GEEKING OUT ON SUSTAINABLE FREIGHT INNOVATIONS

PLANNING HORIZONS
MAY 23, 2019

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+ Faiza! (and big thank you to her)
2019 CALIFORNIA FREIGHT MOBILITY PLAN UPDATE

• 2014 Plan being updated by the California State Transportation Agency (CalSTA) and Caltrans

• CFMP Preliminary Goals:
  • Economic Competitiveness
  • Safety and Security
  • Freight System Infrastructure Preservation
  • Environmental Stewardship
  • Congestion Relief
  • Innovative Technology and Practices
CA Sustainable Freight Action Plan Overview

Action Plan Finalized in July 2016, includes:

- Vision and Guiding Principles
- 2030 Statewide Freight Targets
  - Increase efficiency by 25%
  - Deploy over 100,000 zero emission vehicles and equipment and maximize near-zero vehicles and equipment powered by renewable energy
  - Establish a target for increased State competitiveness and future economic growth
- Freight Funding Approach
- State Agency Actions and Implementation Steps
- Pilot Project Concepts
9 Statewide Agency Actions

1. Work with legislature on a freight transport funding package
2. Work with legislature on distribution of federal FAST Act funds
3. Plan and invest in infrastructure to modernize freight corridors
4. Accelerate use of advanced technologies and renewable fuels
5. Establish a freight think tank
6. Develop strategies, tools, and data that considers commercial viability and promotes competitiveness
7. Continue work with the freight efficiency group
8. Implement steps to meet existing and future workforce needs
9. Identify regulatory or permitting process improvements
Why Care About Sustainable Freight?

- Freight transportation accounts for about 8.5% of all greenhouse gas emissions in California (2016 - CARB)
- Localized criteria pollutants and diesel particulate matter causing huge health impacts
- Inefficiencies in freight operations create congestion, extra vehicle miles traveled, and increase costs for deliveries
Although statewide per capita GHG emissions have decreased by 12 percent since 2006, transportation specific emissions increased by 2.7 percent from 2014 to 2015.

The number of days with temperatures over 95°F continue to increase regardless of mitigation scenarios. Yearly maximum temperatures will also increase over time, even if emissions peak in 2040.

Scenarios that favor early implementation of mitigation strategies, rather than later implementation, show larger overall emission reductions in recent climate change models.
ROADWAY INNOVATIONS
<table>
<thead>
<tr>
<th>Commercial</th>
<th>2B-3</th>
<th>4-5</th>
<th>6-7</th>
<th>8</th>
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<th>Demonstrations</th>
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<tr>
<td><strong>Mitsubishi</strong></td>
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</table>

*Excludes transit buses, not all models shown*
Heavy-duty Electric Market Growing - Today

2B-3

Commercial Today

Commercial Soon

6-7

8

Demos

*Excludes transit buses, not all vehicles shown
HYDROGEN FUEL CELL TRUCKS

• Nikola and Toyota have produced hydrogen fuel cell powered trucks with long ranges (Nikola 500-750 miles)
• Nikola has partnered with Nel to attempt to build 700 hydrogen fueling stations across the country
• Projected fueling time is 15 minutes, on par with fueling diesel powered engines
Transport refrigeration units (TRU) are refrigeration systems, usually powered by diesel internal combustion engines designed to refrigerate or heat perishable products that are transported in various containers, including semi-trailers, truck vans, shipping containers and rail cars.
Although TRU engines are relatively small, ranging from nine to 36 HP, significant numbers of these engines congregate at distribution centers, truck stops and other facilities, resulting in the potential for health risks to those that live and work nearby.
TOXIC CONTROL MEASURE FOR TRUS

- Since diesel particulate matter has been identified as a toxic air contaminant, the California Air Resources Board (CARB) adopted an Airborne Toxic Control Measure (ATCM) for TRUs and TRU generator sets on Feb. 26, 2004.

- The purpose of CARB regulation is to use a phased approach over about 15 years to reduce the diesel particulate matter emissions from in-use TRU engines that operate in California.
SOLAR POWERED TRU
UBERIZATION OF FREIGHT
Levels of Automation

- **SAE: Level 0**
  - No Automation
  - Driver Involvement: Very high

- **SAE: Level 1**
  - Driver Assistance: Either steering or acceleration/deceleration
  - Driver Involvement: High

- **SAE: Level 2**
  - Partial Automation: Both steering and acceleration/deceleration
  - Driver Involvement: High

- **SAE: Level 2.5**
  - Platooning: All aspects of dynamic driving for following trucks, lead truck requires constant human interaction
  - Driver Involvement: Moderate

- **SAE: Level 3**
  - Conditional Automation: All aspects of dynamic driving, requires constant human monitoring & intervention
  - Driver Involvement: Moderate-low

- **SAE: Level 4**
  - High Automation: All aspects of dynamic driving, requires conditional human monitoring & intervention
  - Driver Involvement: Low

- **SAE: Level 5**
  - Full Automation: All aspects of dynamic driving, requires no human monitoring & intervention
  - Driver Involvement: None
Truck platooning is the linking of two or more trucks in convoy, using connectivity technology and automated driving support systems.

- Lower fuel consumption and CO2 emissions. Given that trucks can drive closer together, the air-drag friction is reduced significantly.
- Can reduce CO2 emissions by up to 16% from the trailing vehicles and by up to 8% from the lead vehicle (according to Ertico ITS4CV study).
- Truck platooning helps to improve safety. Braking is automatic and immediate; the trucks following the lead vehicle only need one-fifth of the time a human would need to react.

[https://vimeo.com/155164547](https://vimeo.com/155164547)
Companies are using geofencing - the use of GPS or RFID technology to create a virtual geographic boundary, enabling software to trigger a response when a mobile device enters or leaves a particular area.

European cities and other locales are using geofencing zones to prevent diesel trucks from operating in sensitive areas.

Some hybrid trucks can automatically switch from diesel powered engines to electric once entering a geofenced zone.
CARGO BIKES

• Cargo bikes are human powered vehicles designed and constructed specifically for transporting loads.

• Vehicle designs include a cargo area consisting of an open or enclosed box, a flat platform, or a wire basket, usually mounted over one or both wheels, low behind the front wheel, or between parallel wheels at either the front or rear of the vehicle.

Velove cargo bikes with e-assist, made for DHL
DELIVERY ROBOTS

- https://www.youtube.com/watch?v=cZTCmx6N7Xc
UNMANNED AERIAL SYSTEMS (UAS)
Unmanned Aerial Systems for Deliveries

An unmanned aerial vehicle (AKA drone) is an aircraft without a human pilot on board. UAVs are a component of an unmanned aircraft system; which include a UAV, a ground-based controller, and a system of communications between the two.

https://www.youtube.com/watch?v=fCtLw4en9JQ
The Industries Where Drones Could Really Take Off

Value of drone powered solutions to industries in 2015 (billion U.S. dollars)

- Infrastructure: 45.2 billion
- Agriculture: 32.4 billion
- Transport: 13.0 billion
- Security: 10.5 billion
- Media & entertainment: 8.8 billion
- Insurance: 6.8 billion
- Telecommunication: 6.3 billion
- Mining: 4.3 billion

Total: $127.3 billion

Source: PwC
Eric’s Not-So-Bold UAS Predictions

- Small packages will be delivered autonomously, no line of sight
- Flights pre-approved by software
- Unauthorized flights or UAVs will be fined
- UAVs will follow main highways to reduce noise
- Veer off to make a delivery
- Properties will have small droneports
- Electric inductive charging
- Within 5-10 years
Maritime Innovations
APL GGC Cold-Ironing Project
Berths 60–63, Oakland, CA

- Existing 460V Main Switchboard
- Transformer
- 6.6KV Shore Connection Switchgear
- 6.6KV Cable Reel
- 6.6KV Power/Control/Data Cable

Ship Loads
Ship Diesel Generators

Control & Communication
Shore Power Outlet Box in Wharf
Shore Power Substation
PG&E Electrical Service
CLEAN TRUCKS PROGRAM

• Launched in 2008, the Port of Long Beach's groundbreaking Clean Trucks Program (CTP) implemented a progressive ban on older heavy polluting diesel drayage trucks. In 2012, the CTP permanently banned the last remaining older, more polluting trucks from Port of LA and Long Beach terminals. When the CTP was fully implemented in 2012, port truck emissions were reduced by more than 90 percent. Today there are over 22,000 drayage trucks available to service the Port of Long Beach terminals, over half of those trucks have 2010 or newer emission-compliant engines.

• Commencing on Oct. 1, 2018, any new trucks registered in the Port Drayage Truck Registry (PDTR) must be model year 2014 or newer. Drayage trucks registered in the PDTR prior to Oct. 1, 2018, that are current on their annual registration fees as of Sept. 30, 2018 and are compliant with state law may continue to operate at the San Pedro Ports.
CARB is exploring amending regulations to accelerate zero emissions cargo handling equipment implementation.

Current regulations apply to cargo handling equipment at ports and rail yards, including but not limited to: yard trucks (hostlers), rubber-tired gantry cranes, container handlers, and forklifts.
Air Emission Reductions

- Sulfur Oxides: 98%
- Diesel Particulate Matter: 87%
- Nitrogen Oxides: 57%
- Greenhouse Gases: 15%
- San Pedro Bay 2005-2016
- Container Volume: 10%
Pasha Green Omni Terminal

Zero and near-zero emission technologies to improve air quality in our community

- Electric Yard Tractors
- High Tonnage Electric Forklifts
- Solar Powered Microgrid
- Electric Top Handler
- Electric On-Road Drayage Trucks

Vessel Exhaust Treatment System
Reduces smog-forming NOx emissions by more than 90%

3,200 Tons Per Year
Greenhouse Gases REDUCED

56,000 Pounds Per Year
Diesel Particulate Matter, Nitrogen Oxides & Other Harmful Emissions ELIMINATED

14,100 Cars Off The Road Per Day
Equivalent South Coast Air Basin CLEAN AIR GAINS
Different Views for Different Users

The Port of Los Angeles Port Information Portal is designed to provide a single location for different port stakeholders to share data on inbound container movements.

By sharing information earlier in the process, supply chain stakeholders are better able to plan moves and position equipment more efficiently.

The Port Optimizer online portal is divided into different “persona” pages, each corresponding to a cargo stakeholder category. Each persona has a unique, secure view into the data about their contracted cargo movements.
# GOPORT! 15 TECHNOLOGY DEPLOYMENTS

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<thead>
<tr>
<th>Improvement Group</th>
<th>ITS Deployments</th>
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<td>GoPort Traveler Information</td>
<td>• GoPort freight ITS information system/application (app)</td>
</tr>
<tr>
<td>Dissemination</td>
<td>• Changeable message signs (CMS)</td>
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<tr>
<td>Communications and Collaboration</td>
<td>• Communications (WiFi)</td>
</tr>
<tr>
<td></td>
<td>• Communications (fiber)</td>
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<tr>
<td></td>
<td>• Center to center (C2C) communications (includes interagency communications and collaboration)</td>
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<tr>
<td>Observation and Detection</td>
<td>• Closed circuit television (CCTV) upgrade to high definition (HD) (including new HD CCTV deployment locations)</td>
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<tr>
<td></td>
<td>• Radio frequency identification (RFID) readers</td>
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<tr>
<td></td>
<td>• Supplemental vehicle detection (speed)</td>
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<tr>
<td></td>
<td>• Queue detection</td>
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<tr>
<td>Traffic and Incident Management</td>
<td>• Advanced rail grade crossing system</td>
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<tr>
<td></td>
<td>• Advanced traffic management system (ATMS)</td>
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<tr>
<td></td>
<td>• Centrally controlled and adaptive signal system</td>
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<tr>
<td>Goods Movement Support</td>
<td>• Weigh in motion (WIM) technology</td>
</tr>
<tr>
<td>Systems &amp; Technology</td>
<td>• Basic smart parking system</td>
</tr>
<tr>
<td>Port Joint TMC/EOC</td>
<td>• Joint Traffic Management Center (TMC) / Emergency Operations Center (EOC)</td>
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**Project Component Integration by the TMC/EOC through the GoPort Mobile App**
ELECTRIC BARGES

• Port Liner, with a history of inland waterway transport, is producing the world's first fully electric, emission-free and potentially crewless container barges that are soon to operate from the ports of Antwerp, Amsterdam, and Rotterdam.

• The vessels, designed to fit beneath bridges as they transport their goods around the inland waterways of Belgium and the Netherlands, are expected to vastly reduce the use of diesel-powered trucks for moving freight.

• The vessels' electric motors will be driven by 20-foot batteries, charged on shore by the carbon-free energy provider Eneco.
• The barges are designed to operate without any crew, although the vessels will be manned initially.

• The vessels are 52 meters long and 6.7m wide, and able to carry 24 20ft containers weighing up to 425 tons. They will be fitted with a power box giving them 15 hours of power.

• As there is no need for a traditional engine room, the boats have up to 8% extra space, according Port Liner. About 23,000 trucks, mainly running on diesel, are expected to be removed from the roads as a result.
• The global shipping fleet now consumes about 4 million barrels per day (bpd) of high Sulphur fuel oil, but about 3 million bpd of that demand will “disappear overnight”, according to the average market forecast calculated by Norway’s SEB Bank.

• Most demand is expected to shift to marine gasoil, a lower Sulphur distillate fuel.
LOW SULFUR FUEL

• The rules, drawn up by the U.N. International Maritime Organization (IMO), will ban ships using fuel with a Sulphur content higher than 0.5 percent, compared to 3.5 percent now, unless a vessel has equipment to clean up its Sulphur emissions.

• Any vessels failing to comply will face fines, could find their insurance stops being valid and might be declared “unseaworthy” which would bar them from sailing.
GE Transportation’s Battery-Electric Locomotive

Massive power generation capabilities up to 2400 kWhrs
Huge fuel savings of at least 10-15%
POSITIVE TRAIN CONTROL

Progress through 3/31/19
100% LOCOMOTIVES EQUIPPED
100% TRACK SEGMENTS INSTALLED
100% RADIO TOWERS COMPLETED
100% TRAINING COMPLETED
80% ROUTE MILES IN PTC OPERATIONS
APPROVED
AVAILABLE

With the FRA’s conditional approval of our PTC safety plan on April 26, 2012, Union Pacific is running PTC operations on over 13,000 miles in Arizona, Arkansas, California, Colorado, Idaho, Illinois, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Nevada, New Mexico, Oklahoma, Oregon, Tennessee, Texas, Utah, Washington, Wisconsin and Wyoming.

HOW PTC WORKS

BRAKING IN PROGRESS

Using GPS, PTC evaluates train’s distance from end of authority limits
Warning given if engineer doesn’t slow train
PTC triggers brakes if engineer doesn’t brake to stop short of limits
DP World Cargospeed & Hyperloop

https://www.youtube.com/watch?v=dQlihCOrvZY
THE RISE OF DISTRIBUTION CENTERS AND AUTOMATION
• Software that runs on a computer
• The software is unique in that it operates through a distributed network of computers across the globe used to record transactions and other types of important information
• This distributed network of computers operating the blockchain software acts as an immutable online ledger that is not owned or controlled by anyone— it is distributed
• Each block contains encrypted information and hashed pointers to a previous block, making it difficult to retroactively alter without modifying the entire chain and the replicas within the peer network.

• New blocks are validated by peers on the network, providing credibility and preventing malicious activity and policy violations.

• According to Stephen P. Williams “The internet that we have now is the internet of information meaning you can pass a lot of information to and fro. But with the internet that’s based on blockchain you can actually pass value, currency, property, intellectual property, physical property and all sorts of data.”
Block Chain Tracking

Supply chains are still using manual processes for tracking food sources and shipping.

Currently difficult and time consuming to track down an issue should one like the recent E. coli romaine lettuce problem rear its head.

By placing a supply chain on the blockchain, it makes the process more traceable, transparent and fully digital.

Each node on the blockchain could represent an entity that has handled the food on the way to the store, making it much easier and faster to see if one of the affected farms sold infected supply to a particular location with much greater precision.

Before moving the process to the blockchain, it typically took approximately 7 days to trace the source of food. With the blockchain, it’s been reduced to 2.2 seconds. That substantially reduces the likelihood that infected food will reach the consumer.
Top Five Priorities:

1. Traffic Management
2. Supply Chain Technology Improvements
3. Collaborative Logistics
4. Freight Parking
5. Rail-Focused Strategies
TRUCK PARKING

- Finding available and safe parking has been a problem for drivers for decades.
- In recent years, this issue has gotten worse as Federal Hours of Service and mandatory rest breaks were instituted.
- Most drivers now are tracked by Electronic Logging Devices to ensure their trucks are not moving and are taking mandatory rest breaks.
- A severe lack of truck parking has forced drivers to park in unsafe and unlit areas without amenities.
TRUCK PARKING

• Drivers often receive tickets for parking in unauthorized areas.

• Fatalities have occurred due to parked trucks.

• ATRI reported that drivers are spending on average about one hour of drive time per day looking for a safe place to park.

• That time results in $4,600 in lost wages annually.

• 63% of drivers are taking 15 minutes or more to look for parking between the hours of 4pm and 12am. Peak truck parking time is 3am in many states.
STATEWIDE TRUCK PARKING STUDY

- Our branch is leading a Statewide Truck Parking Study to help mitigate the impacts of truck parking.
- The study will acquire data of where drivers are actually parking, estimate the unmet demand, and prioritize locations to take actions to address the shortage.
I-10 TRUCK PARKING AVAILABILITY SYSTEM

ATCMTD GRANT
USDOT’s Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant awarded to the I-10 Corridor Coalition of Caltrans, TXDOT, AZDOT, NMDOT
$6.85 million awarded, $13.7 million total project costs, TXDOT lead agency

DETAILS
Covers 37 truck parking locations at public rest areas over 1,700 miles across 4 states
Will provide detection and information and dissemination system in real time
Coordination between D-8 & HQ Traffic Ops and Planning, led by DRISI
In 2005, the Sacramento Valley produced $1.2 billion worth of agricultural goods and 100% of those goods traveled by truck.

60% of all outbound commodities from Sacramento are destined for the San Francisco Bay Area.

All that stuff moving back and forth between the Bay and the Valley generates a TON of GHGs!

*cough cough* *such pollution* *sickness*
The Marine 580 Highway (M-580)

- In 2009, the ports of Oakland, Stockton, and West Sacramento teamed up and were awarded $56 million in TIGER grant funds to make a “Marine Highway” on which to move goods between the Bay and the Valley on the rivers adjacent to the highways.

- This would lead to reduced congestion on the highway, less wear and tear on the road pavement, faster travel times for perishable goods, and clean air.

- In addition to purchasing new barges and cranes for the project, the TIGER grant also provided electric charging stations for ships to plug into while they are docked so they can keep refrigerated goods cold without having to burn diesel to do so. This is called Cold Ironing.
M-580 Corridor Multimodal Freight Network Optimization Study

- Due to labor and logistical complications, the M-580 is not currently in service.
- A new SP&R (State Planning and Research) study is being conducted to come up with supply and demand models for the Marine 580 Highway Corridor, looking at all modes (short line rail, drayage trucks, marine highway) as well as to identify if there are potential customers for restarting the M-580 barge service.
Los Angeles County Metropolitan Transportation Authority (Metro) is building off the USDOTs Freight Advanced Traveler Information System (FRATIS) research

Metro’s offshoot, called Drayage, Freight, and Logistics Exchange (DrayFLEX), is now underway and will look to build upon previous concepts and deployments to explore how connected vehicle technology can improve goods movement.
DRAYFLEX

• The project uses information from the marine terminal operators, trucking companies and traveler information systems to provide status updates on container availability

• Enables trucking companies to set up automated appointments and provide truck drivers the best routes to use to and from the ports

• Metro is testing the system on a fleet of 500 trucks throughout the current four-year project period
OFF HOUR DELIVERY PROGRAM

• Deliveries made at non-peak hours or during the night
• Helps reduce congestion, double parking, blocking business entrances
• Gives businesses more certain arrival times
• Reduced delivery costs, fewer parking tickets, more efficient delivery in the evening hours
• Rail transport of freight and passengers is highly energy efficient when compared to highway modes such as trucking and driving, and the impacts of those efficiencies are multiplied across California’s geographical expanse and major industries.

• A primary source of this advantage comes from the relatively low rolling resistance of steel wheels on steel rail, which requires a smaller amount of energy to pull passenger or freight cars than rubber-tired vehicles.

• When traffic shifts from road to rail, benefits can be achieved not just from the greater environmental efficiency of rail, but also from reductions in congestion on the roadways, reducing pollution and energy use.

• Rail supports efficient (high density and compact) land use with reduced disturbances to natural and agricultural lands
SHORT-LINE RAIL

Rail Fast Facts For 2017

<table>
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<th>Operations</th>
<th>Number of freight railroads</th>
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<tr>
<td></td>
<td>Freight railroad mileage</td>
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<tr>
<td>Employment and Earnings</td>
<td>Number of freight rail employees</td>
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<td></td>
<td>Average wages &amp; benefits per freight rail employee</td>
<td>$123,400</td>
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<tr>
<td>Railroad Retirement</td>
<td>Number of railroad retirement beneficiaries</td>
<td>25,593</td>
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<tr>
<td></td>
<td>Railroad retirement benefits paid</td>
<td>$572 million</td>
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Economic Impact

Nationwide, in 2017, major U.S. railroads supported approximately 1.1 million jobs (about eight jobs for every railroad job), nearly $219.5 billion in annual economic activity, $71 billion in wages and almost $26 billion in tax revenues.

Fuel Efficiency

In 2017, America’s railroads moved a ton of freight an average of 479 miles on one gallon of fuel. That’s like going from Los Angeles to Tucson, AZ. On average, railroads are four times more fuel efficient than trucks. Moving freight by rail instead of truck reduces greenhouse gas emissions by an average 75 percent.

Cutting Highway Gridlock

One train can carry as much freight as several hundred trucks. It would have taken approximately 9.0 million additional trucks to handle the 162.3 million tons of freight that originated in, terminated in, or moved through California by rail in 2017.
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