Public Workshop
Vessel Speed Reduction
for Ocean-Going Vessels
Sacramento
September 9, 2008

Air Resources Board
California Environmental Protection Agency

Overview

- Background
- Proposed Approaches
- Impacts
  - Emissions
  - Environmental
  - Economic
- Potential Issues
- Next Steps

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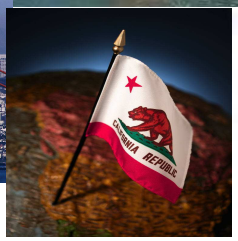
Background



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Background

Evaluation Update

- **VSR Technical Assessment Report**
  - Evaluate Emissions Impacts
  - Estimate Potential Exposures
  - Estimate Health Risk
  - Evaluate Economic Impacts

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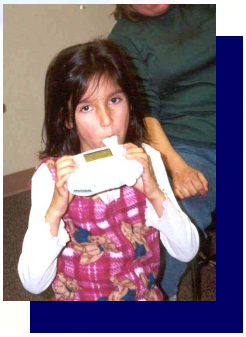
Background

Air Pollution is a Serious Public Health Concern

- **Numerous studies have confirmed a link between air pollution and adverse health impacts**
  - **premature death**
  - **respiratory disease**
  - **reduced lung function in children**
  - **cardiovascular disease**
  - **cancer**



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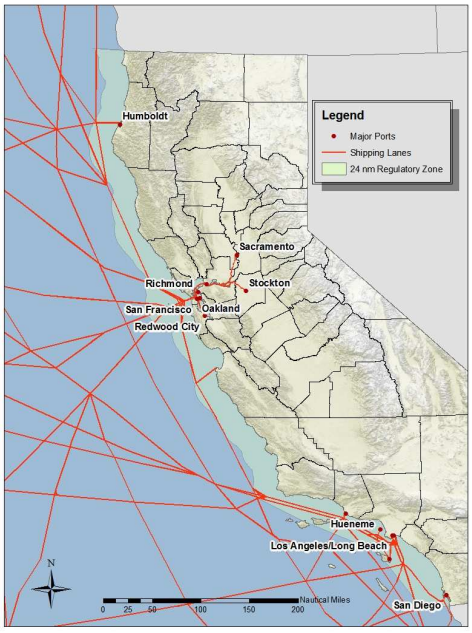
Background

- **California: major gateway to global trade**
- **16 ports involved with waterborne commerce**
- **About 11,000 ship visits per year**



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Background

Ocean-Going Vessels Impact Air Quality and Public Health

- Large and growing source of PM, NOx, SOx, and CO_2 emissions
- Significant localized and regional impacts
- Contributor to ambient levels of PM and ozone
- Contributor to cancer risk and PM mortality

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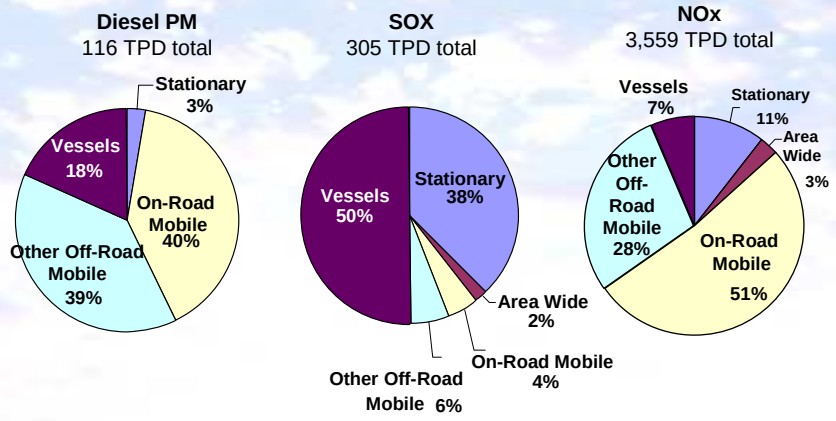
Background

Ocean-Going Vessels are a Large Source of Emissions



Total CO_2 emissions from OGVs are 16,950 TPD

*** Source: 2006 ARB Emissions Inventory. Does not include benefit of ARB Ship Auxiliary Engine Regulation (Vessel emissions within 100 nm)**

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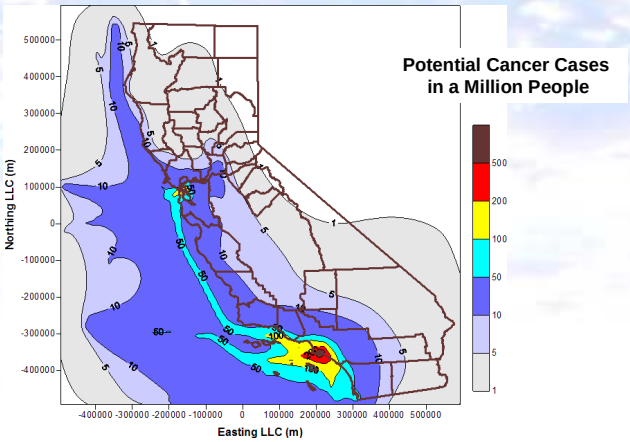
Background

Ocean-Going Vessels Diesel PM Exposures and Cancer Risk*



*2005 ARB Statewide Emissions Inventory
(Based on emissions within 100 nm)

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Background

Ocean-Going Vessels Non-Cancer Impacts*

- **1,100 premature deaths per year**
- **31,000 cases of asthma-related and other lower respiratory symptoms per year**
- **2,600 cases acute bronchitis per year**
- **190,000 work loss days per year**

***Estimates are based on air dispersion modeling of direct PM2.5 emissions statewide and indirect PM2.5 (sulfates and nitrates) in the South Coast for the year 2005.**

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Background

Key California Initiatives

- **Diesel Risk Reduction Plan (2000)**
- **Goods Movement Emission Reduction Plan (2006)**
- **AB 32-Global Warming Solutions Act (2006)**

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Background

Current Efforts to Reduce Ocean-Going Vessel Emissions

- Onboard Incineration Regulation
- Shore-Power Regulation
- Low Sulfur Fuel Regulation

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Background

Benefits of a VSR Measure

- **Provide Reductions in Toxic Air Contaminants**
  - **Diesel PM**
- **Provide Reductions in Criteria Pollutants**
  - **NOx**
  - **SOx**
- **Provide Reductions in Greenhouse Gases**
  - **CO_2**

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Proposed Approaches

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Proposed Approaches

- Voluntary Programs
  - 12 knots at 24 nm or 40 nm
  - At major ports or along busy shipping channels
- Regulatory Measures
  - 12 knots at 24 nm or 40 nm
  - At major ports or along busy shipping channels
  - ARB enforcement

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Impacts

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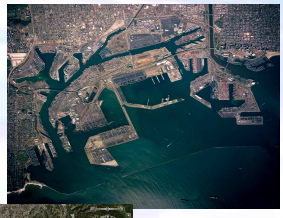
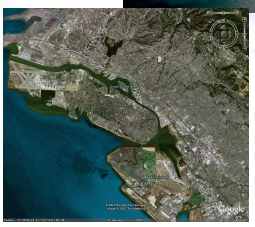
Impacts of VSR

- **Emissions Impacts**
- **Environmental Impact**
  - **Modeling**
  - **Health**
- **Economic Impact**





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Emissions Impacts

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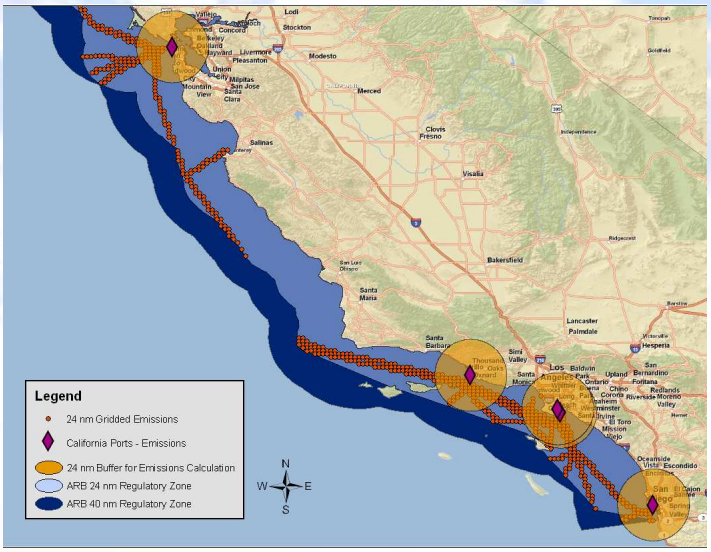
Emissions Impacts

Emissions within the 24 nm Zones



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Emissions Impacts

Emissions Estimates

Total Emissions for Five Major Ports with and without VSR in the 24 nm Zone for 2008 (tons/day)*

Pollutants	Without VSR	With VSR	% Emission Reduction
Diesel PM	5	4	20
NOx	52	41	21
SOx	44	37	16
CO_2	2995	2578	14

*Assume all vessels reduce speed to 12 knots within 24 nm zone. Numbers are rounded

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Emissions Impacts

Emissions Estimates

Total Emissions for Five Major Ports with and without VSR in the 24 nm Zone for 2012 (tons/day)*

Pollutants	Without VSR	With VSR	% Emission Reduction
Diesel PM	1	0.8	20
NOx	59	46	21
SOx	1.9	1.6	16
CO_2	3397	2924	14

*Assume all vessels reduce speed to 12 knots within 24 nm zone.
Numbers are rounded

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Emissions Impacts

Emission Reduction Benefits 24 nm

2008 and 2012 Emission Reductions at Five Major Ports for 12 Knot VSR Measure at 24 nm (tons/day)

Ports	Diesel PM	NOx	SOx	CO_2
2008				
Los Angeles/Long Beach	0.1	1	0.6	41
San Diego	0.04	0.4	0.3	21
Bay Area	0.4	4.7	2.8	172
Hueneme	0.4	5.1	3.1	184
Total	0.9	11.2	6.8	418
2012				
Los Angeles/Long Beach	0.02	1.1	0.03	46
San Diego	0.008	0.5	0.01	24
Bay Area	0.07	5.2	0.1	193
Hueneme	0.08	5.6	0.1	206
Total	0.2	12.4	0.2	469

***Numbers are rounded**

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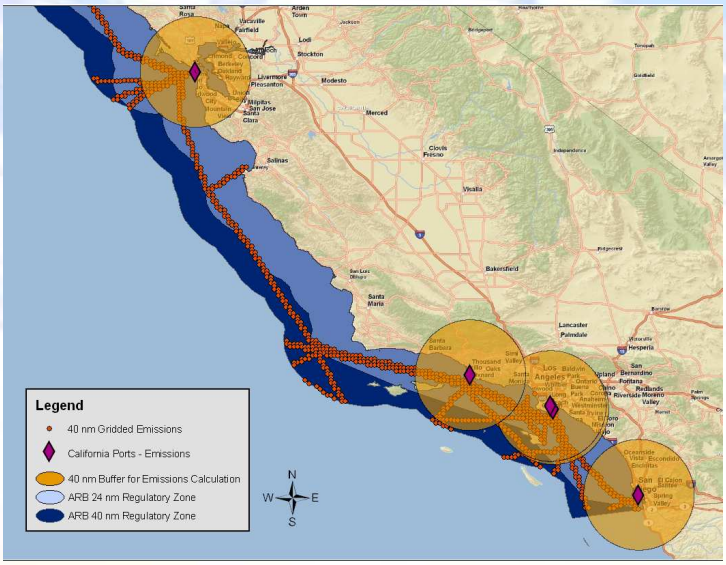
Emissions Impacts

Emissions within the 40 nm Buffer Zones



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Emissions Impacts

Emissions Estimates

Total Emissions for Five Major Ports with and without VSR in the 40 nm Zone for 2008 (tons/day)*

Pollutants	Without VSR	With VSR	% Emission Reduction
Diesel PM	8.4	5.7	32
NOx	92	59	36
SOx	68	48	30
CO_2	4481	3247	28

*Assume all vessels reduce speed to 12 knots within 40 nm zone. Numbers are rounded.

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Emissions Impacts

Emissions Estimates

Total Emissions for Five Major Ports with and without VSR in the 40 nm Zone for 2012 (tons/day)*

Pollutants	Without VSR	With VSR	% Emission Reduction
Diesel PM	16	11	32
NOx	115	74	36
SOx	147	103	30
CO_2	5602	4059	28

*Assume all vessels reduce speed to 12 knots within 40 nm zone. Numbers are rounded.

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Emissions Impacts

Emission Reduction Benefits 40 nm

2008 and 2012 Emission Reductions at Five Major Ports for 12 knot VSR Measure at 40 nm (tons/day)

Ports	Diesel PM	NOx	SOx	CO_2
2008				
Los Angeles/Long Beach	0.6	7.4	4.6	286
San Diego	0.1	1.3	0.8	56
Bay Area	0.8	9.5	5.8	352
Hueneme	1.2	14.7	8.9	541
Total	2.7	32.9	20.1	1235
2012				
Los Angeles/Long Beach	1.2	9.2	10.0	358
San Diego	0.2	1.6	1.8	70
Bay Area	1.5	11.8	12.5	440
Hueneme	2.3	19.9	19.4	676
Total	5.2	42.5	43.7	1544

***Numbers are rounded**

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Emissions Impacts

Comparison of Emissions Benefits 24 nm and 40 nm

Emission Reduction benefits at 24 nm and 40 nm for 12 knot VSR measure for 2008 and 2012

Pollutant	24 nm (tons/day)	40 nm (tons/day)
2008		
Diesel PM	0.9	2.7
NOx	11.2	32.9
SOx	6.8	20.1
CO_2	418	1235
2012		
Diesel PM	0.2	5.2
NOx	12.4	42.5
SOx	0.2	43.7
CO_2	469	1544

***Numbers are rounded. Emissions are the sum of all 5 major ports.**

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Emissions Impacts

AB-32 Greenhouse Gases

- ARB required to develop and implement measures to reduce greenhouse gas (GHG) emissions
- VSR recognized as a GHG measure
  - Slowing vessel speeds reduces CO_2 emissions
- For 2020, reductions of about 0.3 $MMTCO_2E$ (690 tpd) at 24 nm and 0.8 $MMTCO_2E$ (2260 tpd) at 40 nm
  - Assumes vessels do not speed up at other parts of the voyage to make up for lost time in the VSR zone.

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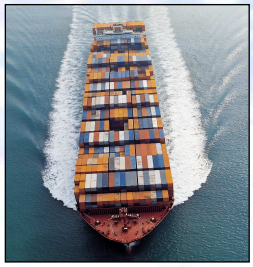
Environmental Impacts

- Modeling
- Health Impacts



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Modeling

Air Dispersion Modeling

- Air dispersion models are being used to estimate emissions impacts from OGVs on regional and local (near-source) coastal communities
- Baseline modeling from OGV Fuel Regulatory Analysis for the South Coast Air Basin (SCAB)

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Modeling

VSR Modeling Overview

Direct Diesel PM Emissions:

- CALPUFF
- Focus on Diesel PM
- 2005 emissions within 24nm and 40 nm
- Port Specific (BA, LA/LB, SD) and a Coastal location near Santa Barbara

Direct and Secondary PM Emissions:

- CMAQ
- Applies to Diesel PM, PM, NOx, SOx
- 2005 emissions within 24nm and 40nm
- Photochemically impacted emissions in the SCAB

Projected Modeling Completion October 2008

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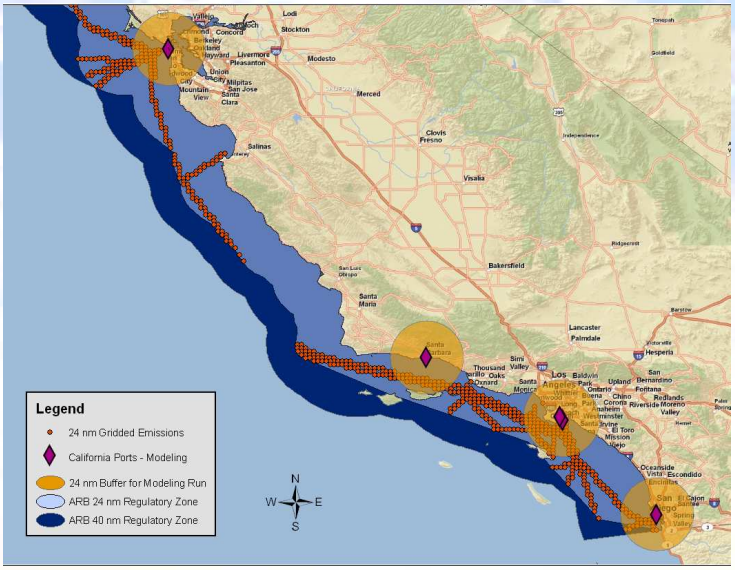
Modeling

Air Dispersion Modeling (24 nm)



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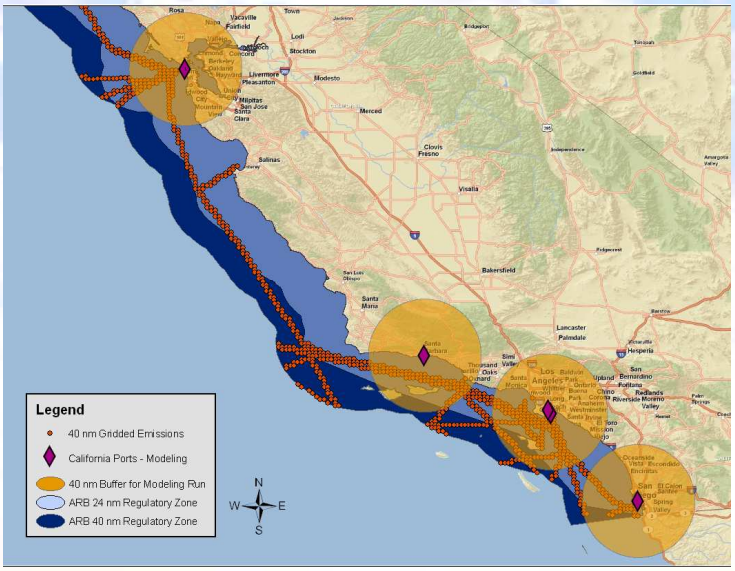
Modeling

Air Dispersion Modeling (40 nm)



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Health Impacts

Health Risk Assessment

- A health risk assessment (HRA) is an evaluation to determine the potential health impacts that may be associated with a source of emissions
- HRA provides an estimate of the risk (probability) of developing of cancer or non-cancer health impacts

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Health Impacts

Proposed VSR Health Risk Assessment

- Include emissions of Diesel PM, NOx, and SOx
- Focus on busiest ports and one coastal location within 24 and 40nm of coastline
- Use 2005 OGV emissions inventory and the results from the various models and modeling scenarios previously discussed
- Present the regional and local health impacts of pollutants from OGVs with and without VSR measures
- Potential cancer impacts from Diesel PM
- Potential non-cancer impacts from directly emitted and secondarily formed PM

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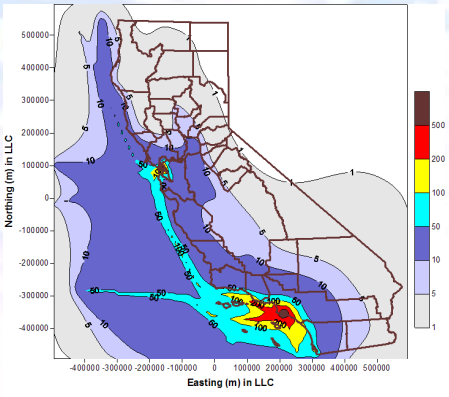
Health Impacts

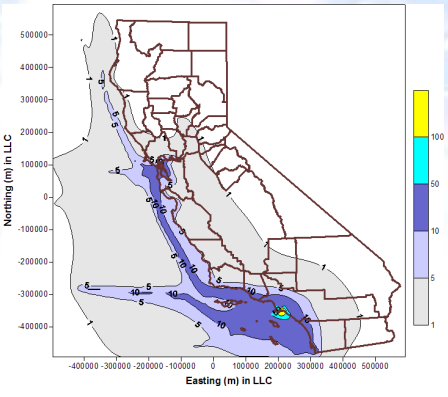
Example Map of Potential Regional Cancer Risk*

Without Measures



Isopleth of Diesel PM Potential Cancer Risk in 2012 without Control

With Measures



Isopleth of Diesel PM Potential Cancer Risk in 2012 with OGV Regulation

***FOR ILLUSTRATION PURPOSES ONLY – NOT ACTUAL VSR DATA**

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Economic Impacts

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Economic Impacts

Potential Costs

- Ports
- Terminal Operators
- Vessel Owners/Operators
- ARB

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Economic Impacts

Port Costs

- Administrative costs to implement a VSR program
  - yearly cost ranges from $50,000 to $100,000
  - additional costs for computer software
- AIS receiver
  - cost $2,000 per receiver (1st year only)
- Outreach efforts
  - yearly cost ranges from $10,000 to $15,000
- Marine Exchange
  - yearly cost for monthly speed report is $7,200
  - yearly technical support cost ranges from $5,000 to $15,000

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Economic Impacts

Terminal Operator Costs

- Terminals may incur costs for vessel delays
  - $10,000 - $20,000/hour depending on ship size
  - additional overtime costs of $30,000/hour on weekends and holidays
  - If vessels make up time during other segments of voyage, then no additional cost.

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Economic Impacts

Vessel Owner/Operator Costs

Approx. Cost Due to 1 hour Delay	Notes	Reference
$145	based on 10,000 TEU containership for Twin-Screw Propulsion for super container	(Marine News No. 2 -2000) Wartsila Switzerland Ltd.
$1,500	based on 5,000 TEU containership	Mercator Transport Group Report (Feb. 22, 2005)
$3,000	Include maintenance and labor costs	from No-Net Increase Report
$5,000	based on estimated labor costs and port calls	from a vessel operator

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Economic Impacts

Example of Fuel Cost and Savings for One Vessel at 24 nm

	Speed traveled in the VSR zone	Approximate time spent in the VSR zone (inbound only)	Fuel Used in VSR Zone (inbound only)	Fuel Cost (dollar)	Fuel Savings (dollar)
Without VSR	22 knots	1 hour	1977 gallons (6.4 metric tones)	$5,670	N/A
With VSR	12 knots	2 hours	728 gallons (2.3 metric tones)	$2,040	$3,600

1. Based on average container ship coming from north into LA/LB. Assumes VSR zone goes from 6-24 miles from shore. Precautionary zone is at 6 nm and speeds slow to 11 knots. All values are for inbound only
2. Assumes fuel is 0.1% distillate- avg. price of $886/metric tonne
3. Time spent and fuel used excludes the precautionary zone

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Economic Impacts

Fuel Use & Cost Savings

2012 Estimated Fuel Use and Savings for Five Major Ports with and without VSR Measure out to 24 nm and 40 nm

Ports	Without VSR (tons/day)	With VSR (tons/day)	Fuel Reduction (tons/day)	Saving on Fuel (dollar/year)
0 – 24 nm				
Los Angeles/Long Beach	747	733	14	$4.1 m
San Diego	49	42	7	$2.0 m
Bay Area	127	66	61	$18.0 m
Hueneme	141	75	66	$19.4 m
Total	**1064**	**916**	**148**	**$43.5 m**
0 – 40 nm				
Los Angeles/Long Beach	1015	903	112	$18.2 m
San Diego	79	57	22	$3.6 m
Bay Area	269	131	138	$22.5 m
Hueneme	395	182	213	$34.8 m
Total	**1758**	**1274**	**485**	**$79.1 m**

Based on 2005 gridded inventory. Numbers are rounded.

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Economic Impacts

ARB Cost

- Implementation and Enforcement costs
  - $50, 000 - $100,000/year
- Outreach efforts
  - $5,000 to $10,000/year

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Summary of Cost Data Needs

- Costs to ports
- Costs to vessel operators/owners, and terminal operators for delay
- How VSR costs impact the overall costs of goods movement?
  - What costs will be passed on to the consumer?

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Potential Issues

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Potential Issues

- U.S. Navy concerned that ships will travel through missile test range near Santa Barbara Channel with a VSR measure
- Environmentalists concerned that ships may speed up in Santa Barbara Channel
  - Concerns over ship strikes to blue whales

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Potential Issues

- Overall increase in emissions (outside VSR zone) if ships speed up during other segments of voyage
  - Preliminary results show that increasing speeds by ½ knot or more could increase overall emissions
  - Additional analysis
  - Looking at global impacts to CO_2 if ships speed up

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Next Steps

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Next Steps

Next Steps

- Work with stakeholders to address data gaps
- Survey (late September)
- Release Draft Technical Assessment Report for comment (Fall 2008)
- Next workshop (December 2008)

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