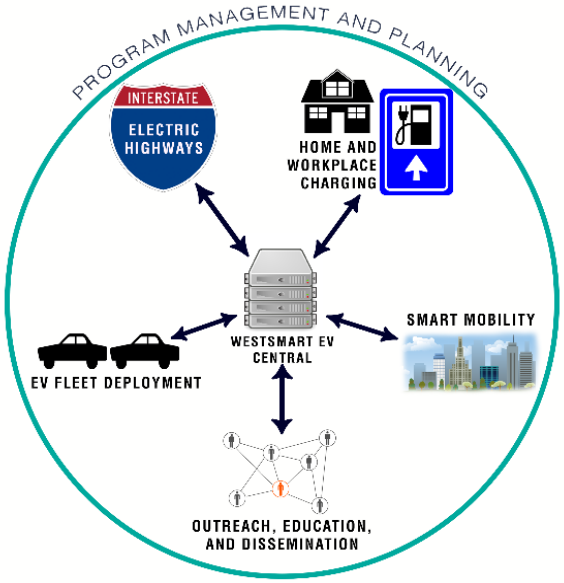
01/22/2018

James Campbell

PACIFICORP

WestSmart EV Program

- DOE award to coordinate aggressive rollout of PEV charging infrastructure across the intermountain west
- Leverages DOE funding, RMP incentives, private investment and public partnerships
- Targets
  - Double PEV growth rate from 20% to 40% (50,000 within 10 years)
  - Electric highway corridors
    - Utah, Idaho, Wyoming including national parks
    - 1,500 miles of DC fast chargers every 50-80 miles
    - Public Level 2 AC at least every 50 miles
    - Coordinated and connected to corridors in Colorado, Oregon, Nevada
  - Incentives for home and workplace charging, EV fleet conversion, downtown smart mobility with e-bikes, electric buses, EV ride hailing programs
- $4M DOE Cost share award, $10M RMP incentives and outreach



ROCKY MOUNTAIN POWER
Let's turn the answers on.

Utah State University

Utah Clean Cities
Alternative Fuels

THE UNIVERSITY OF UTAH

INL
Idaho National Laboratory

SALT LAKE CITY

BREATHE -UTAH-

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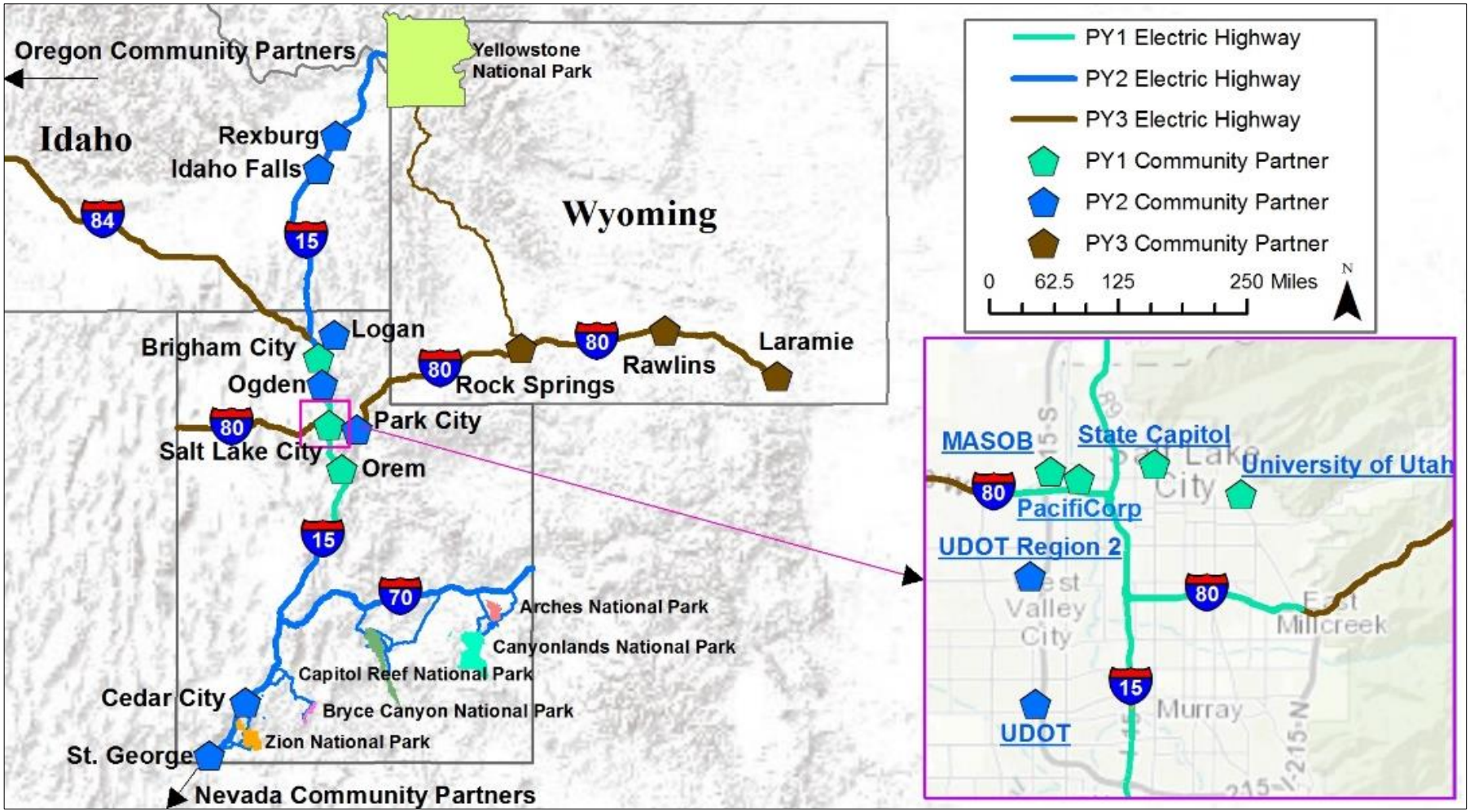
WestSmart EV 3-Year Phased Rollout



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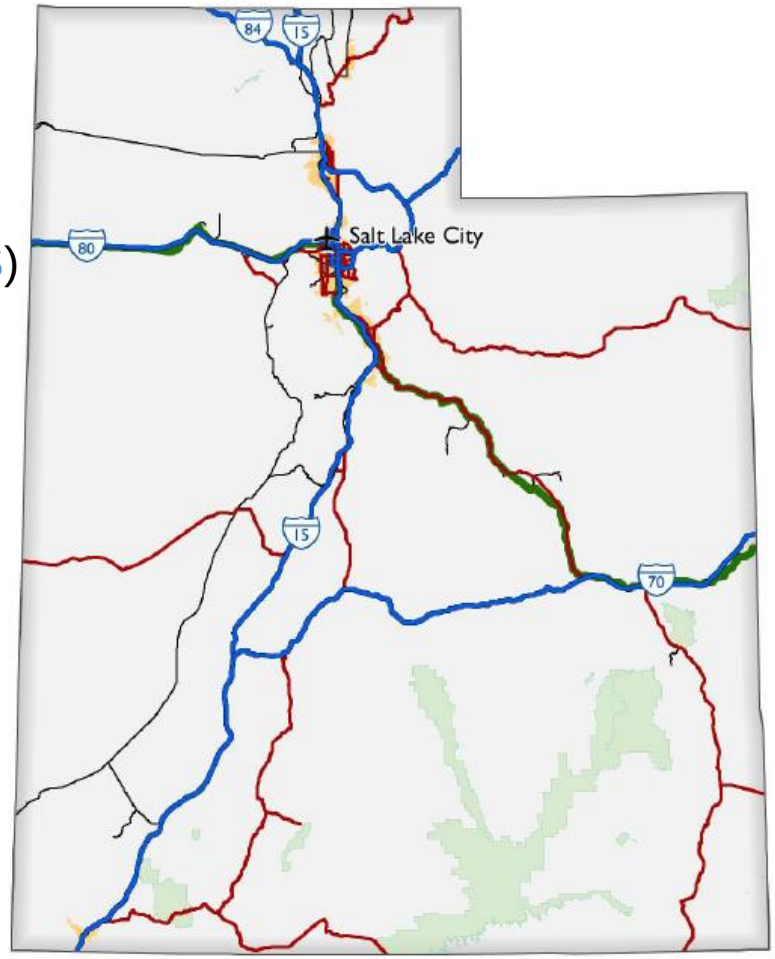
Utah transportation by the numbers

- Vehicles & drivers
  - Licensed drivers: 1.7 Million
  - Registered vehicles: 2.1 Million
    - 80% along Wasatch Front
    - PEVs: 4,200+ (10th in market share in US)
- Road miles in Utah
  - All public roads: 46,254
  - Interstate Highways: 1,100
  - US highways: 2,000
  - State Routes: 5,200
- Miles traveled
  - Average daily per person: 43.6 (2009)
  - Highway annual: 27 billion (2013)
    - >75% of total vehicle miles traveled
- National parks
  - Mighty 5 national parks, >15% growth rate
  - 4.3M visitors per year to Zion national park



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Summary of market need in Utah

Annual highway VMT	PEV % of LDV sedan market	Annual PEV highway VMT need	PEV highway MWh need per year	PEV highway EVSE peak power need	# of 50 kW DCFC plugs needed
30 billion	0.25%	45 million	11,250	3.72 MW	75
30 billion	1.0%	180 million	45,000	14.9 MW	298
30 billion	15%	2.7 billion	540,000	179 MW	3,575
30 billion	30%	5.4 billion	1,350,000	447 MW	8,938

- To consider
  - # plugs needed assume optimal location relative to traffic
    - Numbers can be scaled for higher power DCFC (e.g. 100 kW to 350 kW)
  - Today PEVs in Utah are at ~0.71% of market
    - Today, 37 single plug DCFCs in Utah (not optimally located)
  - Approx. 42 million MWh net generation, 9,000 MW capacity in Utah

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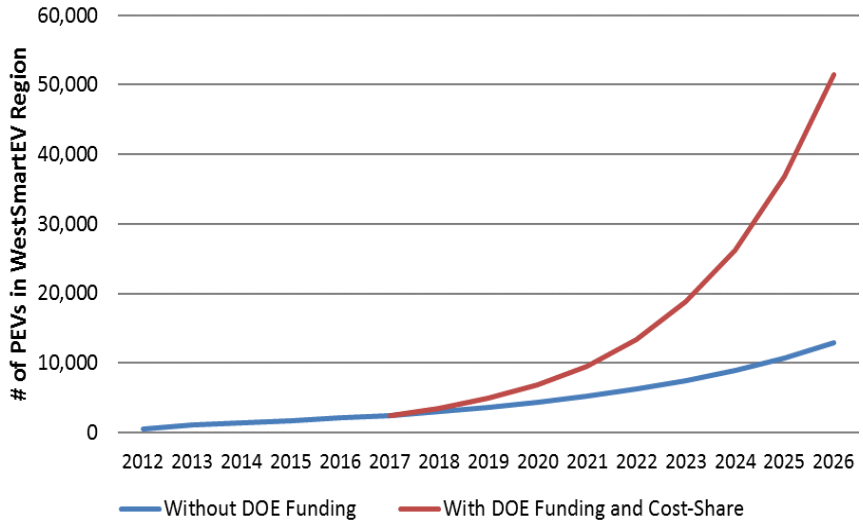
Overview

- Goal
  - Maximize growth rate of PEVs and EV miles traveled in Intermountain West region
- Approach
  - Determine optimal EV charging infrastructure rollout to minimize total cost and maximize benefit
    - Achieves close to 100% utilization at peak hours, more than 400 kWh and 15 charges per day per plug for 50 kW DCFCs
  - Inform and incentivize open market
    - Actively incentivize commercial partners at high ranking locations
    - Actively incentivize consumer vehicle adoption
    - Inform all of benefits using data driven approach
  - Iteratively update optimization model for EV infrastructure rollout based on new market data
    - Repeat process quarterly based on EVSE, EV sales, and survey data



Optimization of Charger Infrastructure

- Determining optimal placement of chargers:
  - Identify combinatorial space of possible charger locations and capacities
  - Utilize high-performance multi-objective optimization algorithms

  - Apply models for:
    - **Cost:** taking into account utility service conditions, economies of scale, business partners, existing and planned grid infrastructure
    - **Energy requirements:** based on road geography, conditions and usage
    - **Quality of service:** based on anticipated needs and feedback from EV drivers

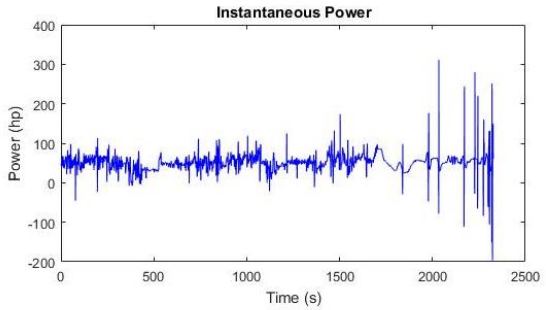
  - Apply machine learning to:
    - Incrementally improve models from EV driving and EV energy consumption patterns and general driver trip data

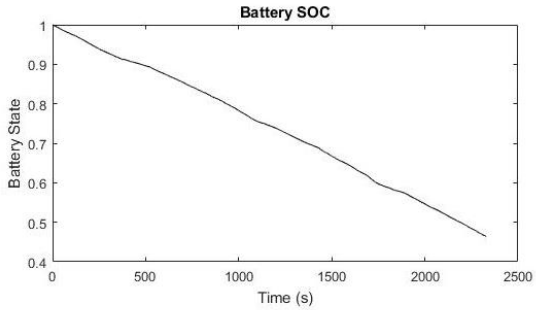
  - Build with extensibility in mind:
    - Rapidly increasing adoption rates
    - Higher kWh battery technologies
    - Higher power chargers (350+ kW etc.)
    - Integration of in-road charging

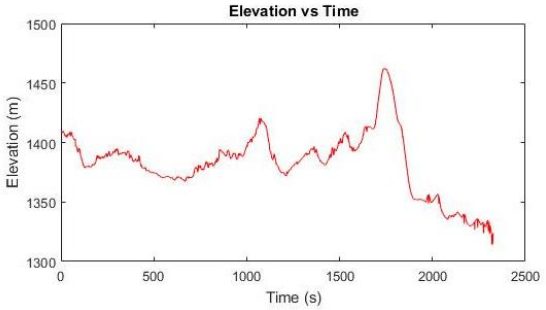
- Produce multiple pareto optimal solutions for working groups
  - Allow tradeoffs to be explored among costs and benefits

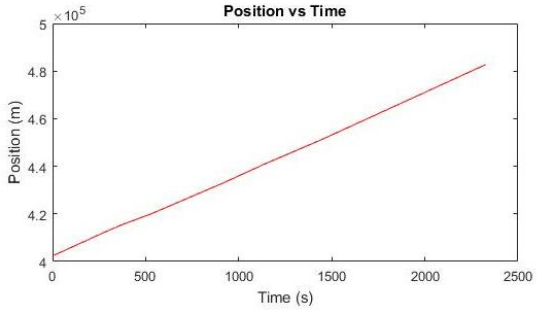
Vehicle analysis along corridors

- Accounts for
  - Air Drag
  - Powertrain inefficiencies
  - Regenerative breaking
  - Grade
  - Rolling resistance
  - Vehicle weight and inertia
  - Passenger weight
  - Air conditioner load (1 hp)









- Developed dynamic vehicle energy and power model for every mile, each direction, along corridors
- Validated vehicle models against highway and urban drive cycles for 10 vehicles
- Data shown above for a Chevy Bolt, near Beaver Utah, southbound

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Modeling assumptions and weighting

Traffic modeling

- 2015 average annual daily traffic (AADT) data
  - UDOT, ITD, WDOT
- 60% estimated to be light duty sedan
  - 40% estimated to be larger light duty to heavy duty
- Adjusted AADT along Wasatch Front to remove short range commuter traffic based on Census reports on commuting (~30-40%)
- Average vehicle speed estimated from speed limits and DOT data
- Peak hour volume (PHV) approx 12% of AADT

Energy and power analysis

- Vehicle SOCs approximately evenly distributed along corridor
- Included Tesla charging network, but limited to 30% of power need at location
- Energy need determined from localized vehicle energy model, AADT data, % light duty sedan, and % PEV
- Power need from average energy per day, multiplied by 2.9 (from PHV)

Scoring and weighting

- Utilization (unmet need)
- Even distribution (range extension)
- Connected corridor development
- Grid connection and installation costs
- User preferred exits
- National park access

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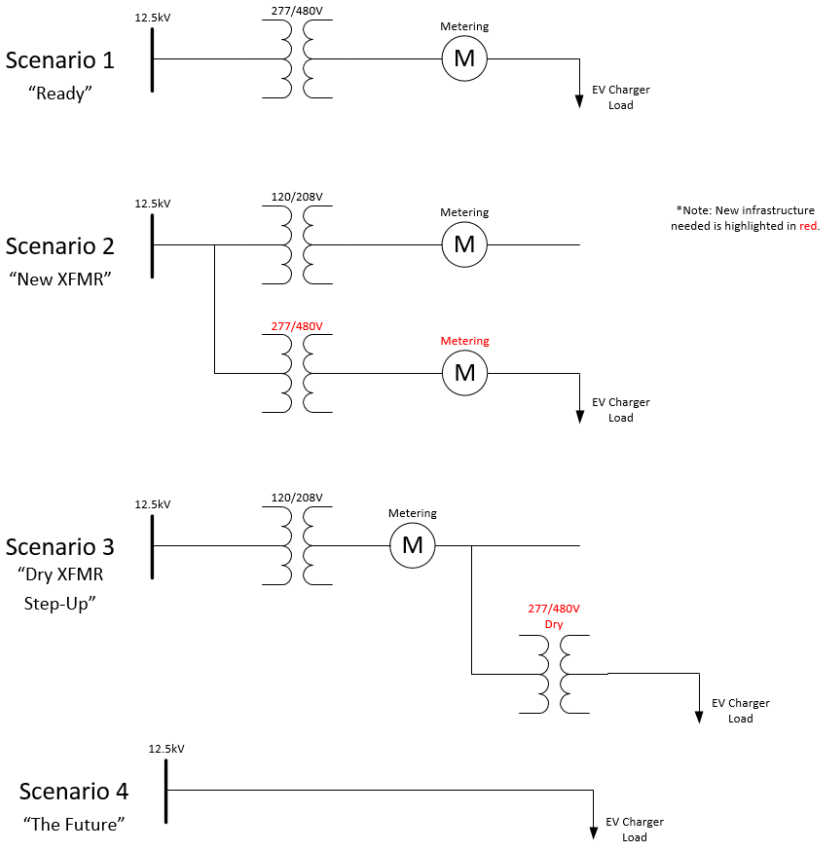
Grid connection analysis along corridors

- Analyzed detailed GIS data for RMP transformers near corridors
- Developed 4 cost screening scenarios
  - #1: Has 480V 3-phase power or direct connect
    - No utility cost (has capacity)
    - Incremental cost to upgrade transformer (needs capacity)
  - #2: Has 208V 3-phase power but not sufficient capacity, needs new transformer and metering cabinet
    - $12,500
  - #3: Has capacity and 3-phase power, but needs 480V dry-type transformer
    - $2,200 for up to 2 DCFC
  - #4: Direct connect (future)
    - No utility cost
  - Other: does not have 3-phase power
    - Not economical to bring in power for DCFC



Overview of Altfueltoolkit.org

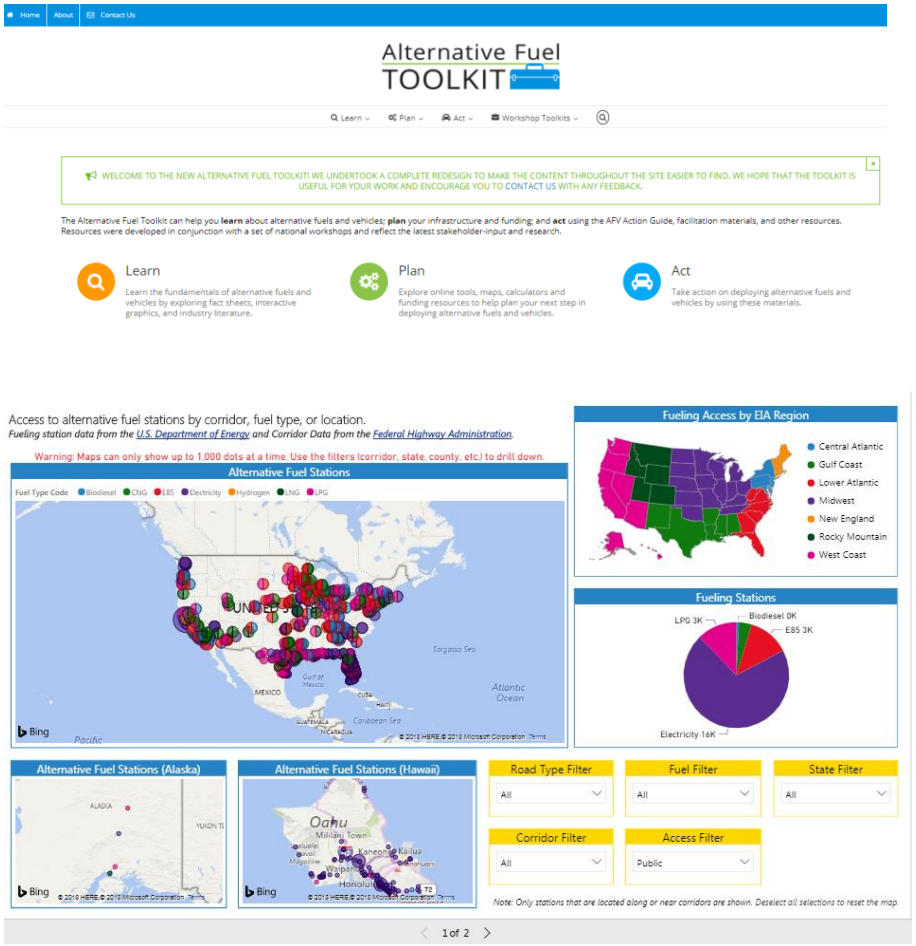
Purpose: provide state DOT, regional planners, and other transportation stakeholders with important information on alternative fuel planning.

Funders: Oregon DOT and FHWA plus 9 other state DOTs in a “pooled-fund”

Launched: in 2015. New version launched on Friday, January 20, 2018.

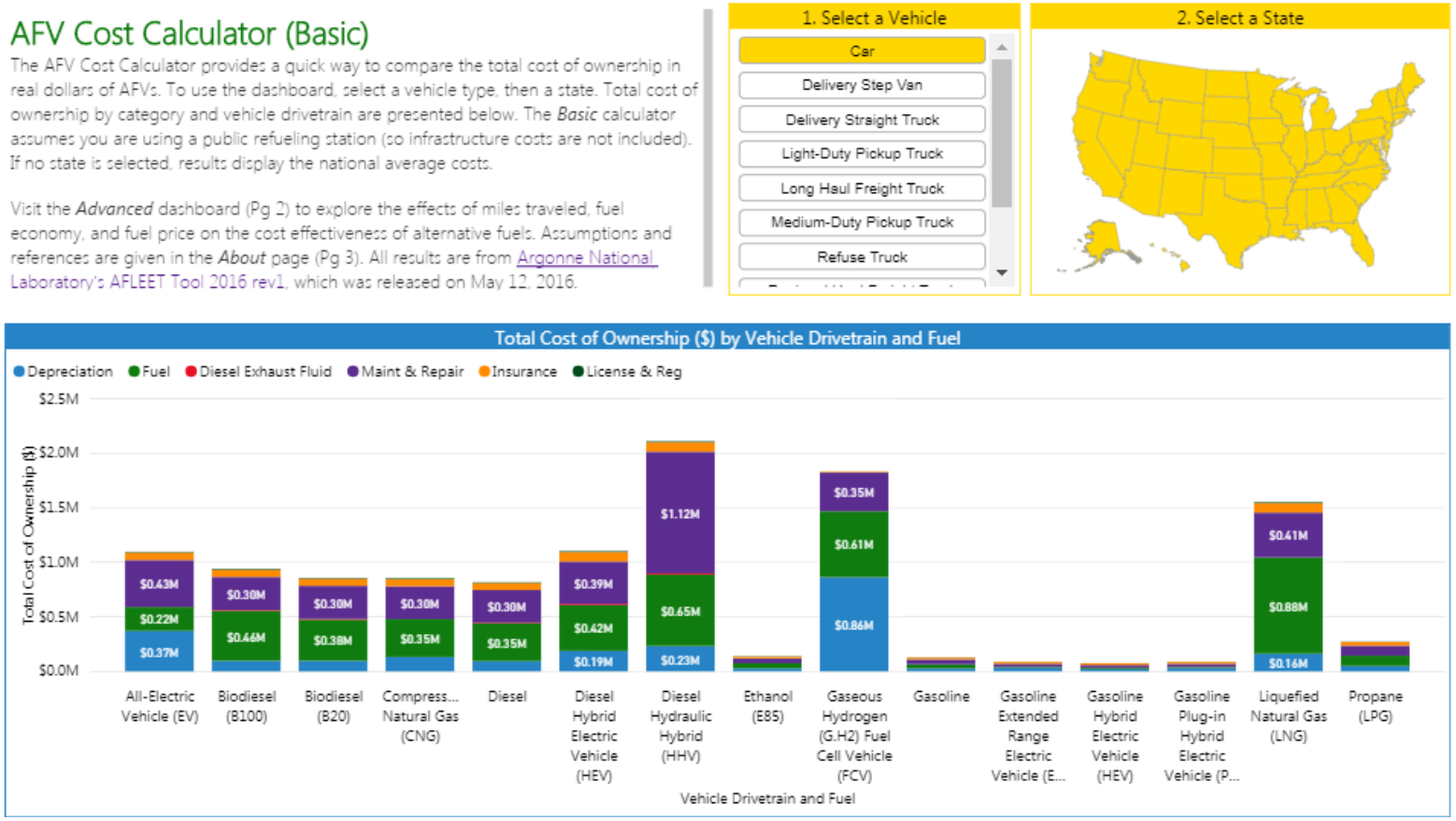
Main content:

- Foundational knowledge
- Fact sheets
- Online tools and maps
- Alt fuel timeline
- Case studies
- Action Guide



AFV Cost Calculator

Purpose: allows users to estimate total cost of ownership of alternative fuel vehicles for any state

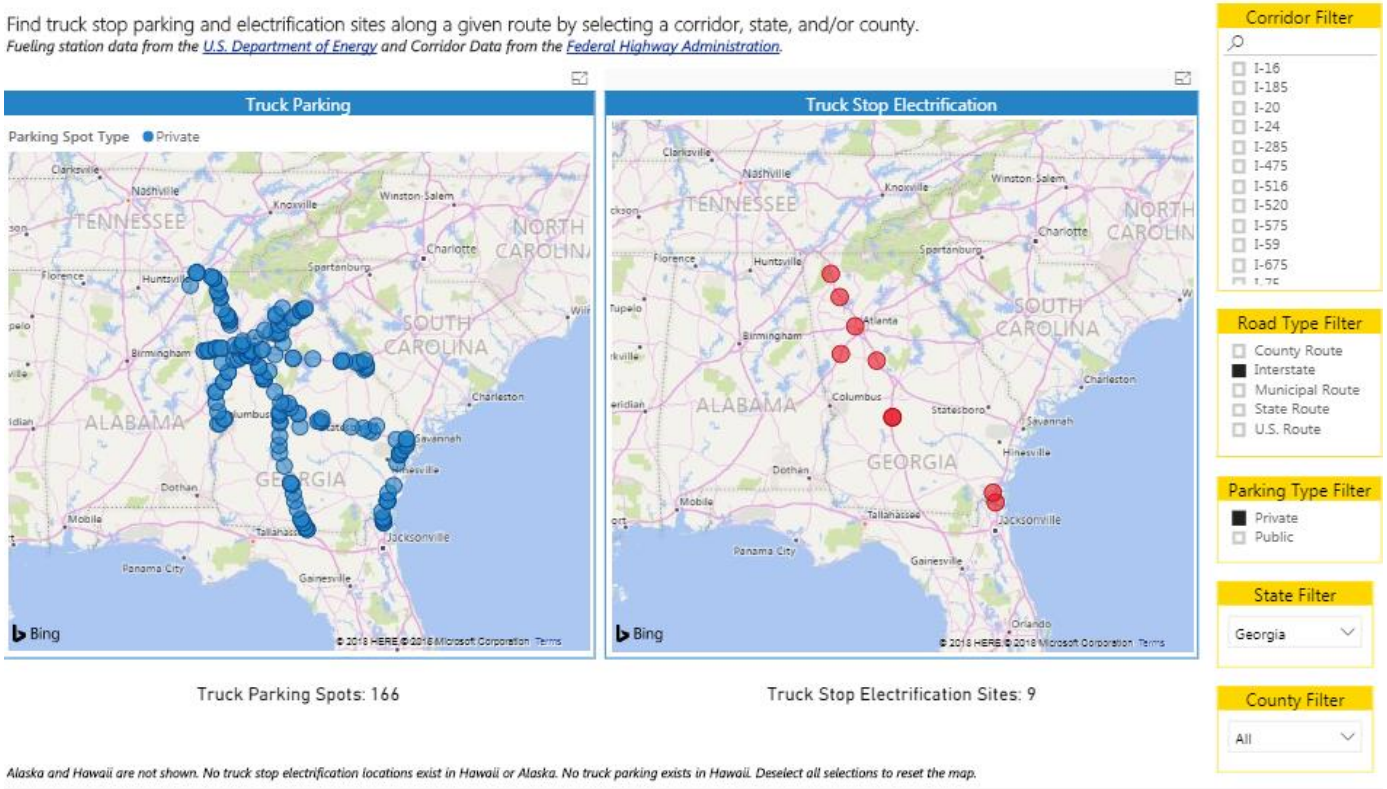


Timeline of Alternative Fuels

Purpose: provides history of alternative fuels in the United States from 1943 to today, including major legislation, scientific discoveries, and engineering feats.

Truck Parking and Truck Stop Electrification

Purpose: help planners understand where truck parking is located relative to current truck stop electrification sites. Filterable by corridor, state, public/private.



Questions for Speakers

Please submit questions via the chat box.

A recording of the webinar and slides will be posted to the altfueltoolkit.org website in the next few days.

Thank you!

A recording of the webinar and slides will be posted to the altfueltoolkit.org website in the next few days.

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