Goods Movement Emission Reduction Strategies

Study for the Southern California Association of Governments

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Faster Freight Cleaner Air 2008

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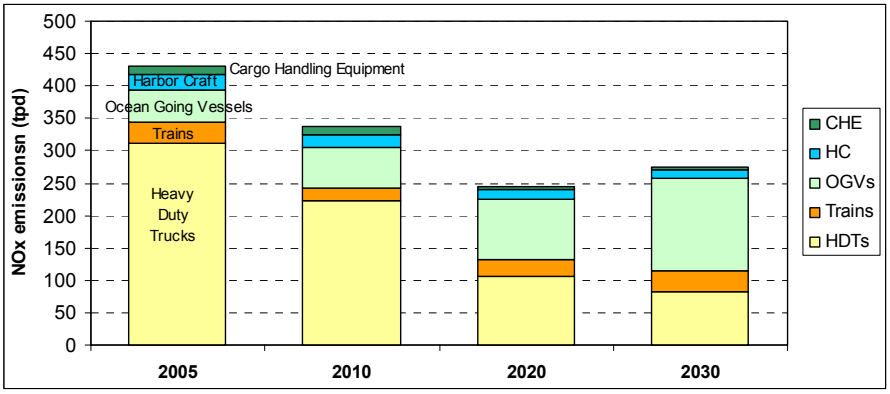
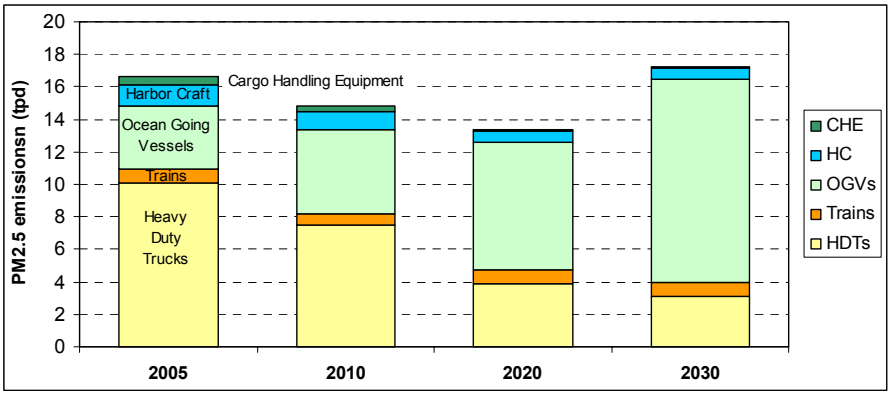
Study Objectives

- Identify potential emission reduction strategies for goods movement
- Estimate emission reductions, costs, and cost-effectiveness of each strategy
- Assess feasibility, timeline, barriers to implementation, and acceptability to stakeholders
- Prioritize strategies and quantify what could be accomplished with given investment
- Support achievement of NAAQS; provide input to AQMP and SCAG RTP updates; project-level mitigation

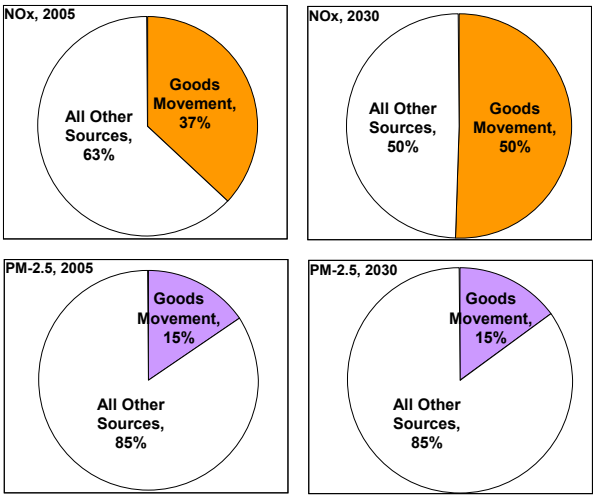
Baseline Goods Movement NOx Emissions (SoCAB)



Baseline Goods Movement PM Emissions (SoCAB)



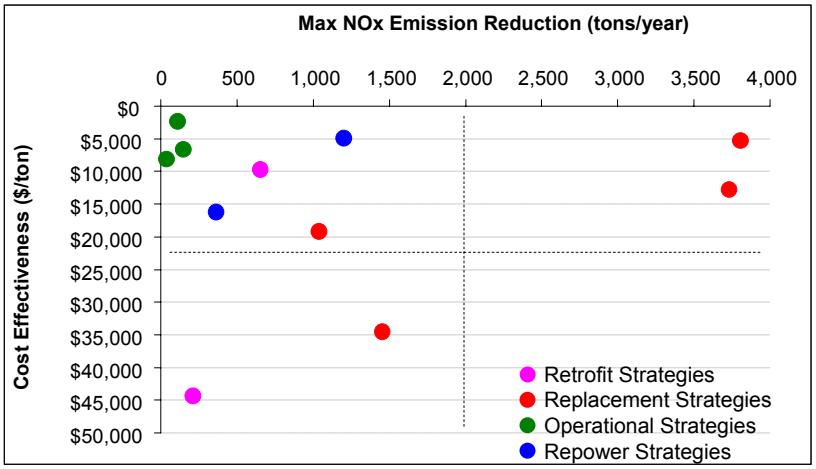
Baseline Goods Movement Emissions (SoCAB)



Truck Emission Reduction Strategies

Strategy Type	Examples
Truck Replacement	• Replace 1999-2006 trucks with 2010+ • Replace 2007-2009 trucks with 2010+ • Replacement with hybrids
Repowering	• Repower pre-1994 truck with 1994-2006 engine
Retrofits	• DOC (25% PM reduction) • FTF (50% PM reduction) • DPF (85% PM reduction); • DPF+LNC (85% PM and 25% NOx reduction)
Alternative Fuels	• Biodiesel • LNG (with truck replacement)
Operational Strategies to Reduce VMT	• Virtual container yard
Operational Strategies to Reduce Congestion	• Truck incident management • PierPass expansion
Infrastructure Projects	• Dedicated truckways • On-dock or near-dock rail expansion

NOx Reductions – Truck Strategies (2010)



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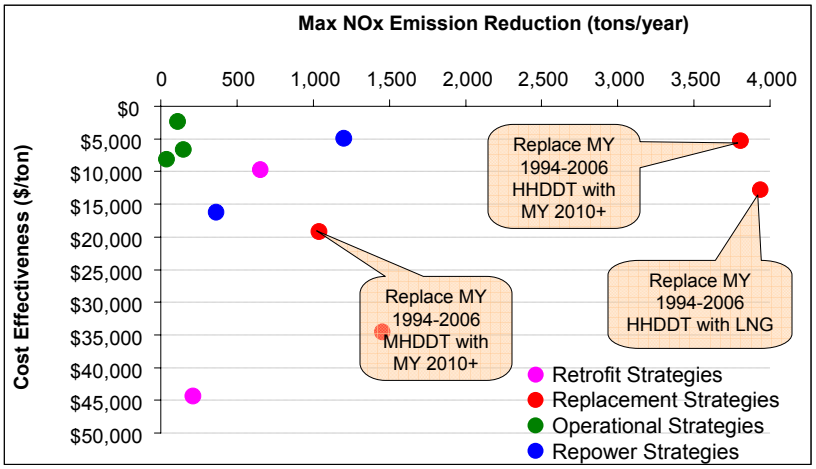

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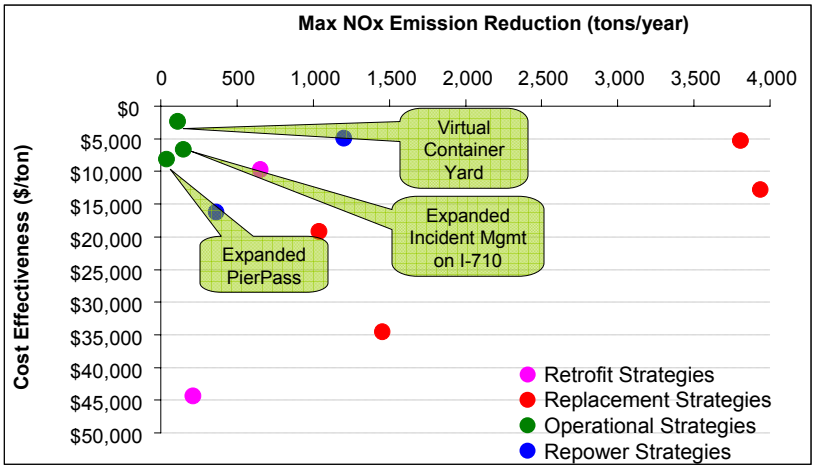

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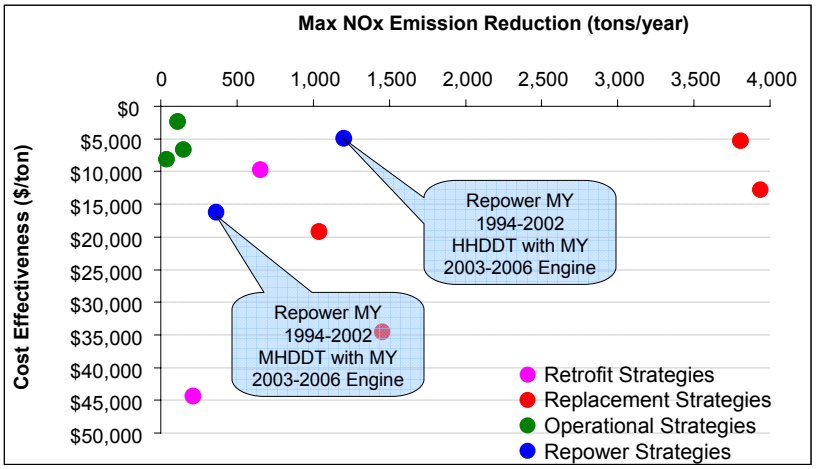

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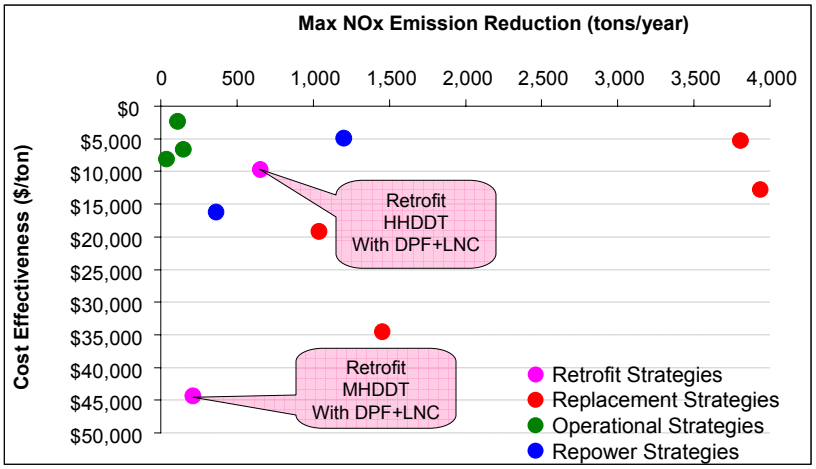
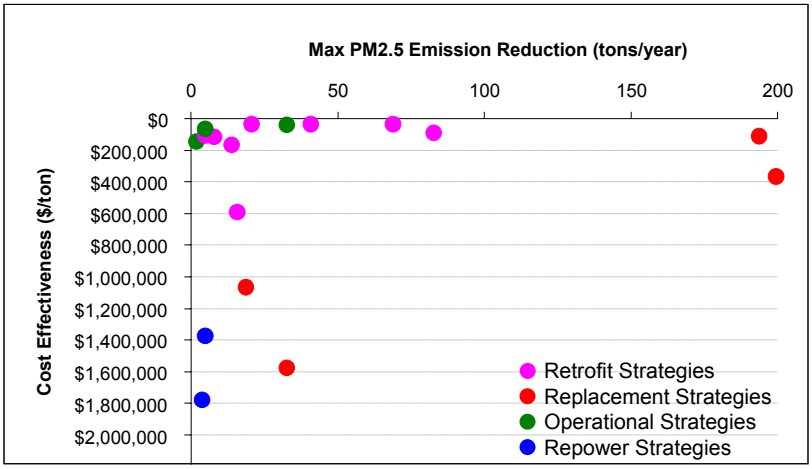


PM Reductions – Truck Strategies (2010)



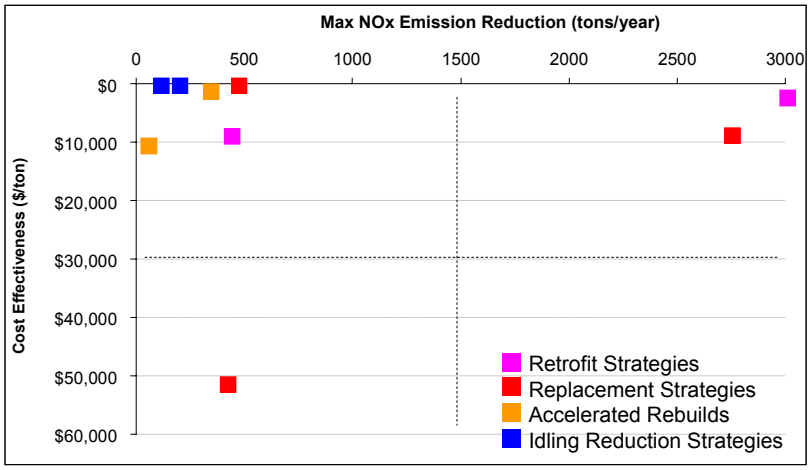
Major Implementation Challenges

- Widely dispersed ownership
- Limited resources to owner-operators and small fleet owners
- Large operating range for some HHDTs
- Participation rates for voluntary programs

Locomotive Emission Reduction Strategies

Strategy Type	Examples
Locomotive Replacement	• Replace Tier 2 locomotives with Tier 4
Repowering	• Repower old Tier 0 engines with Tier 2 engines
Accelerated Rebuilds	• Rebuild Tier 2 engines to new Tier 2/3 standards
Retrofits	• DOCs • DPFs • SCR systems
Hybrid and GenSet Switchers	• Green Goat
Idle Reduction	• AESS devices • Company policy and operator training
Electrification	• Alameda Corridor • Entire mainline system
Infrastructure Projects	• Mainline capacity expansion • On-dock or near-dock rail expansion

NOx Reductions – Rail Strategies (2020)



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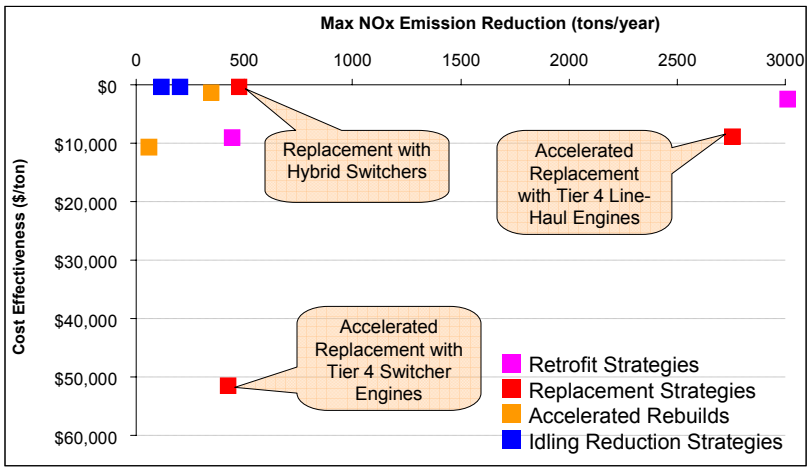

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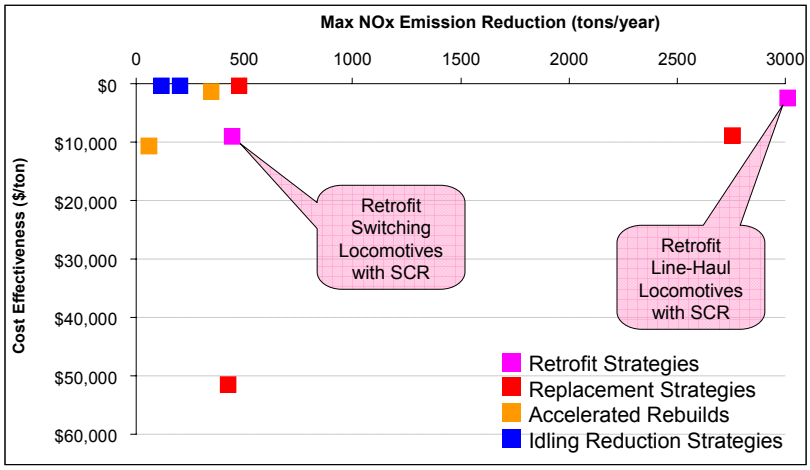

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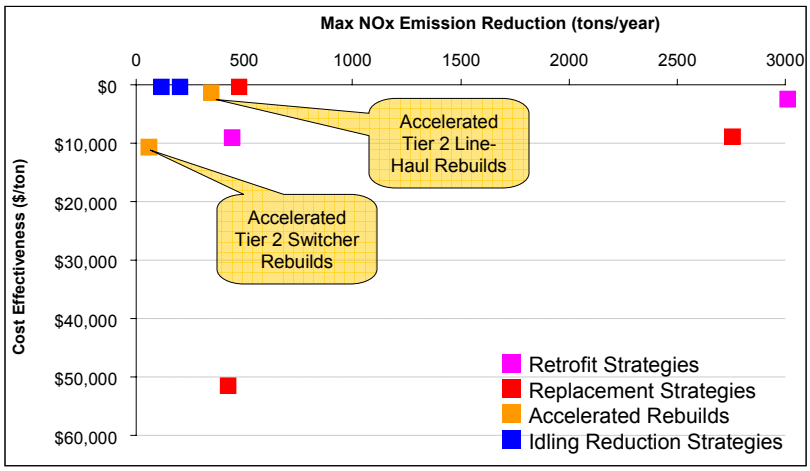

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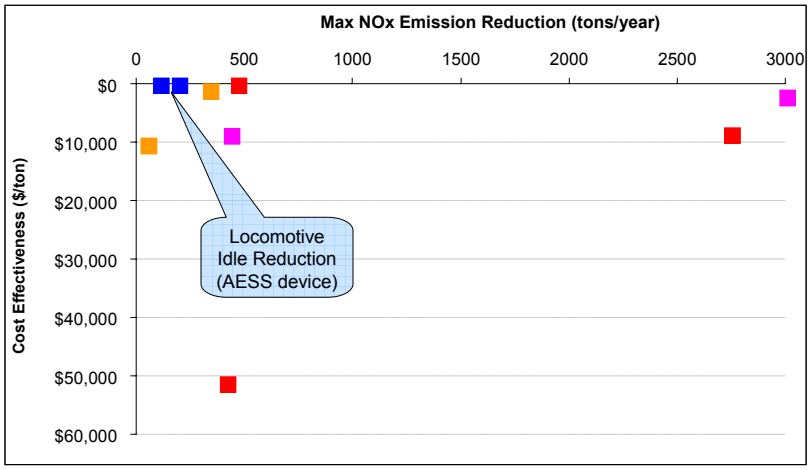
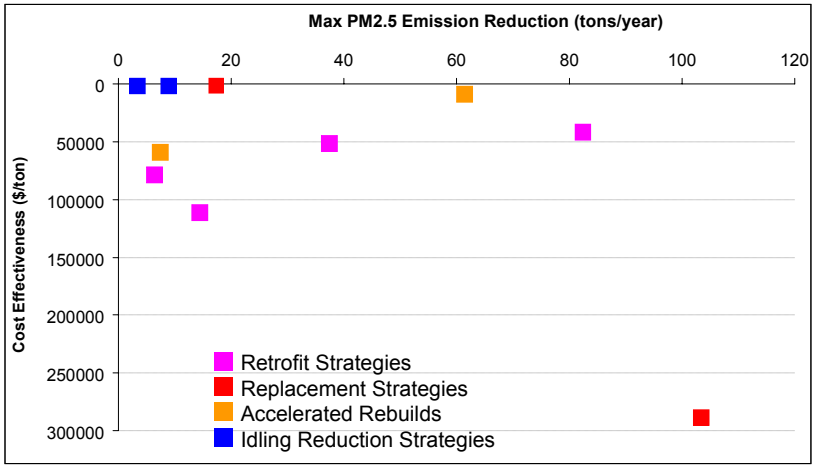


PM Reductions – Rail Strategies (2020)



Major Implementation Challenges

- Retrofits not yet proven, verified
- Large operating range for most line-haul locomotives
- Cost of new locomotives (>$2M for line haul)
- Relatively low production volumes

Infrastructure Strategies Examined

- On-dock rail expansion
- Near-dock rail expansion
- Mainline rail capacity expansion
- Electrification of Alameda Corridor
- Electrification of entire regional rail mainlines

On-Dock Rail Expansion

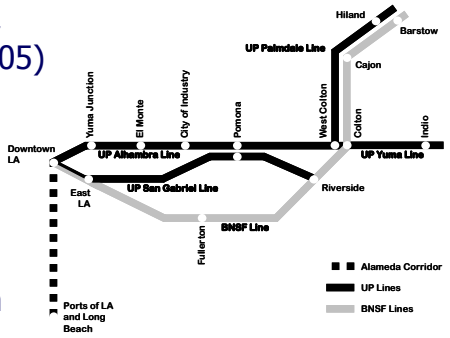
- Methodology and Key Assumptions
  - By 2020, 72 additional trains/weekday carrying on-dock cargo
  - Shift from near-dock
  - Impacts on truck trips estimated using QuickTrip (2.8 trk trips eliminated per 40-ft container)
  - Increase in locomotive emissions based on train fuel efficiency and avg train weight
  - Costs: $1 billion

Near-Dock Rail Expansion

- Methodology and Key Assumptions
  - Based on impact of SCIG
  - Shift trips from Hobart terminal (3 mi vs. 20 mi)
  - Impacts on truck trips estimated using QuickTrip (1.7 trk trips shifted per 40-ft container)
  - Increase in locomotive emissions based on train fuel efficiency and avg train weight
  - Costs: $200 million

Inland Railroad Capacity Expansion

- Methodology and Key Assumptions
  - Rail simulation modeling, from Leachman et al (2005)
  - Benefits:
    - Smoother train flows
    - Grade separation
  - Costs: $2.3 - $2.6 billion

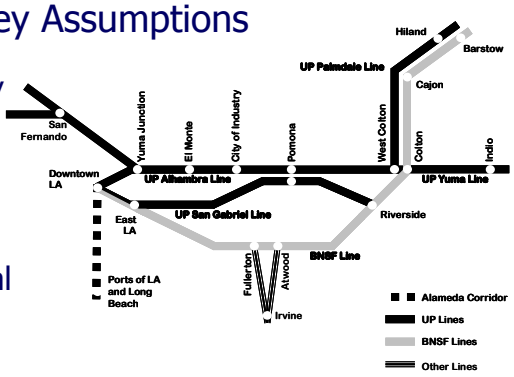


Electrification of Alameda Corridor

- Methodology and Key Assumptions
  - Estimate annual locomotive-miles by rail segment for entire region
  - Alameda Corridor is 10.9% of total locomotive-miles: assume proportional to mainline emissions
  - Estimate incremental electric power demand – assume all generation in SoCAB
  - Cost: $233M for infrastructure, $24M for engines

Electrification of Regional Rail Mainlines

- Methodology and Key Assumptions
  - Locomotive-miles by segment
  - 99% of mainlines electrified
  - Estimate incremental electric power demand
  - Cost: $4.9B for infrastructure, $1.5B for locomotives



Summary of Infrastructure Strategies

Strategy	Emission Reduction (tons/yr) NOx	PM2.5	Cost Effectiveness ($/ton) NOx	PM2.5
On-dock rail expansion	516	23	$100,000	$2,243,000
Near-dock rail expansion	112	5	$63,000	$1,413,000
Railroad mainline capacity expansion	2,069	69	$42,000	$1,371,000
Alameda corridor electrification	831	26	$9,000	$304,000
Total mainline railroad electrification	7,557	236	$25,000	$847,000

Infrastructure Strategies: Limitations and Research Needs

- Source of diversion for incremental on-dock, near-dock moves
- Relationship between railroad capacity, train speeds, and emissions
- Operational feasibility of electrification

Strategy Benefits as Percent of AQMP Reductions for PM2.5 Attainment (2014)

	NOx	PM2.5
Replace MY 1994-2006 HHDDTs w/ 2007+ (10%)	5%	4%
Retrofit MY 1993-2003 HHDDTs w/ DPF+LNC (10%)	1%	2%
Expanded Incident Management for Trucks on I-710	0%	1%
Retrofit Line-haul Locomotives w/ SCR (50%)	4%	0%
Retrofit Line-haul Locomotives w/ DPF (50%)	0%	2%
Accelerate Tier 2 Line-haul Locomotive Rebuilds (50%)	0%	1%
Accelerate Tier 4 Line-haul Locomotive Replacement (50%)	4%	2%
On-dock rail expansion	1%	0%
Railroad mainline capacity expansion	3%	1%
Alameda corridor electrification	1%	1%
Total mainline railroad electrification	11%	5%

Questions or Comments?

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