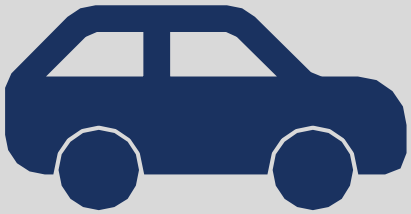


IDENTIFYING THE BENEFITS OF A CLEAN CORRIDOR

Prepared by:
Industrial Economics, Inc. (IEc)
Cadmus Group

Overview of Economic Analysis

Why measure benefits?

- Help decisionmakers understand "corridor-level impacts"
  - Uses simple, publicly available tools
  - I-80 as example – **proxy for national corridor**

What impacts did we quantify?

- Station Construction/infrastructure development (jobs and dollars)
- Station Operations (jobs and dollars)
- Avoided damages related to emissions (monetized social benefits)
  - Criteria air pollutants/health impacts
  - GHG/climate impacts

What did we miss?

- More benefits(!), such as local/specific impacts on communities, changes in expenditure patterns by EV owners…. Others?

Methodology

Baseline: 2018
Current I-80 Corridor

Scenario 1: 2019
EV and CNG Clean Corridor

Scenario 2: 2030
EV and CNG Clean Corridor

Estimate total number of alternative fuel stations

Estimate total VMT supported by stations

Calculate total emissions reductions

1. Calculate total economic impacts related to station construction and operations

2. Calculate total avoided emissions damages

3. Consider additional non-quantified benefits **[We are here]**

Baseline: I-80 Today

I-80 TODAY

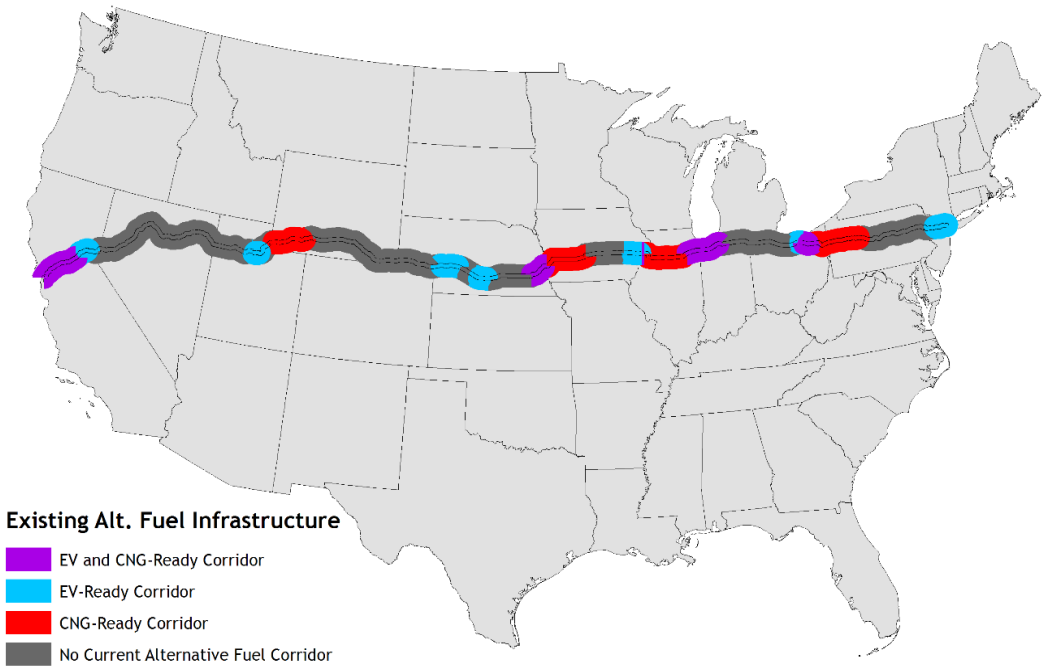
Total Miles: 2,900

- 590 miles EV-Ready
- 820 miles CNG-Ready
- 11% ready for both
- 2,600 miles to be improved

What would completing this corridor do for:

Jobs? Air quality?

Today? In the future?



EXISTING ALTERNATIVE FUEL LOCATIONS

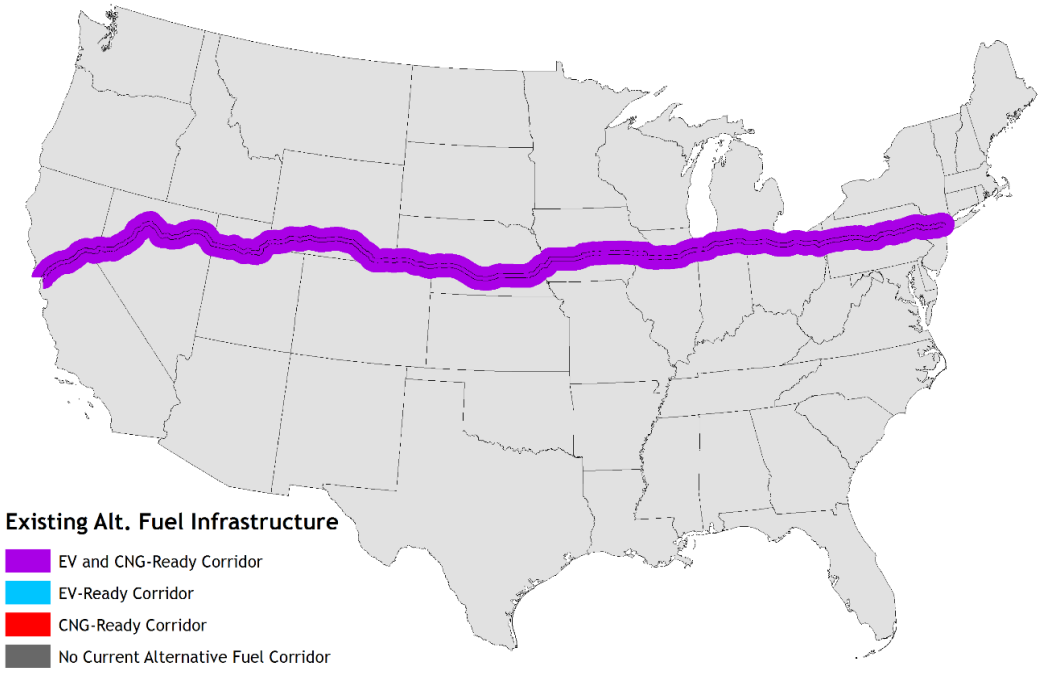
- EV (light-duty): **90 DCFC**
- CNG (freight): **46 CNG**

Clean Corridor Impacts: 2019 I-80 Scenario

I-80 CLEAN CORRIDOR 2019

Total Miles: 2,900

- 100% EV-Ready
- 100% CNG-Ready
- 62 new stations
  - Construction jobs
  - Operations
- Clean VMT supported:
  - 83M eVMT
  - 64M CNG-VMT



ALTERNATIVE FUEL LOCATIONS

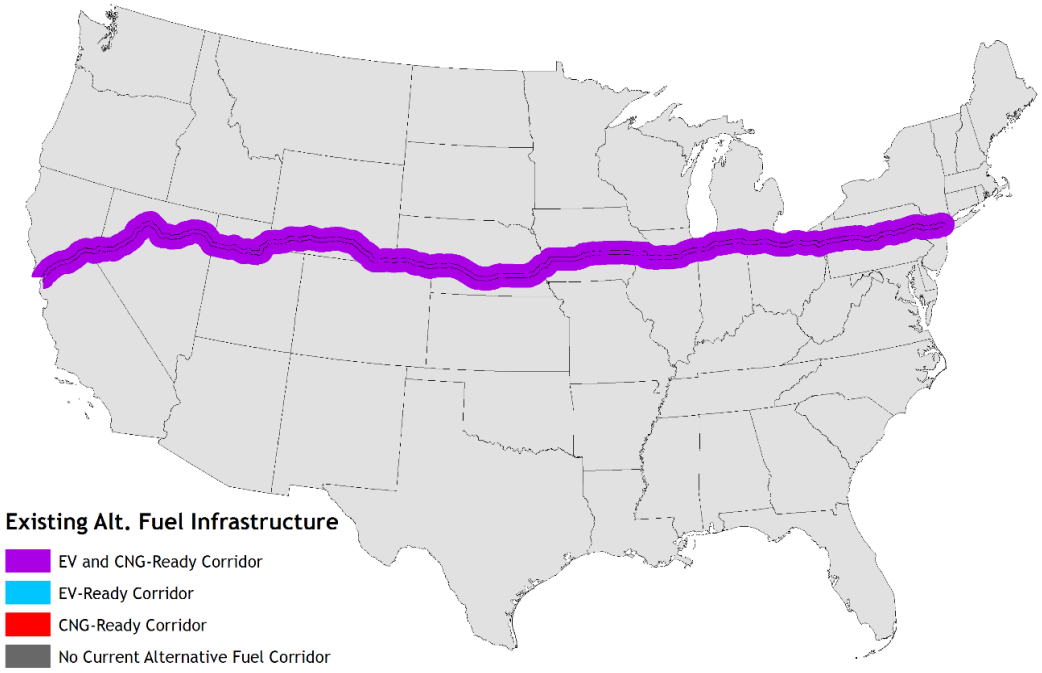
- EV (light-duty): **136 DCFC**
- CNG (freight): **62 CNG**

Clean Corridor Impacts: 2030 I-80 Scenario

I-80 CLEAN CORRIDOR 2030

Total Miles: 2,900

- 100% EV-Ready
- 100% CNG-Ready
- 3 new EV stations annually
  - Construction jobs
  - Operations
- Clean VMT supported:
  - 1.2B eVMT
  - 170M CNG VMT



ALTERNATIVE FUEL LOCATIONS

- EV (light-duty): **173 DCFC**
- CNG (freight): **62 CNG**

Results: Employment Impacts

NEW STATION CONSTRUCTION AND OPERATION

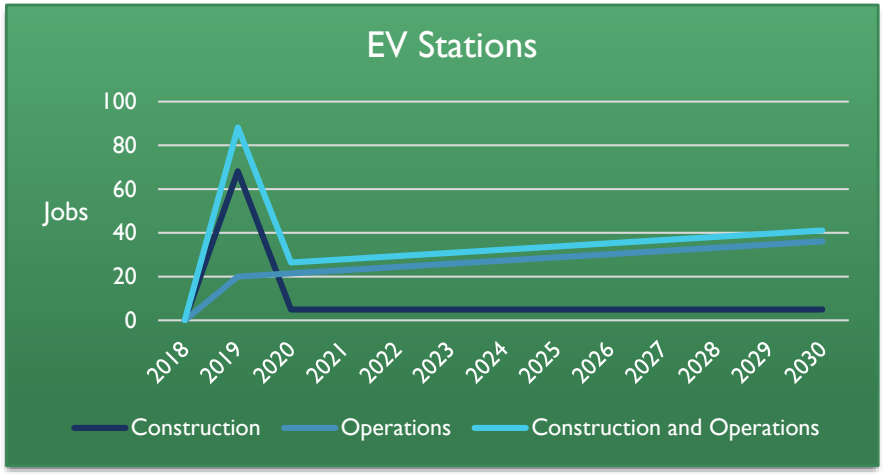
Construction:

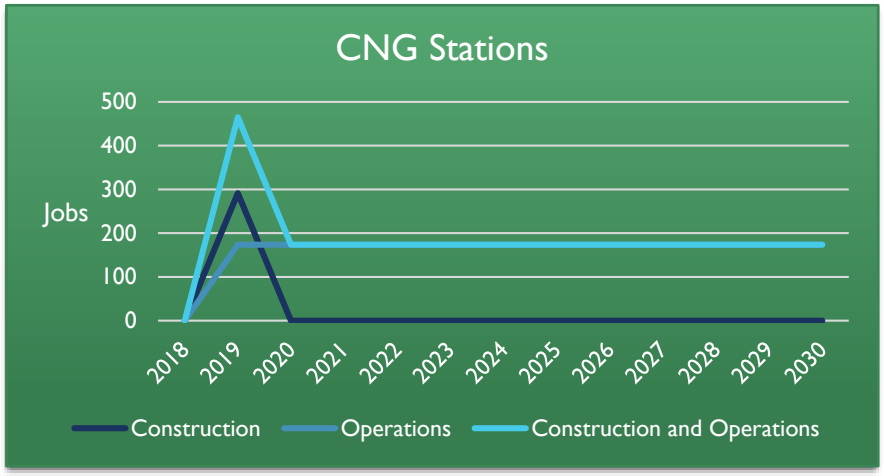
- Initial build (2019)
  - 68 jobs for EV
  - 290 jobs in CNG
- EV keeps expanding

Operation (ongoing):

- 20 jobs in EV – increasing
- 170 jobs in CNG

Value: $110M output in 2030



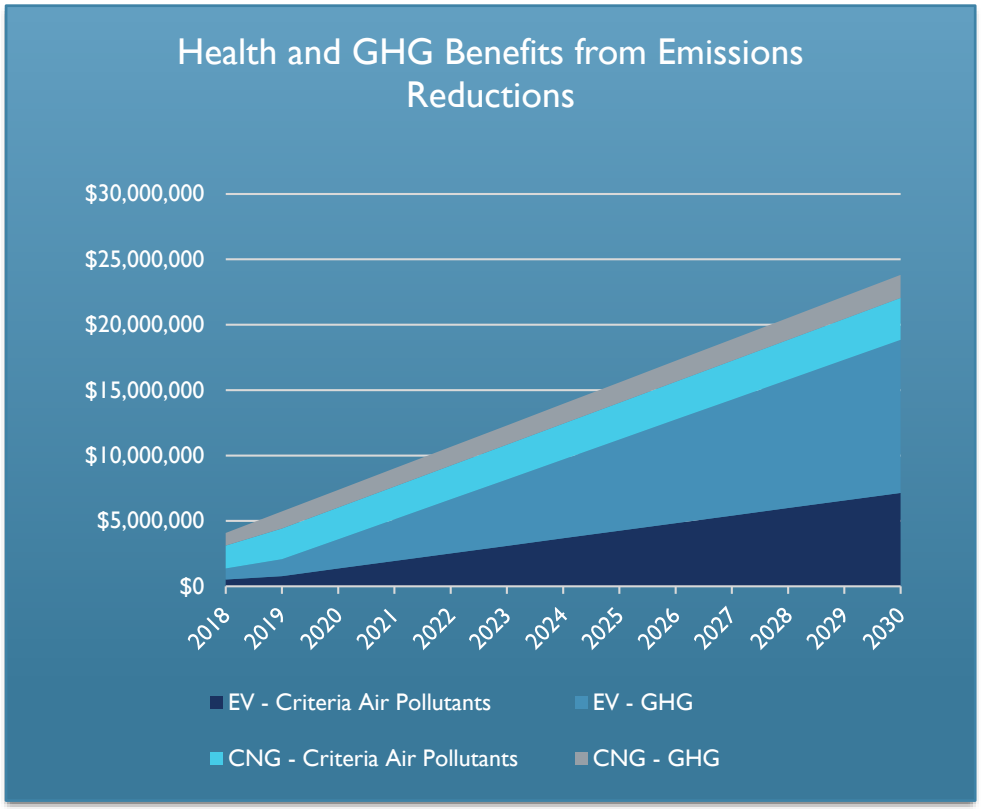


Results: Emissions Reductions

IMPACT OF THE VMT POWERED BY THE I-80 CORRIDOR

Value of avoided "wells to wheels" emissions:

- Criteria pollutants emissions avoided: value grows to $10 million/year for VMT powered by I-80 corridor fueling locations
- GHG emissions avoided: value grows to over $13 million/year
- EVs account for out-year benefits growth, CNGs for near-term



I-80 Corridor Scenarios: Summary

IN 2030, I-80 CORRIDOR WOULD SUPPORT:

1.2B eVMT

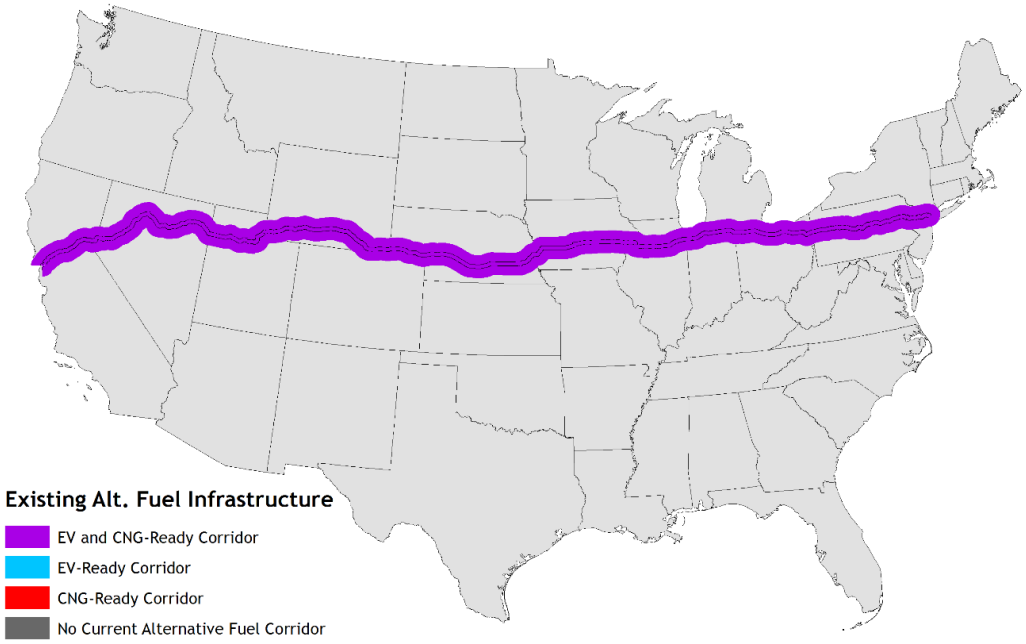
170M CNG VMT

753 ongoing jobs

- 5 Construction jobs
- 748 Operations jobs

Emissions benefits near $24 million

Very rough estimates!



Additional Economic Impacts

A CNG- and EV-ready corridor could contribute to/benefit from:

1. Increased revenue near charging stations by "drawing customers"
   - "1$/minute" spent while charging (may decrease with charging time)
2. Changes in revenues related to reduced operating costs to EV owners
   - Electric miles cost less than gasoline miles – can change "on the road" cash flow
3. Changes in local economies due to less "exported" money for gasoline
   - Fuel (esp. electricity) produced "locally" – money spent on fuel stays in local economy
   - Growth in maintenance, equipment to serve, produce alternative fuel vehicles
4. Potential (non-linear) increases in regional alternative fuel use (e.g., freight hubs)
   - Potentially localized impacts on air quality, noise, economic development
5. Contribute to reduced costs to electric utilities (and ratepayers)

QUESTIONS?

Your Input Is Welcome as We Refine / Finalize the Analysis

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Key Data Sources and Assumptions

DATA / ASSUMPTION	VALUES	SOURCE
Current Alternative Fuel Corridor Designations	590 miles EV-ready; 820 miles CNG-ready	FHWA (as of April 23, 2019)
Current alternative fuel infrastructure	90 DCFC; 46 CNG Stations within 5 miles	DOE Alternative Fuels Data Center Station Locator.
Economic impacts of CNG stations	18 short-term jobs per CNG station construction; 11 jobs per CNG station operation.	Argonne National Lab (ANL) NG JOBS Model, supply-chain impacts for CNG stations.
Economic impacts of EV stations	1.5 short-term jobs per EV station construction; 0.43 jobs per EV station operation.	Extrapolated from NG JOBS Model and EV station costs from AFLEET.
Well-to-wheels emissions reductions	See next slide for values.	AFLEET 2018.
Marginal damage estimates	See next slide for values.	EPA, Michalak, and Muller.
VMT increases linearly	BEV VMT increases 909% from 2019 to 2030; CNG VMT increases 136% from 2019 to 2030.	EIA Annual Energy Outlook 2019
Station utilization	EVs: 4 hr/day in 2019; 8 hr/day in 2030. CNG: 6 hr/day in 2019; 12 hr/day in 2030.	Assumption for EV; Default value for CNG from NG JOBS in 2019. Assume doubling in utilization.
Station capacity	EVs: 60 kWh DCFC in 2019; 200 kWh DCFC in 2030. CNG: 331 GGE/hr.	EVs: Newest Chargepoint model is 62.5 kWh. CNG: Fast-fill default from NG JOBS.
Fuel economy	EVs: 4 VMT/kWh. CNG: 5.51 VMT/GGE.	EV: ANL, 2017. CNG: AFLEET.

Key Data Sources and Assumptions (cont.)

EMISSIONS REDUCTIONS (TONS/MILE)		
Pollutant	Passenger Car (EV)	Long-Haul Truck (CNG)
CO	1.9E-06	-1.6E-05
NOx	1.2E-07	2.1E-06
PM10	-7.3E-09	2.2E-08
PM2.5	3.0E-09	2.0E-08
VOC	2.7E-07	-8.5E-08
GHGs	2.0E-04	2.2E-04

MARGINAL DAMAGE VALUES			
Pollutant	**2018$ per ton**	**Source**	**Externalities included in Estimate**
CO	$923	Michalek (2011)	Authors account for damages associated with environmental impact, mortality, and morbidity (using a $6 million value of statistical life); and assess location-specific damages in the regions where emissions take place.
NOx	$15,338	Muller, N. (2014)	Using concentration response functions, author estimates impact on human health end points such as premature mortality, chronic bronchitis, and hospital admissions. Damages also include impacts on agriculture, forestry, and recreation.
PM10	$10,144		
PM2.5	$90,457		
VOC	$7,553		
GHGs	$48	EPA (2016)	Net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning.