A proposal for zero-emissions, electrified short-haul intermodal freight rail in Southern California

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Rail Propulsions Systems

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The Ports of Los Angeles and Long Beach together handle about 40% of all containerized U.S. imports

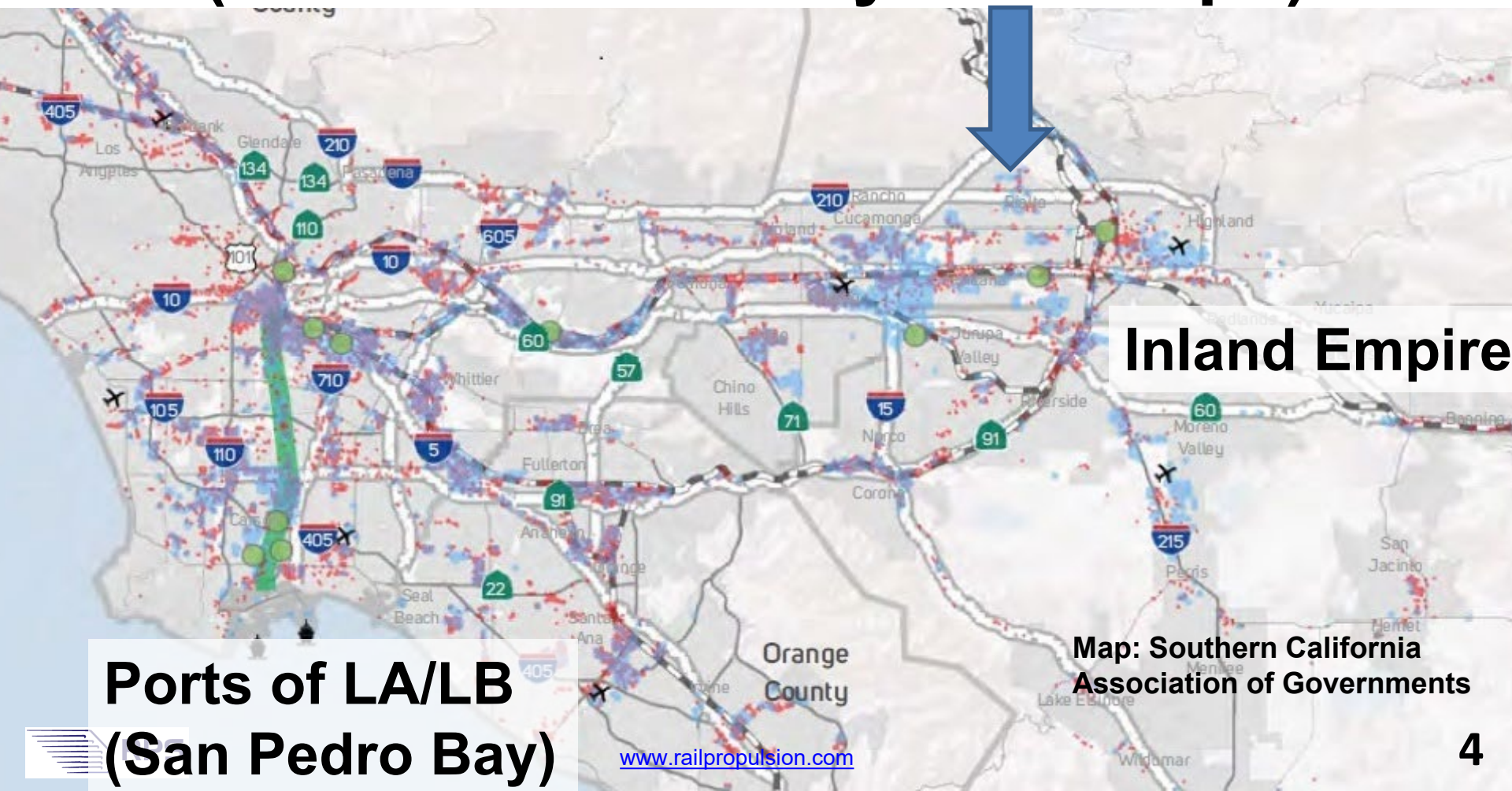
In 2017, nearly 17 million twenty-foot-equivalent units (TEUs) of intermodal container traffic moved through the San Pedro Bay Ports

- **In 2016, 28% of containerized import cargo moving through the San Pedro Bay ports left the docks by rail, and 72% by truck.**

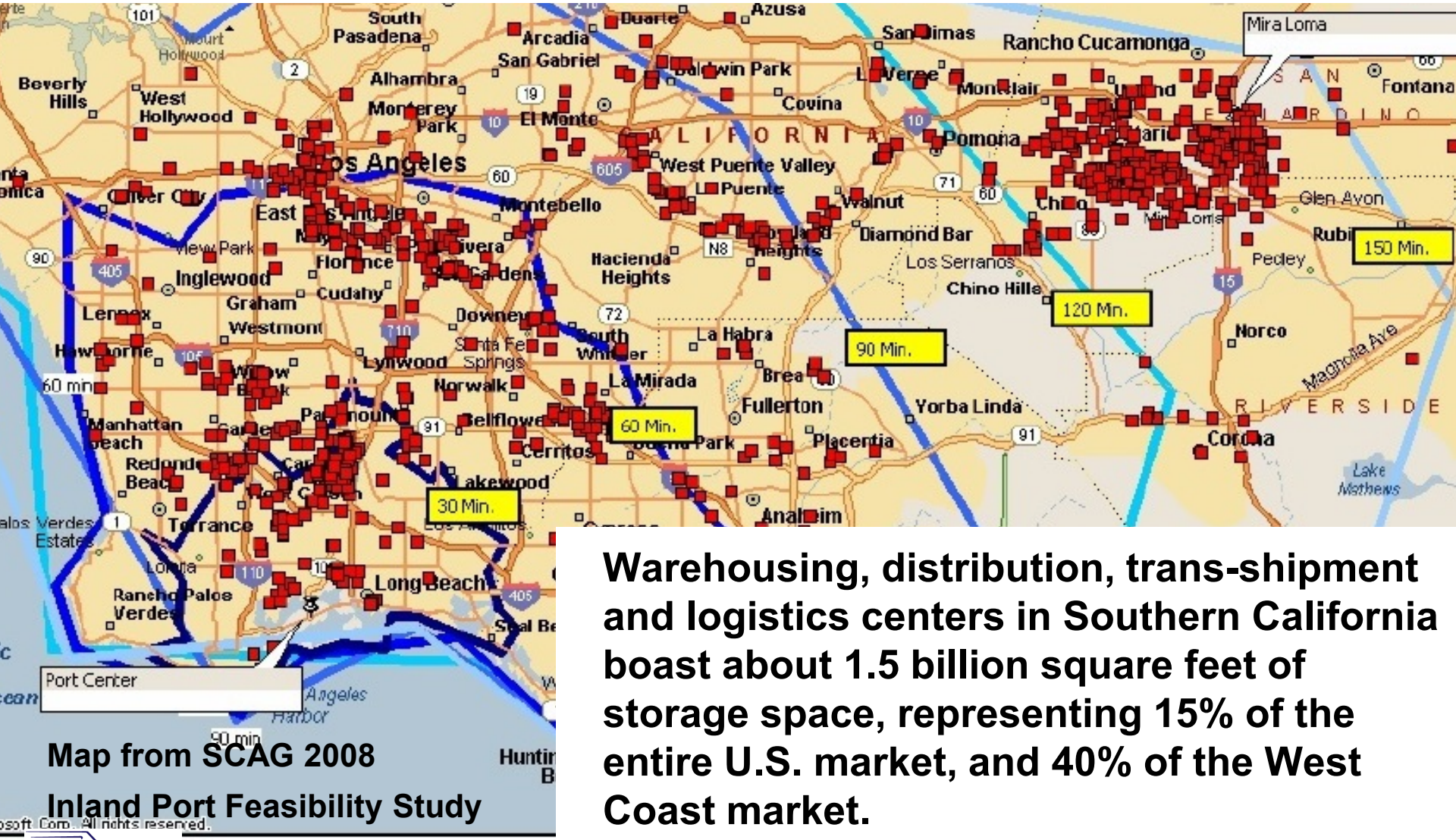
- **In 2012, the San Pedro Bay Ports were responsible for approximately 55,000 direct daily regional truck trips, many of which are for moving containers.**

(Photo: Port of Long Beach)

Over 1/3 of LA/LB port containers are moved by truck less than 80 miles to the Inland Empire (thousands of daily truck trips)



During congested times of day, truck travel time from Ports to Inland Empire is over 2 hours



Map from SCAG 2008 Inland Port Feasibility Study

Warehousing, distribution, trans-shipment and logistics centers in Southern California boast about 1.5 billion square feet of storage space, representing 15% of the entire U.S. market, and 40% of the West Coast market.

Inland Empire
(San Bernardino and Riverside Counties)

If the Inland Empire were its own container port, the region would rank 4th busiest in the U.S. (just behind combined Port of New York and New Jersey), and in the top 25 in the world.

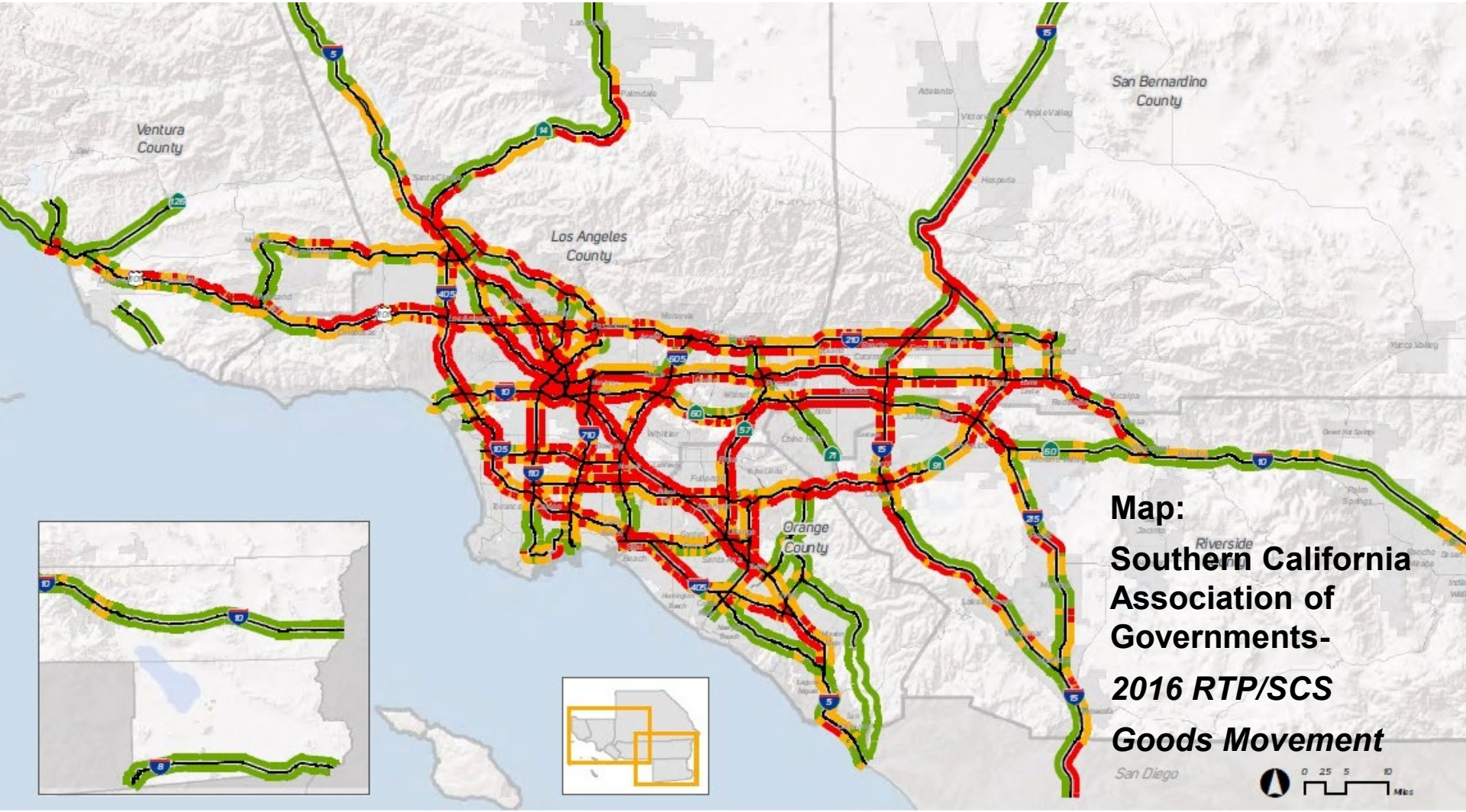
The cost of trucking in Southern California is increasing:

Port fees, fuel prices, cost of newer & cleaner trucks, *congestion delays*.

Road congestion in the Los Angeles-Inland Empire area costs the trucking industry greater than $2 billion per year in added operational costs, the most of any metropolitan area in the nation

(*2019 Urban Mobility Report,* Texas A&M Transportation Institute)

Projected 2040 Highway Congestion



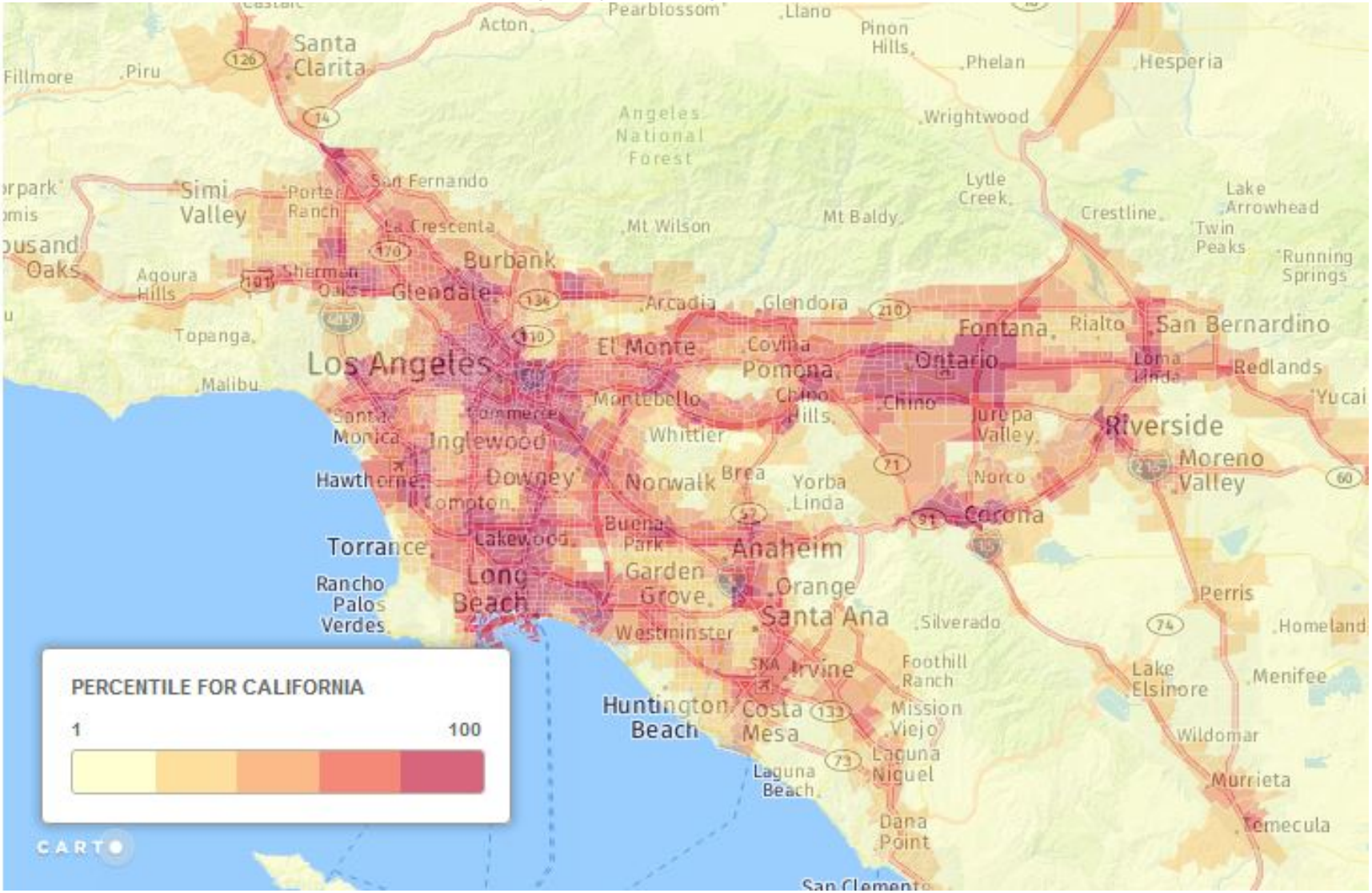
Emissions from goods movement, (majority from diesel trucks) is a significant part of Southern California's air pollution

710 Freeway in Long Beach

(Photo: Brian Yanity)

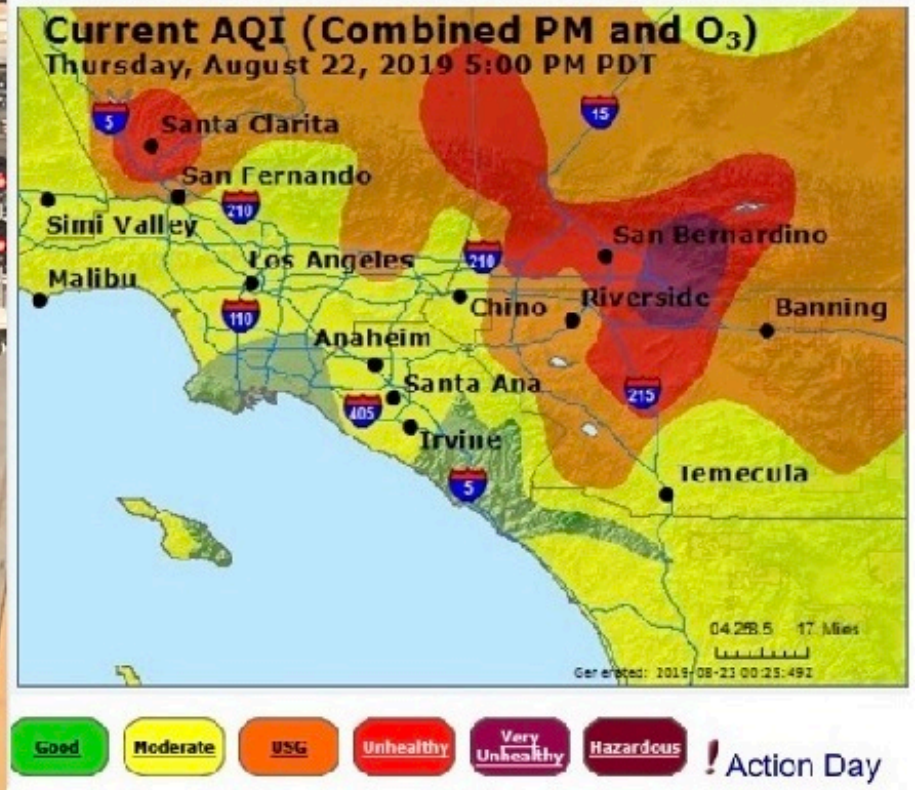
Diesel Particulates in South Coast Air Basin, linked to over 2,000 premature deaths each year

(Source: California Environmental Protection Agency, http://graphics.latimes.com/responsivemap-pollution-burdens/)



View from San Bernardino train station on a smoggy day, Real-time EPA AirNow air quality map at time of photo

(Photo by Brian Yanity)



Air Pollution from Freight Movement

Looking over Inland Empire and LA Basin

(Photo: Brian Yanity)

Railyard Pollution

CANCER RISK: People living near BNSF Railway operations in San Bernardino face a much greater railyard-related cancer risk than people living near any of 15 other rail operations examined in state studies.

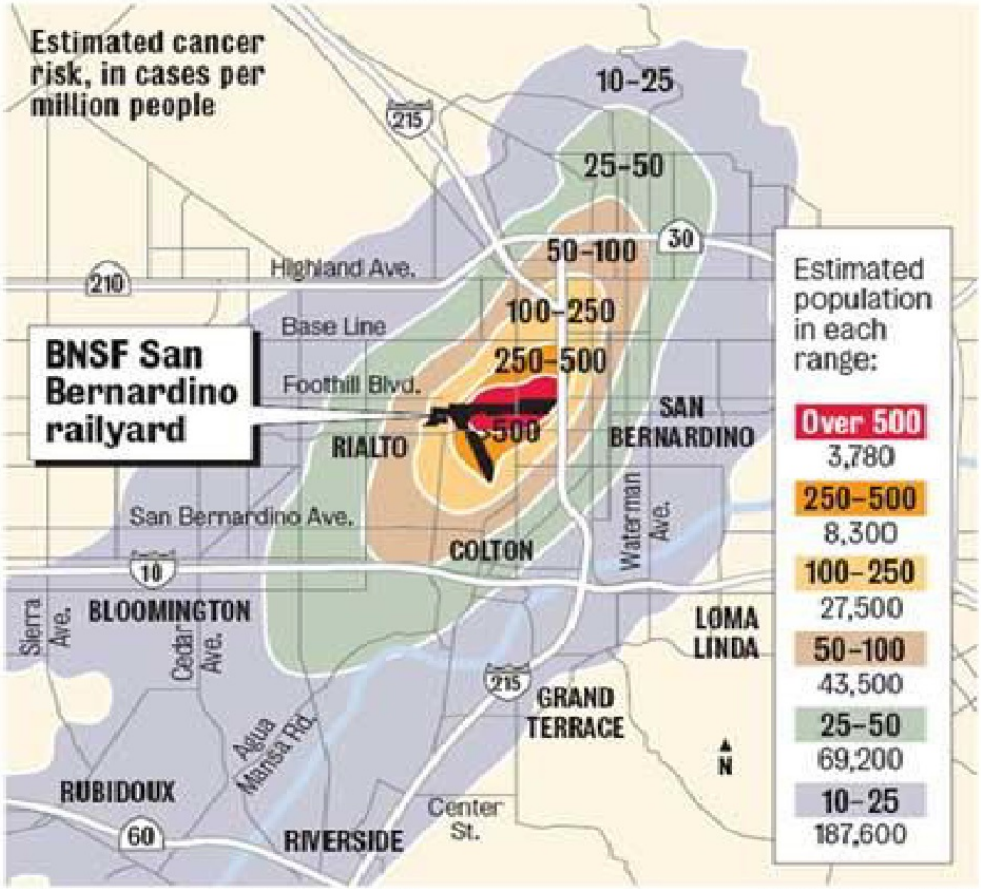
Railyard	Company	Max cancer risk to resident*
San Bernardino	**BNSF Railway**	**3300**
Four railyards in the city of Commerce	BNSF & UP	Less than 1,000
Container tranfer facility Long Beach & Carson	Union Pacific	800
Oakland	UP	460
Barstow	**BNSF**	**450**
City of Industry	UP	450
Los Angeles Transportation Center	UP	250
Watson Railyard, Wilmington	BNSF	174
Colton	**UP**	**150**
Stockton	UP	150
Stockton	UP	120
Mira Loma auto railyard	**UP**	**100**
Richmond	BNSF	100
San Diego	BNSF	70

* Number of cancer cases expected per million people, based on 70 years of exposure.

SOURCE: CALIFORNIA AIR RESOURCES BOARD

THE PRESS-ENTERPRISE

DANGER ZONE: A state study found that people living downwind of the BNSF railyard in San Bernardino face an increased cancer risk of as many as 2,500 cases per million people. The estimated regional cancer risk from all air pollution is 1,000 cases per million people.



SOURCE: CALIFORNIA AIR RESOURCES BOARD

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Major parts of the solution:

1. Mode shift of more freight from truck to rail

- Better integration of rail and truck intermodal operations/infrastructure
- New intermodal facilities for short-haul freight rail services

2. Electrification of rail (zero-emissions)

Short Haul Freight Rail

- **The Port of Long Beach & Port of Los Angeles are currently studying the short-haul freight rail shuttle concept, which has periodically been studied in the region over the past two decades.**

- **Ports have a goal of 50% of all cargo shipped by rail in 2030, up from 28% in 2016- *short-haul freight rail service is needed for this*.**

Short Haul Freight Rail (less than 80 miles)

Short Haul Freight Rail

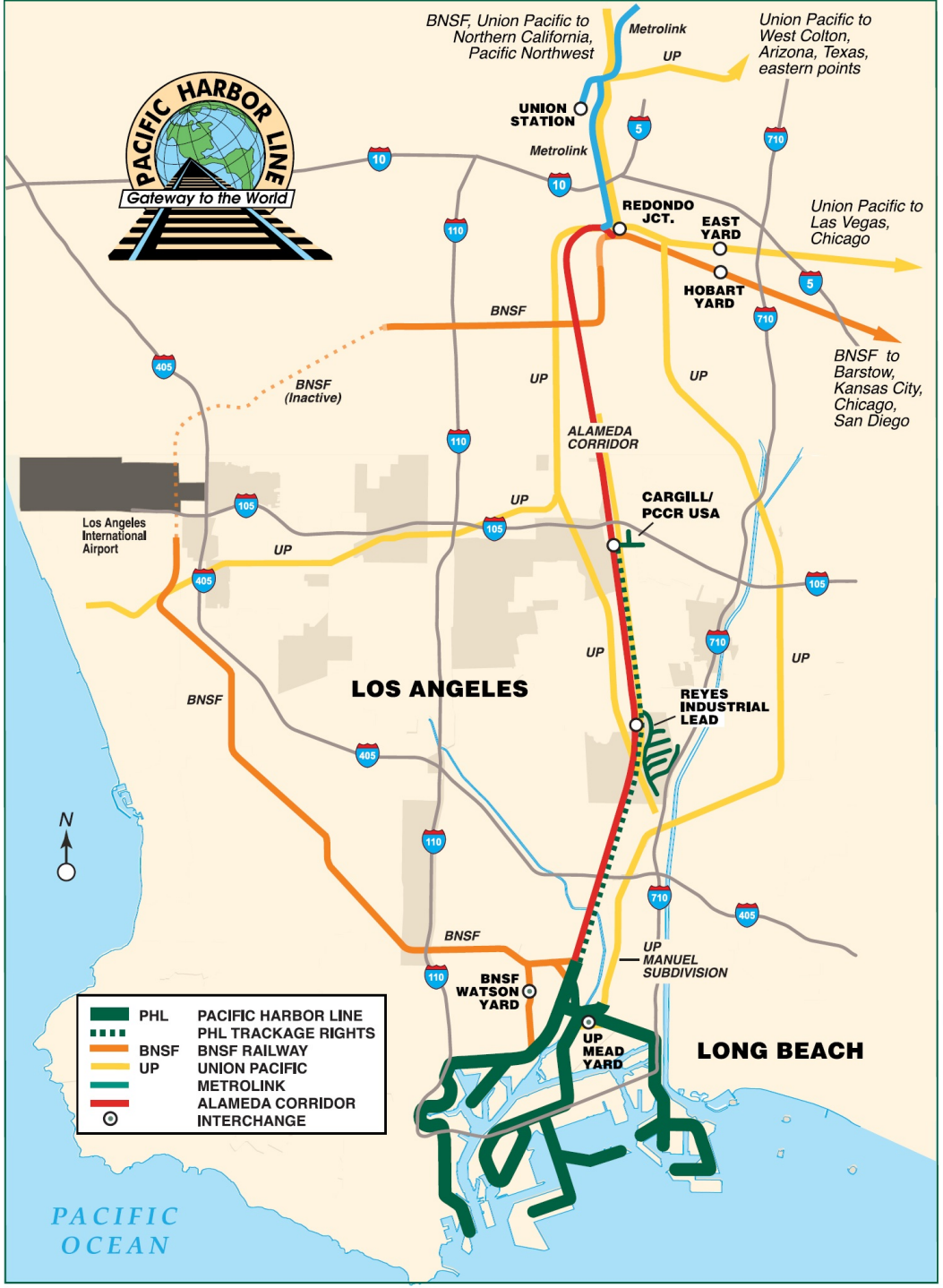
Several major studies of the past two decades (most recent was completed in 2008) found short-haul freight rail in Southern California to be operationally feasible, but not yet cost-effective.

Class I railroads (UP and BNSF) have traditionally not seen short-haul freight service to be profitable enough to pursue:

- **Capital cost of new or upgraded inland intermodal facilities**
- **Complex 'disruption' of existing operations**
- **Do not want it to interfere with profitable long-haul trains**

Today, increasing road traffic congestion is making short-haul rail look more competitive with trucks for drayage between San Pedro Bay and the Inland Empire.

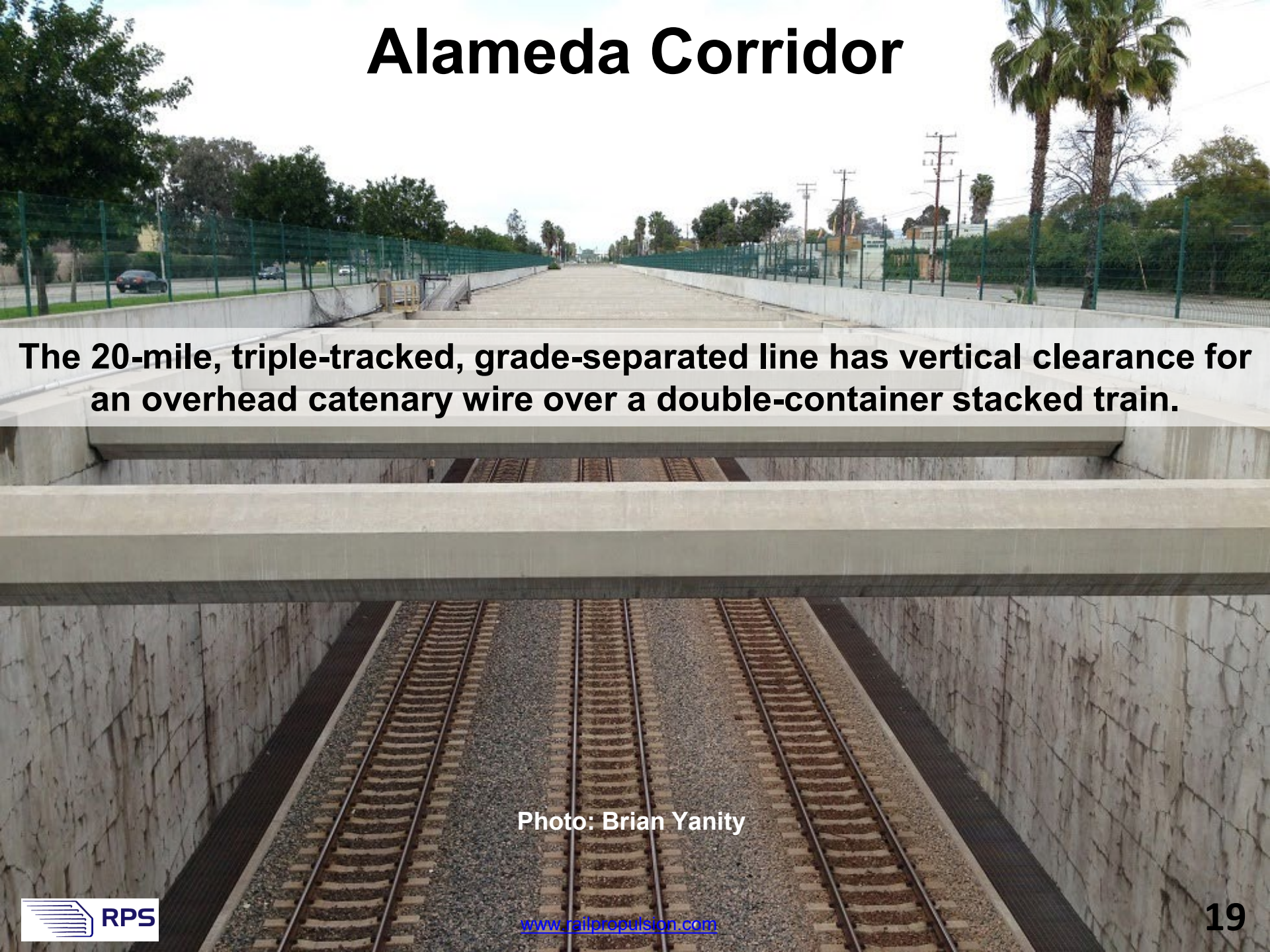
Alameda Corridor



- **Completed in 2002, Alameda Corridor is operated by the Alameda Corridor Transportation Authority (ACTA), a public joint powers authority formed by the cities of Long Beach and Los Angeles**

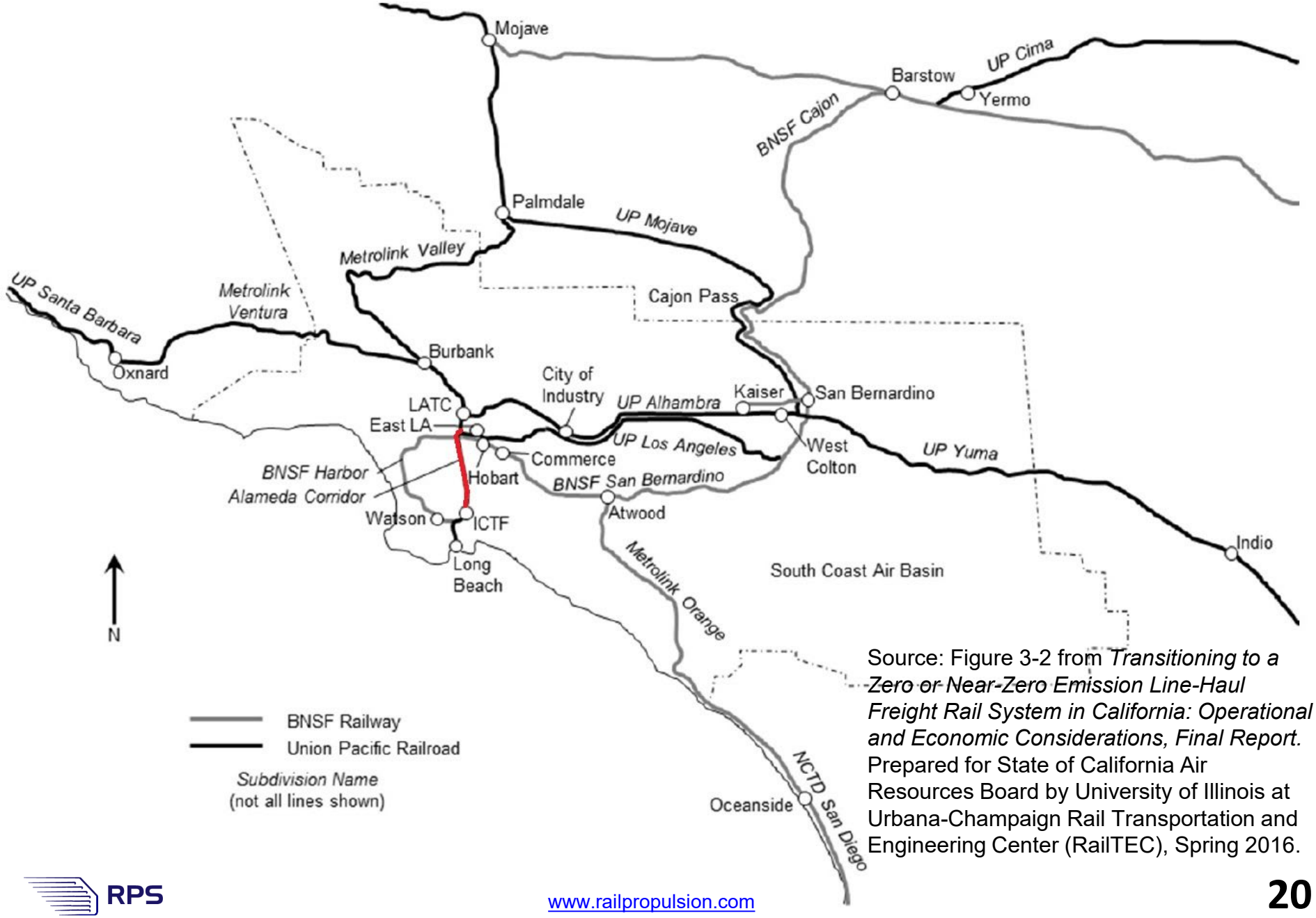
- **The project's main goal is the shifting more freight to rail instead of truck.**

Alameda Corridor



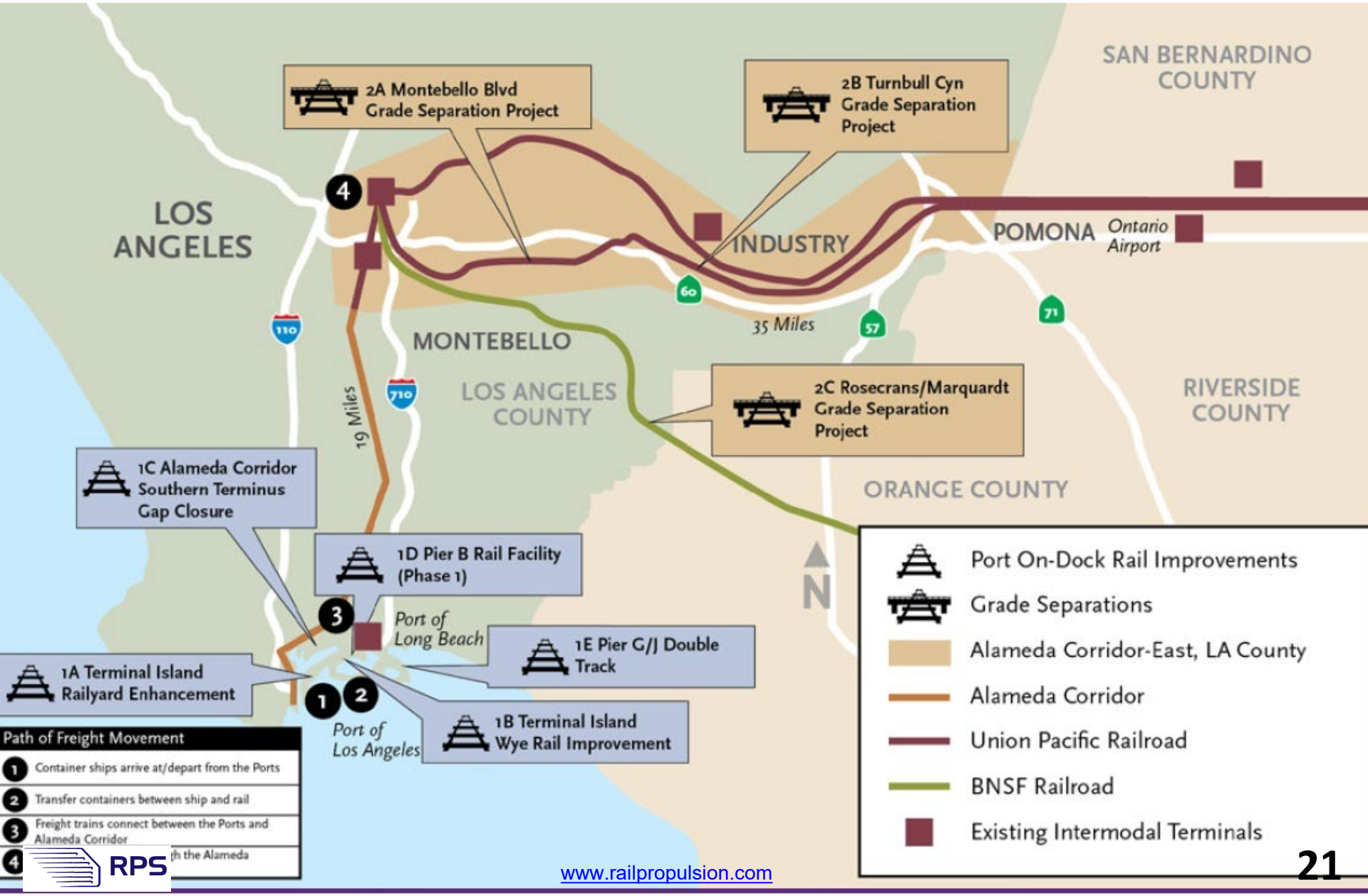
The 20-mile, triple-tracked, grade-separated line has vertical clearance for an overhead catenary wire over a double-container stacked train.

Photo: Brian Yanity

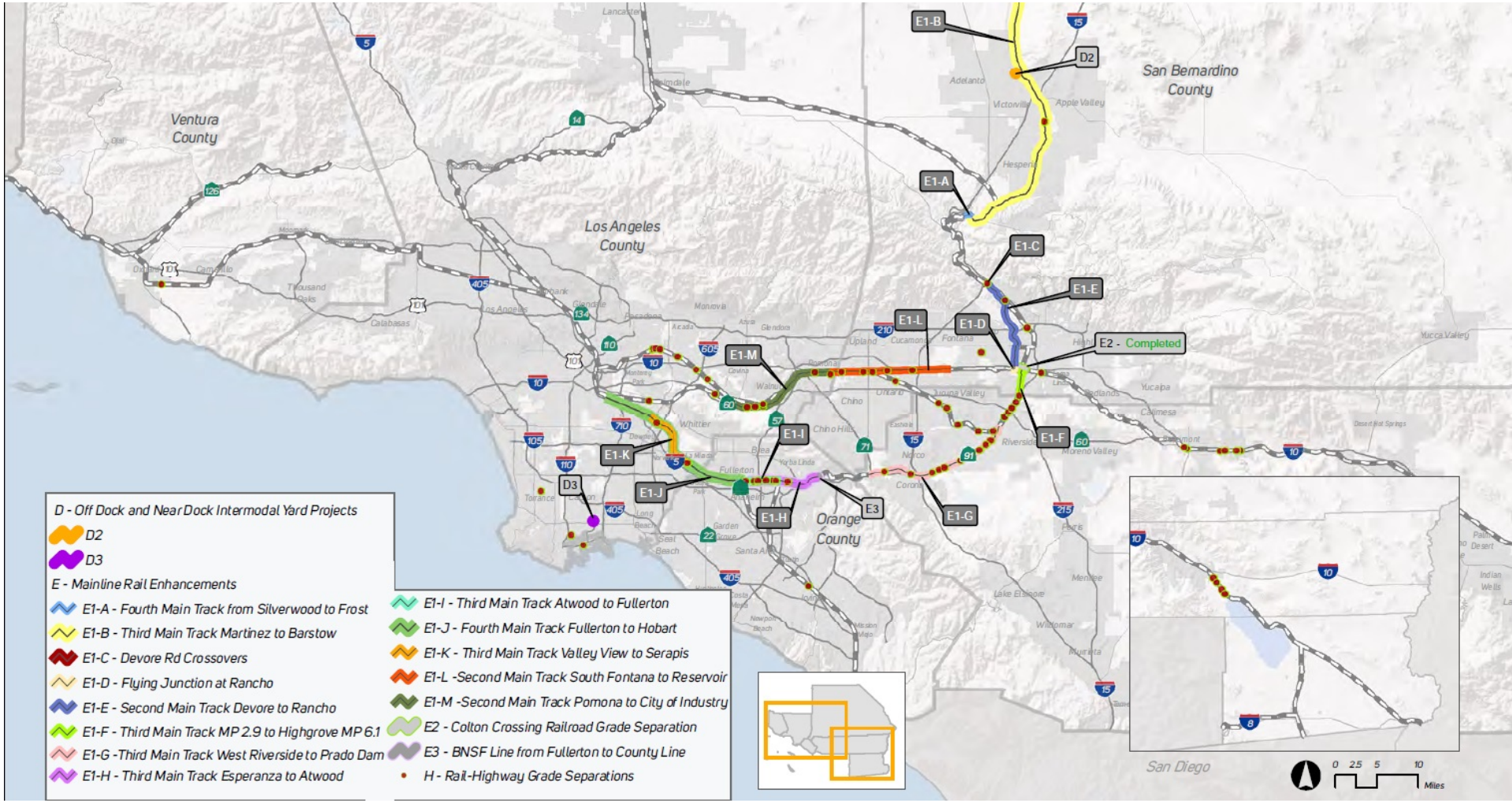


Source: Figure 3-2 from *Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations, Final Report.* Prepared for State of California Air Resources Board by University of Illinois at Urbana-Champaign Rail Transportation and Engineering Center (RailTEC), Spring 2016.

Short-haul rail would build upon ongoing investments in regional freight rail network

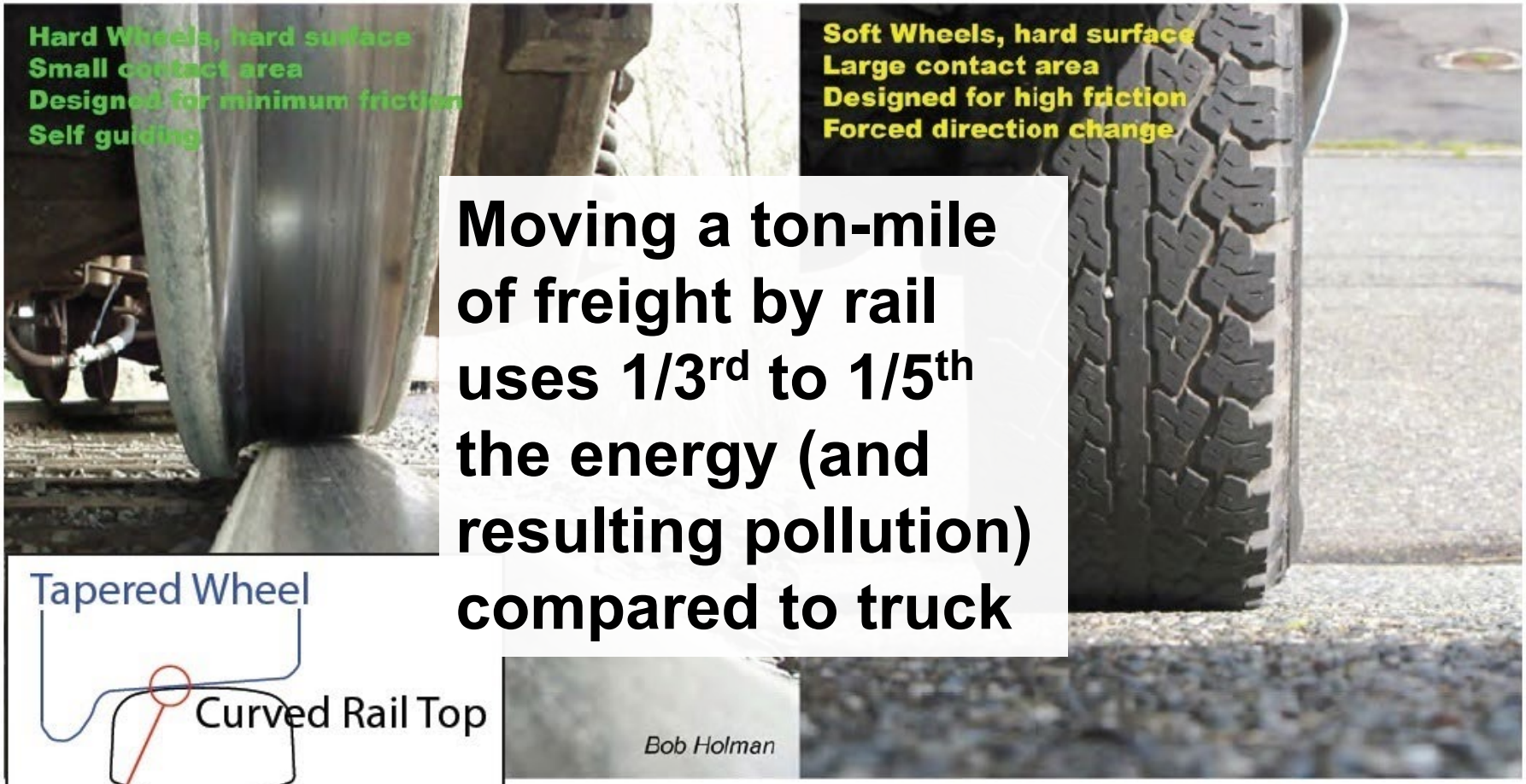


Short-haul rail would build upon ongoing investments in regional rail capacity expansion, intermodal facilities, and rail-road grade separations.

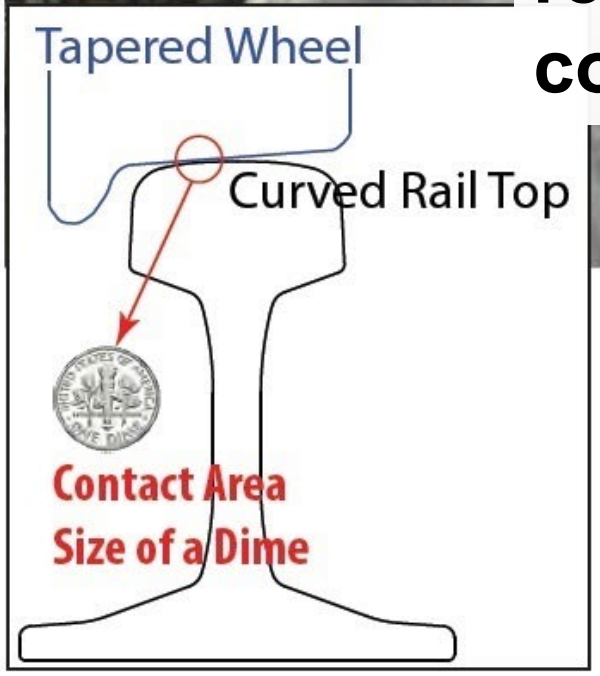


Map: Southern California Association of Governments

2016 Regional Transportation Plan



Moving a ton-mile of freight by rail uses 1/3rd to 1/5th the energy (and resulting pollution) compared to truck



Rail transporation with steel wheels will always be more energy efficient than vehicles with rubber tires, due to the physical (mechanical) relationship between traction & friction.

(source: VTD Rail Consulting)

Intermodal Electric Freight Rail

Hector Rail intermodal freight train in Germany, pulled by Bombardier TRAXX electric locomotive

(Photo: pxhere.com, Creative Commons CC0)

Rail Electrification

- Zero emissions
- Quieter than diesel locomotives
- Lower energy cost, can be powered by renewable energy via the power grid
- Simpler locomotives, lower O&M costs
- Established, proven technology (main lines in Europe and Asia are electrified)

Overhead Catenary Wire:

- Required for conventional electric locomotives to run
- Typical cost >$10 million/mile
- Needs clearance of overhead obstructions, i.e. bridges
- Can face NIMBY opposition for aesthetic reasons

Electric freight trains were once common in Southern California

Pacific Electric Railway all-electric local freight train in South LA, 1953

(Photo: Pacific Electric Railway Historical Society)

Battery Electric Switcher Locomotive (under construction by RPS)

Converting MK1200G natural gas locomotive, with re-used lithium-ion EV batteries

(Photo: Brian Yanity)

Battery Electric Switcher Locomotive Range Extension

To work outside of a railyard, range-extension to pull trains up to 80 miles (short-haul distance between San Pedro Bay and Inland Empire) is possible by hybridization with:

- **Natural gas**
- **Hydrogen**
- **Overhead Contact System (Catenary Wire)**
- **Wireless Power Transfer**

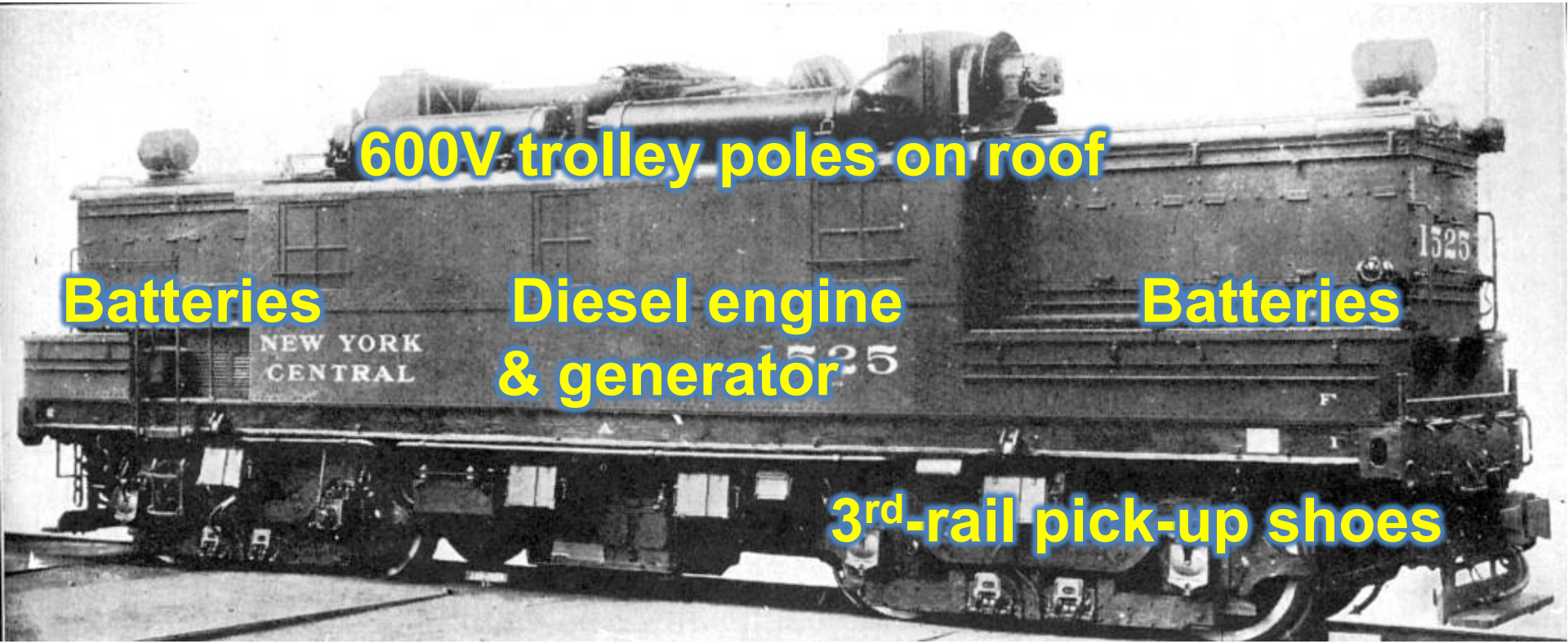
Rail Propulsion Systems Prototype Battery-Electric Switcher Locomotive

Photo: Brian Yanity

Catenary-Battery Hybrid Electric Switcher Locomotive

Austrian Federal Railways ÖBB InnoShunt eHybrid prototype catenary-supercapacitor-battery switcher. Rebuild of Class 1063 electric locomotive by vehicle modernisation company TecSol.

All-electric locomotive operation has been required, & hybrids used, in New York City since the 1920s



GE “three-power boxcab”, 1928
New York Central #1525

Catenary- Diesel Hybrid Electric "Dual Mode" Locomotive

Bombardier ALP-45

(Photo: Robert Pisani, railcolor.net)

RPS Proposed Stages of Southern California Rail Electrification

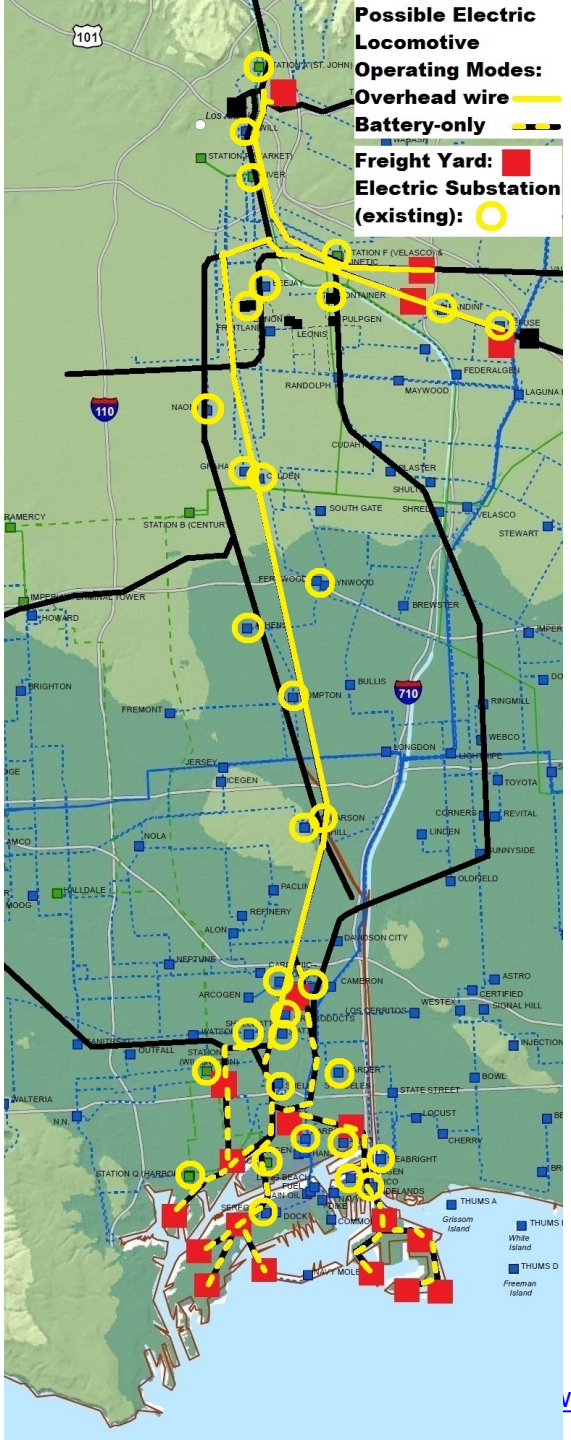
1. Battery-electric 'yard switcher' locomotives, (that do not leave railyards).

2. Range-extension of battery-electric locomotives for port switching and short-haul regional rail passenger and freight service (less than 100 miles).

3. Battery-"booster" locomotives paired with existing diesel-electric units (passenger and freight).

4. Regional deployment of electric locomotives and supporting infrastructure

   (overhead catenary wire, charging stations, etc.)

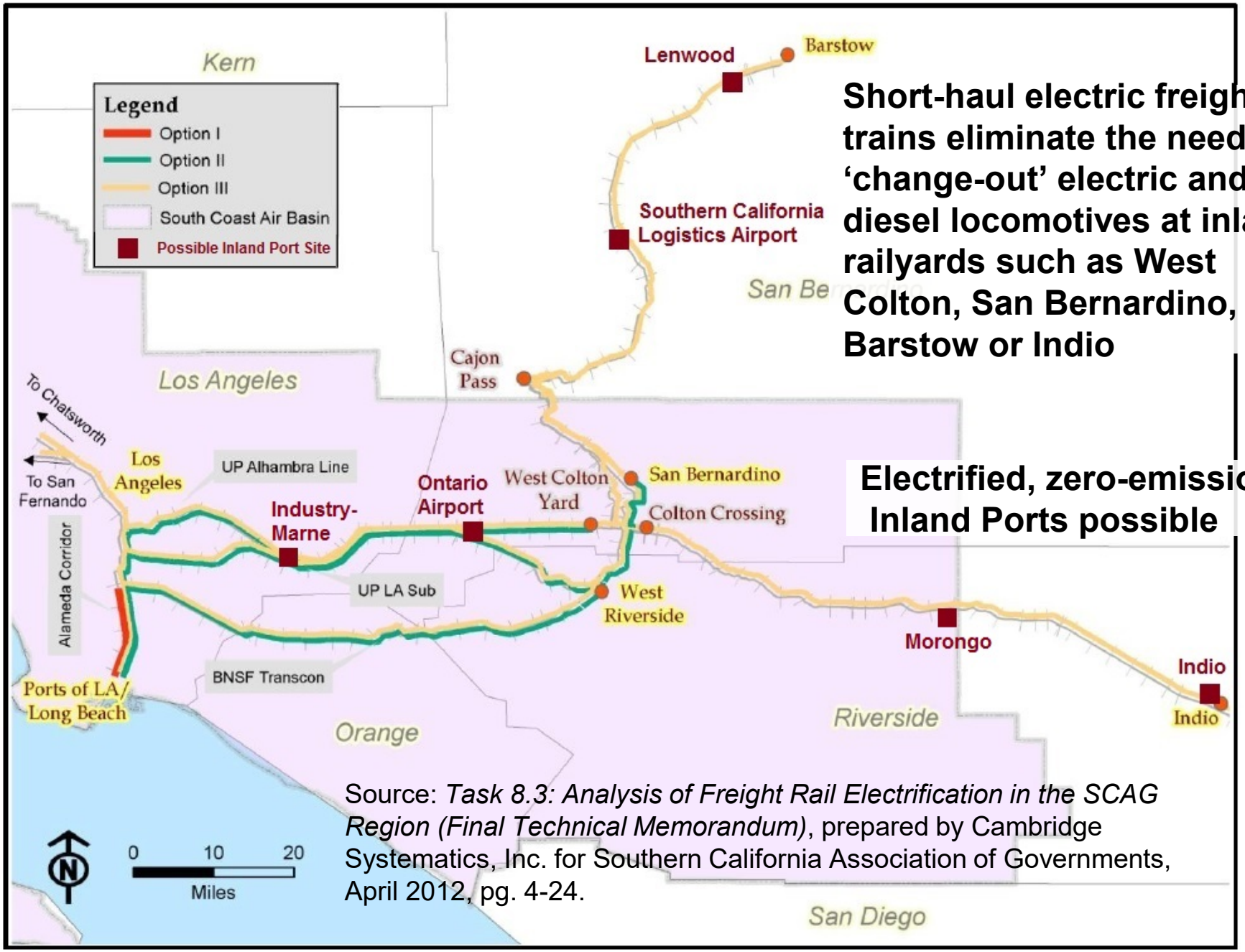


Possible operating scenario of Alameda Corridor electrification using catenary/battery hybrid locomotives

Rail lines (black) and rail yards (red) overlaid on map of existing, adjacent electric utility transmission lines and substations (yellow circles)

(Background map: California Energy Commission)

Regional Electrification Options and the SCAB Boundary



Short-haul electric freight trains eliminate the need to 'change-out' electric and diesel locomotives at inland railyards such as West Colton, San Bernardino, Barstow or Indio

Electrified, zero-emissions Inland Ports possible

Source: *Task 8.3: Analysis of Freight Rail Electrification in the SCAG Region (Final Technical Memorandum)*, prepared by Cambridge Systematics, Inc. for Southern California Association of Governments, April 2012, pg. 4-24.

“Rolling Highway” Roll-on/Roll-off Intermodal “Truck Train”, Switzerland

Fast electric ‘land ferry’ freight trains, running on regular schedules like a passenger train, designed to be competitive with highway trucking for distances less than 500 miles.

Photo: RAILpin

FLEXI WAGGON®

The person who operates the train can load and unload directly from the train cabin. Or, the truck driver can load and unload by him / her self.

FLEXI WAGGON®

Each railcar can be loaded or unloaded in as little as 7 minutes

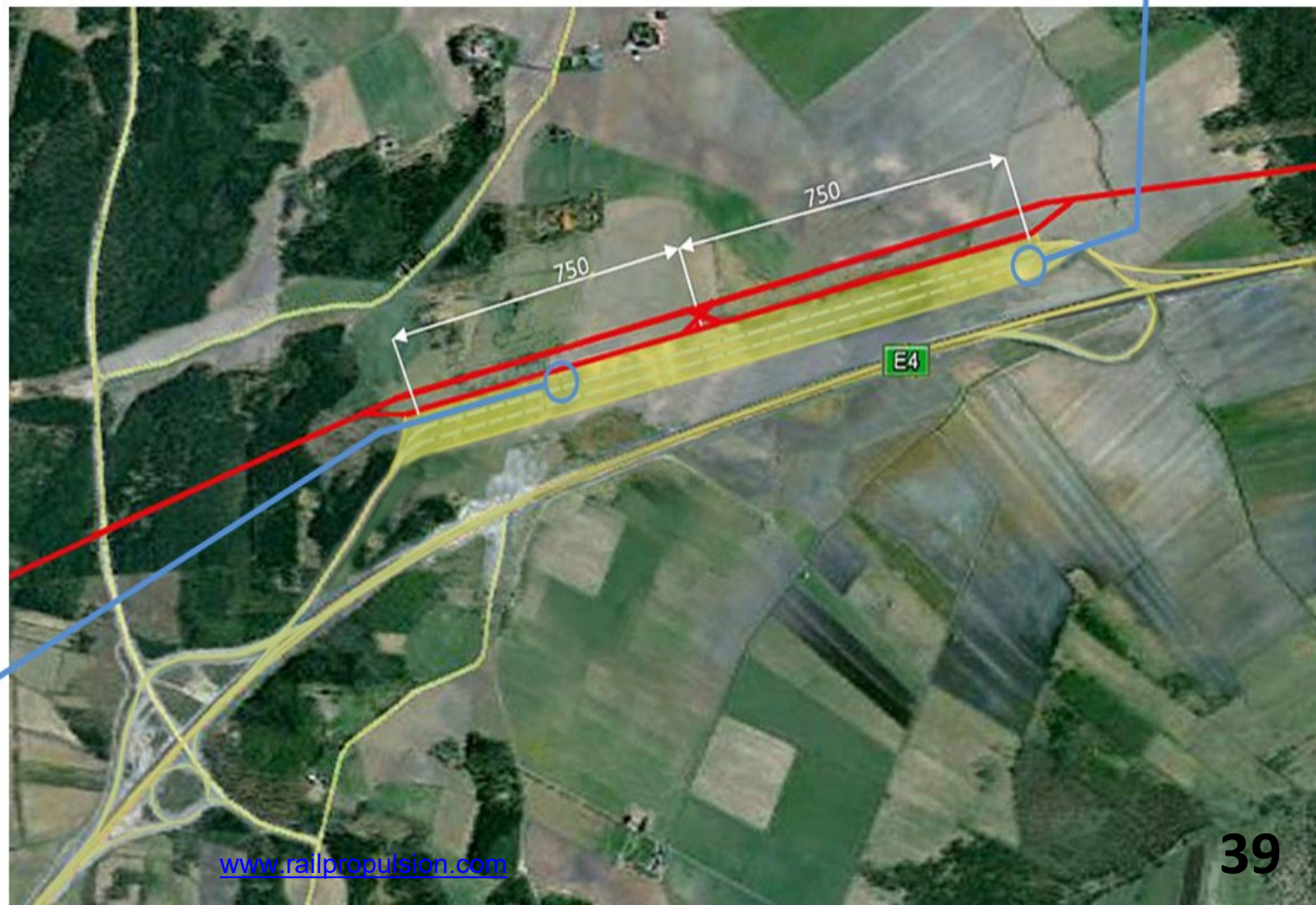
Simultaneous loading/unloading with many tractor/trailers ,
of an entire train in as little as 10 -15 minutes.

FLEXI WAGGON®

Can load and unload under overhead electric wire,
Train can also carry passenger cars

FLEXI WAGGON®

Intermodal facility can be simple and low cost, can use existing railyards and sidings.



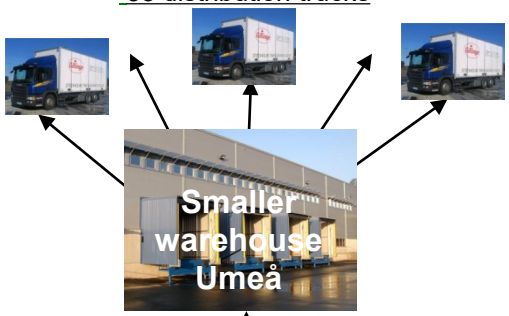
RPS

Logistic Solution: Example ICA Sweden

Borlänge city - Umeå City 578 km one way

Today

35 distribution trucks



Number of trucks= 27 st
(Swedish 24 meter trucks) that
supply the interlayer daily with food

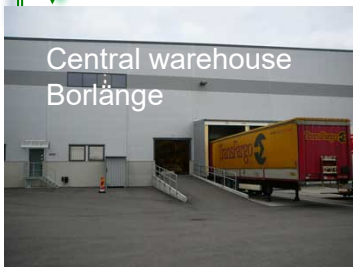
Profit / savings / year

53%	Cost reduction
11,000 tonne	CO^2 reduction
4,000,000	Litre diesel reduction
150 MSEK	Society cost reduction

Tomorrow

35 distribution trucks

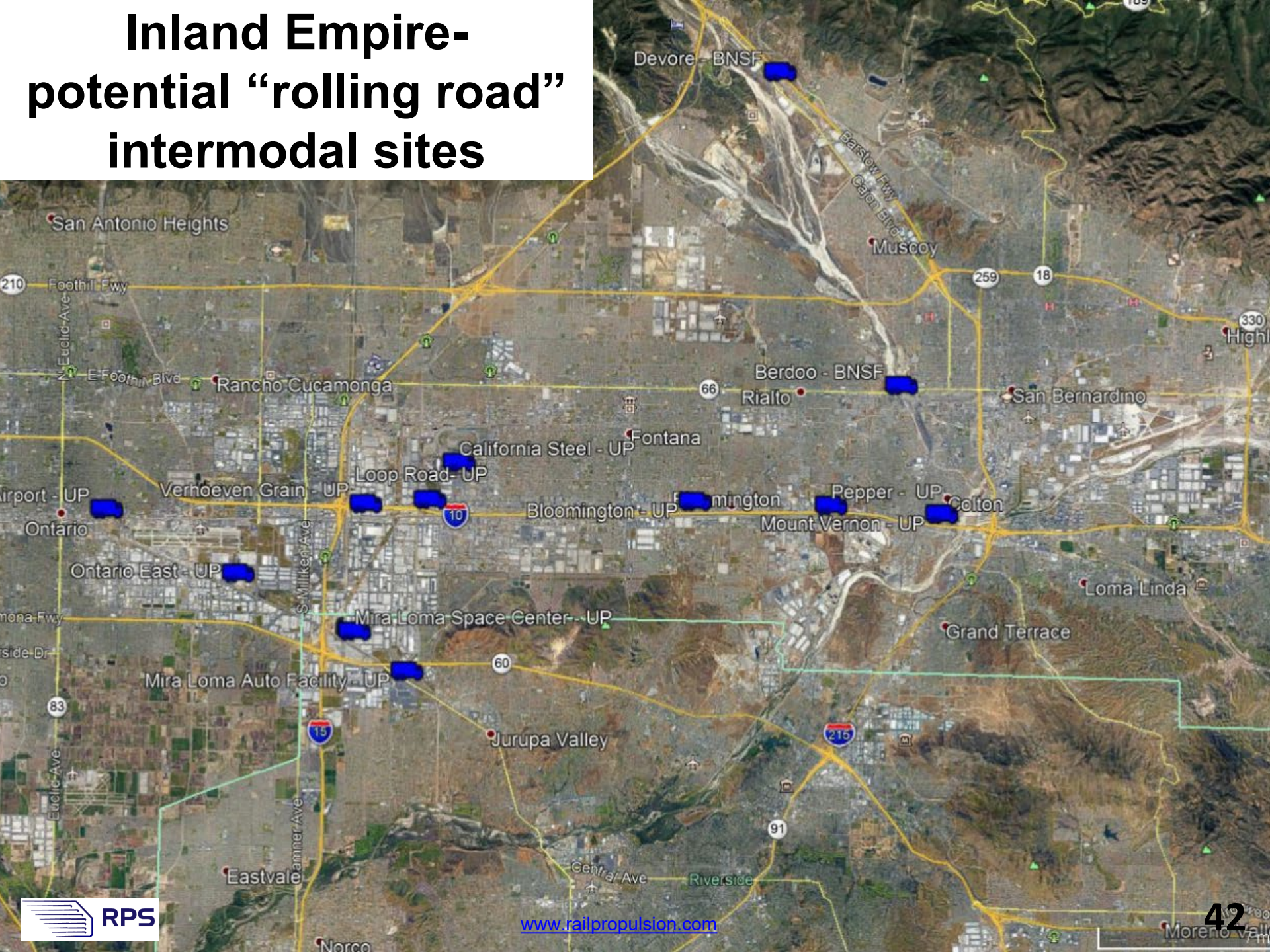
- The 35 distribution trucks transported on flexiwaggons to the central warehouse in Borlänge city in the afternoon-evening
- Loaded up and transported again on flexiwaggons overnight to Umeå city
- Be in place in the morning when drivers come to drive out the goods to the customer



Southern California has potential for European-style “Rolling Highway” or roll-on/roll-off intermodal sites

..at existing railyards and sidings, minimal new infrastructure required.

Inland Empire- potential “rolling road” intermodal sites



RPS

www.railpropulsion.com

San Bernardino Intermodal Yard

Photo: Brian Yanity

Next steps

Demonstrations needed in Southern California:

- Battery-electric switcher and charging infrastructure deployed in railyard (Anaheim, then others)

- Construction of electric freight rail demonstration line
  - –Conventional overhead wire
  - –Battery-charging stations
  - –Emerging technologies (wireless power transfer, etc.)

- Pilot deployment of roll-on/roll-off intermodal rail car short-haul freight rail service-

  San Pedro Bay to an inland location

Thank you

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www.railpropulsion.com