

SmartWay Transport Partnership

The SmartWay DrayFLEET Model:
Modeling Port Drayage Emissions and
Costs

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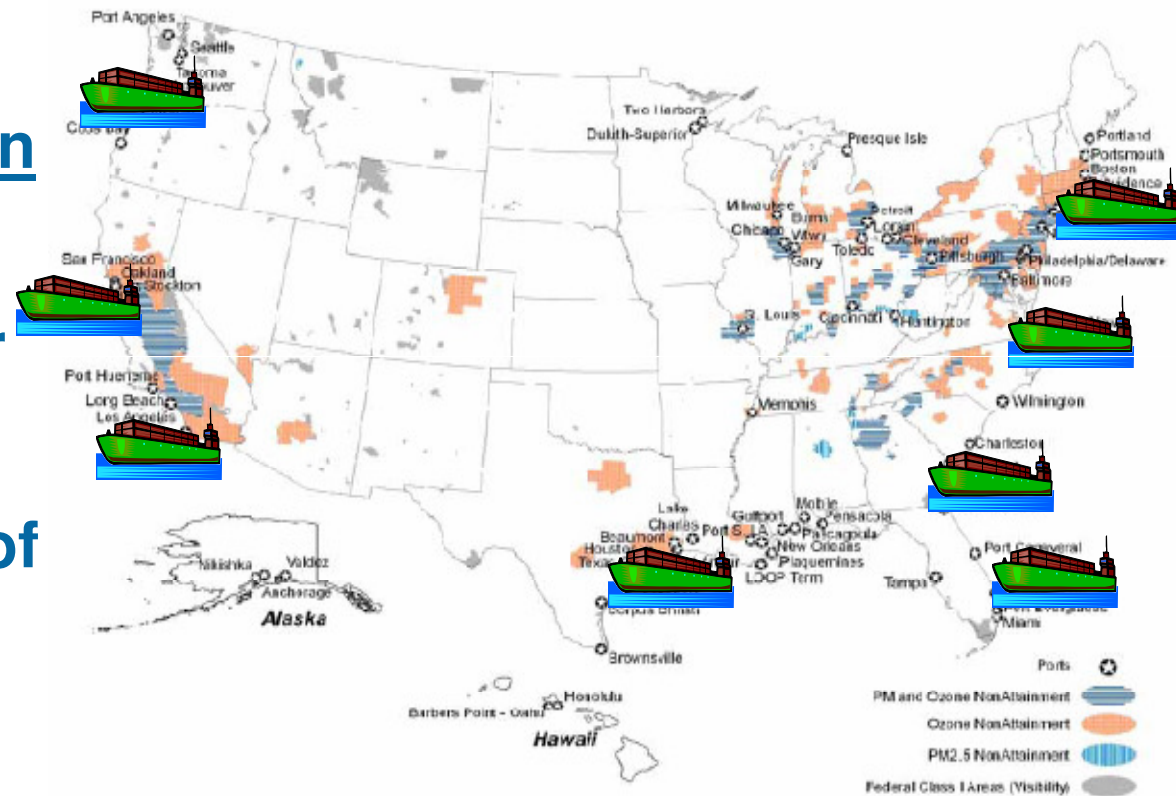
FASTER FREIGHT - CLEANER AIR
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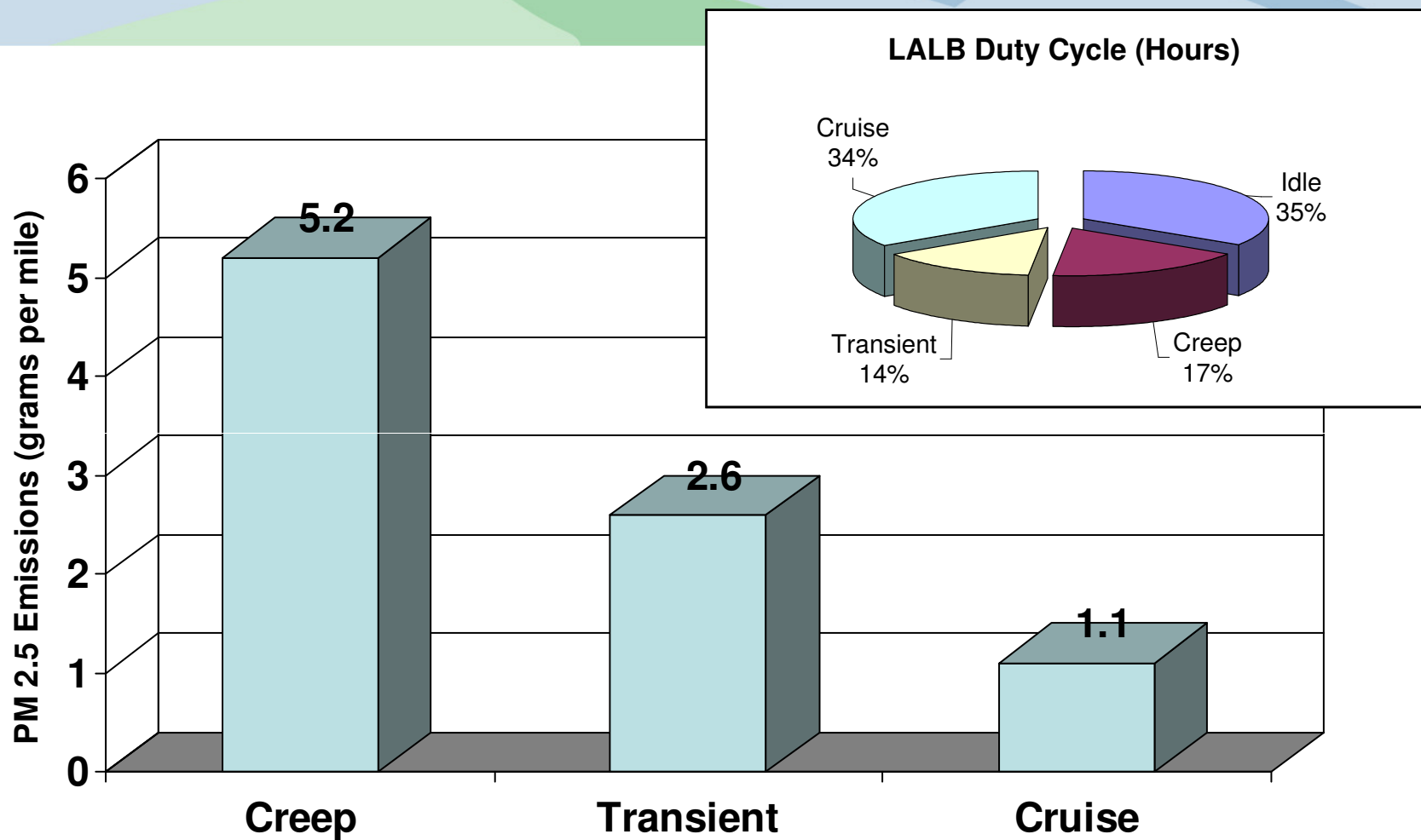


Port Drayage and Nonattainment Areas

- Ports are urban environments
- Typically older Class 8s
- Major source of PM and NO_x emissions



PM 2.5 Emissions by Drive Cycle/Speed



Clark, Nigel N., et al. *California Heavy Heavy-Duty Diesel Truck Emissions Characterization for Program E-55/99*. West Virginia University Research Corporation. Morgantown: November 11, 2005

Strategies to Reduce Drayage Emissions

- **Technology Solutions**
 - Diesel Oxidation Catalysts
 - Diesel Particulate Filters
 - Flow Through Filters
 - Idling Control
- **Terminal Management Strategies**
 - Chassis Pools
 - Virtual Container Yards
 - Improved Gate Operations/reduced queues
 - On-dock rail

SmartWay DrayFLEET Model



Key Stakeholders

- EPA
- DOT
- Associations
- Ports



THE PORT AUTHORITY OF NY & NJ

DrayFLEET Goals and Users

- **Goals**
 - Estimate comprehensive drayage emission inventories
 - Identify cost-saving emissions reduction strategies
 - Integrate drayage into the SmartWay supply-chain network
- **Audience/Users**
 - Port Authorities
 - Terminal Owners and Operators
 - State and Regional Trucking Associations
 - State and Regional Air Quality Agencies
 - Metropolitan Planning Organizations
- **Can support SIP modeling with additional analysis**
- **Part of Agency-wide Ports Sustainability Strategy**

Primary Inputs and Outputs

Primary Inputs

- Number of containers
- Rail intermodal share
- Distance to
 - Rail
 - Shippers & receivers
 - Container depots
- Gate queue minutes
- Labor costs
- Fuel costs

Primary Outputs

- Number of trips
- VMT
- Hours of idle, creep, transient, and cruise
- Criteria and CO2 emissions
- Gallons of fuel
- Total drayage costs
- Costs per container

DrayFLEET Input Page

**DEFAULTS –
ADJUSTED TO MATCH
PORT**

Primary Inputs		Default	Scenario
Port			
Calendar Year		2007	2007 ▼
Annual TEU		15,667,504	15,667,504
Average TEU per Container		1.85	1.85
Inbound Share		53%	53%
Inbound Empty Share		2%	2%
Outbound Empty Share		57%	57%
Rail Intermodal Share		45%	45%
Marine Terminals			
Average Inbound Gate Queue Minutes		11	11
Average Marine Terminal Min. per Transaction		19	19
Rail Terminals			
Weighted Average Miles from Port		14	14
Average Inbound Gate Queue Minutes		5	5
Average Rail Yard Min. per Transaction		15	15
Container Depots			
Weighted Average Miles from Port		4	4
Share of Empties Stored at Depots		5%	5%
Container Shippers/Receivers			
Weighted Average Miles from Port		15	15
Weighted Average Crosstown Trip Miles		15	15
Cost Factors			
Average Drayage Labor Cost per Hour	\$	12.00	\$ 12.00
Average Diesel Fuel Price per Gallon	\$	4.00	\$ 4.00

**SCENARIOS –
ADJUSTED TO TEST
OPTIONS**

DrayFLEET Terminal Initiatives

DEFAULTS – EXISTING STRATEGIES

Initiative Inputs	Default	Scenario
Port/Terminal Initiatives		
Stacked Terminal (% stacked)	0%	0%
On-Dock Rail (% of rail on-dock)	40%	0%
Automated Gates (% of gate transactions)	50%	0%
Extended Gate Hours (% off-peak, 50% max)	30%	0%
Container Info System (% used)	90%	0%
Virtual Container Yard (% available)	0%	0%
Neutral Chassis Pool (% used)	0%	0%

SCENARIOS – CANDIDATE STRATEGIES

DrayFLEET Technology Options

Drayage Fleet Technology Inputs*			SHARE OF FLEET USING TECHNOLOGY
Technology Retrofits			
<input type="checkbox"/> Particulate Filter/Trap	% of eligible fleet retrofit		50%
<input type="checkbox"/> Oxidation Catalyst	% of eligible fleet retrofit		50%
<input type="checkbox"/> Flow-Through Filter	% of eligible fleet retrofit		50%
Idle Reduction			
<input type="checkbox"/> Idling Control Strategies	% reduction in idle		50%
Fuel Conservation			
<input type="checkbox"/> Single-Wide Tires	% of fleet		50%
<input type="checkbox"/> Automatic Tire Inflation	% of fleet		50%
<input type="checkbox"/> Tare Weight Reduction	% of fleet		50%
	lbs of weight saved		2,000
<input type="checkbox"/> Low Friction Engine Lubricant	% of fleet		50%
<input type="checkbox"/> Low Friction Drive Train Lubricant	% of fleet		50%
<input type="checkbox"/> Direct Drivetrain	% of fleet		50%
<input type="checkbox"/> Single Axle Drive (vs. Dual Axle)	% of fleet		50%
<input type="checkbox"/> Speed Management Policy (55 mph)	% of fleet		50%

TECHNOLOGIES IN USE

Additional Detailed Inputs

DrayFLEET incorporates additional detail where available for marine terminals, rail terminals, depots, etc.

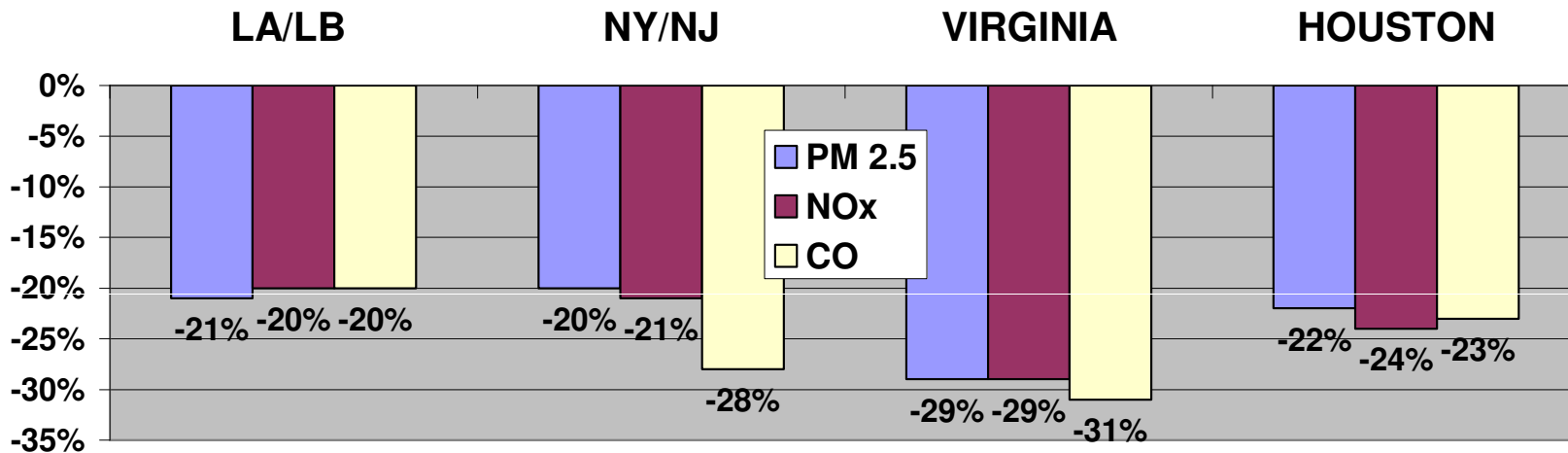
Marine Terminal Drayage Activity						
This worksheet reflects movements of loaded containers, empty containers, bare chassis, and bobtail tractors to and from marine container terminals						RESTORE GENERIC DEFAULTS
Note: OB/Export Containers come IN to the Marine Terminal Gate, and vice versa						
Activity	Trips	%	Duration (Minutes)	Waiting Time (Minutes)	Travel Time (minutes)	Distance (Miles)
Bound/Export Containers						
= user changeable inputs						
Total Containers Entering Terminal Gate	876,334					
Loaded Containers	432,857	30%				(over-the-road movement shown on other worksheets)
Empty Containers	443,477	30%				
Bare Chassis	145,871	10%	12	-	12	5
Bobtail Tractors	438,167	30%	35	-	35	15
Total Trips	1,460,372	100%				
Entry Gate Transactions						
Entry Gate Transaction	1,460,372	100%	3	3	-	-
Outside Queuing	1,460,372	100%	15		15	0.5
Trouble Window	73,019	5%	45	41	4	0.1
Bypass Entrance	-	0%	1	-	1	0.3
Container Yard Activity						
Pick Up Loaded Container on Chassis	548,286	27%	27	25	2	0.5
Pick Up Empty Container on Chassis	326,939	16%	27	25	2	0.5
Locate & Pick Up Bare Chassis	146,056	7%	27	15	2	0.5
Drop Loaded Container on Chassis	432,857	21%	27	25	2	0.5
Drop Empty Container on Chassis	443,477	22%	27	25	2	0.5
Drop Bare Chassis	145,871	7%	5	5	2	0.5
Chassis Flip/Transfer	8,752	0%	42	40	2	0.5
Live Lift Container onto Chassis	-	0%	27	27	0	0.1
Live Lift Container off of Chassis	-	0%	27	27	0	0.1
Total Transactions	2,052,237	100%				
Container Yard Delays						
Trouble Window	102,612	5%	30	27	3	0.1
Equipment Issue	51,064	5%	60	52	8	0.3
Bound/Import Containers						
Total Containers Exiting Terminal Gate	875,224					
Loaded Containers	548,286	38%				(over-the-road movement shown on other worksheets)
Empty Containers	326,939	22%				
Bare Chassis	146,056	10%	12	-	12	5
Bobtail Tractors	435,763	30%	35	-	35	15
Total Trips	1,457,043	100%				
Exit Gate Transactions						
Exit Gate Transaction	1,457,043	100%	3	5	-	-
Inside Queuing	1,457,043	100%	5		17	0.5
Trouble Window	72,852	5%	30	-	-	-
Bypass Exit	-	0%	1		-	-
Loaded Subtotal						
	981,143	34%	49,447,049	31,525,762	17,921,286	970,870
Bobtail/Chassis/Empty Subtotal						
	1,936,271	66%	102,551,426	41,235,576	61,315,850	16,041,668
Marine Terminal Total						
	2,917,414	100%	151,998,474	72,761,339	79,237,136	17,012,538

DrayFLEET Case Study Results

- Four case studies: LA/LB, NY/NJ, Virginia, Houston
- Worked closely with ports to develop case study data inputs and results
- Evaluated effectiveness of existing strategies already implemented at ports – five mile impact area

Emission Reductions from Existing Management Strategies

% REDUCTION

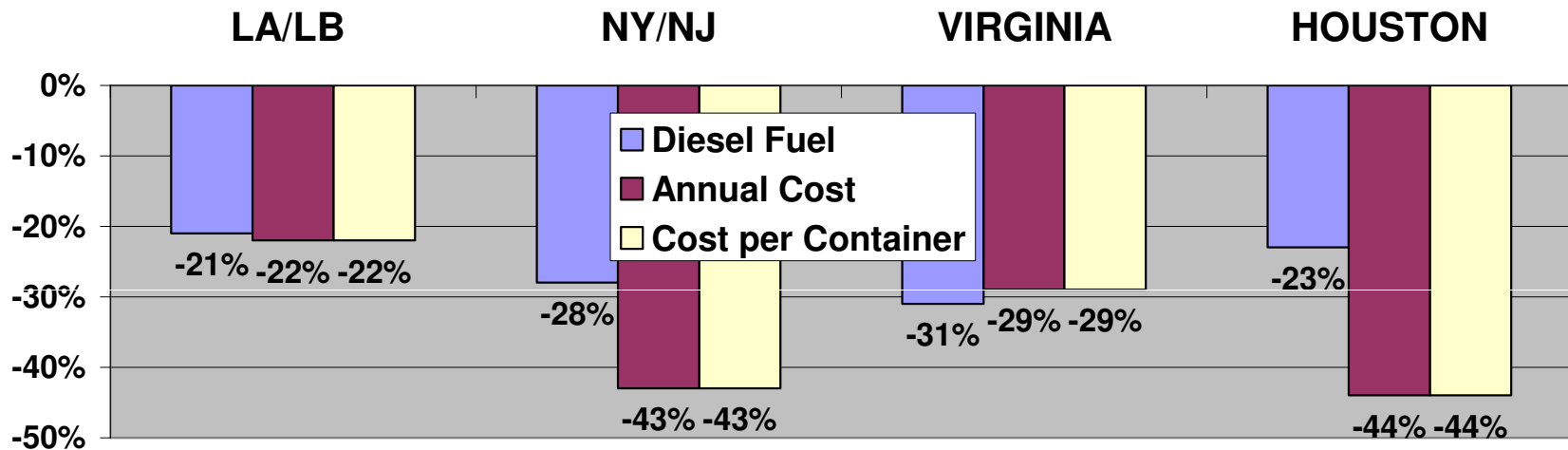


ANNUAL TONS SAVED

	LA/LB	NY/NJ	VIRGINIA	HOUSTON
PM 2.5	42	10	3	3
NOx	1,394	394	167	90
CO2	132,633	31,214	11,385	9,936

Cost Savings from Existing Management Strategies

% REDUCTION



ANNUAL SAVINGS

	LA/LB	NY/NJ	VIRGINIA	HOUSTON
Gallons of Fuel (millions)	12	3	1	1
Drayage Cost (millions)	\$ 142	\$ 100	\$ 23	\$ 32
Cost per Container	\$ 17	\$ 32	\$ 19	\$ 50

Conclusions

- Operational improvements can reduce port-area emissions by 20% to 29%, and costs by 22% to 44%
- Chassis pools, improved gate operations, and on-dock rail could substantially reduce emissions and costs
- EPA is encouraging every major U.S. port to:
 - **use the DrayFLEET model**
 - **publish a drayage emissions inventory, and**
 - **develop an emission reduction strategy**

Downloading DrayFLEET

- From EPA SmartWay
 - epa.gov/smartway/transport/partner-resources/resources-drayage.htm
- From Tioga FTP site
 - <ftp://ftp.tiogagroup.com/htdocs/DrayFLEET/>
 - username: drayfleet%0163e52
 - password: DrayFLEET2008
- email dsmith@tiogagroup.com