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

Background

Evaluation Update

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

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As you may recall from our first public workshop, we are in the process of developing a technical assessment report for the purpose of evaluating impacts of a VSR program. This report will evaluate the emissions and health impacts, timing and geographical range, technical and economic feasibility, and what approaches we may consider taking, such as regulatory or non-regulatory measures in considering a VSR measure.

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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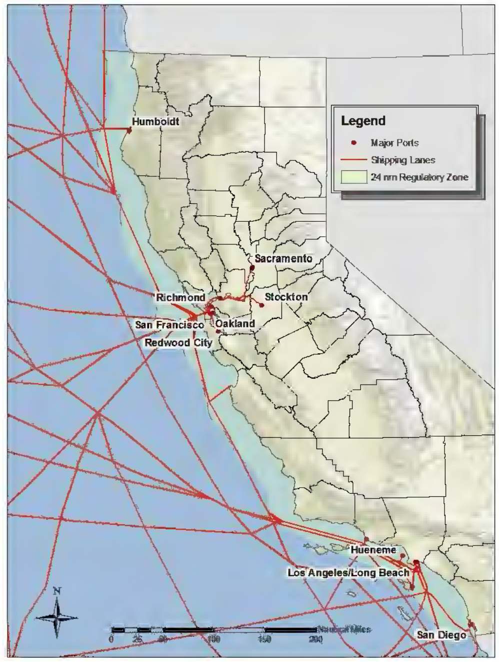
As you know, many studies have demonstrated that air pollution is harmful to public health.

The health effects associated with exposure to particulate matter and ozone include premature death, reduced lung function in children, and

increased respiratory disease, cardiovascular disease and cancer.

Background

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



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Oceangoing vessels are a large contributor to air pollution in California.

California is an important maritime hub on the Pacific Rim having 16 ports involved with waterborne commerce with about 11,000 ship visits per year.

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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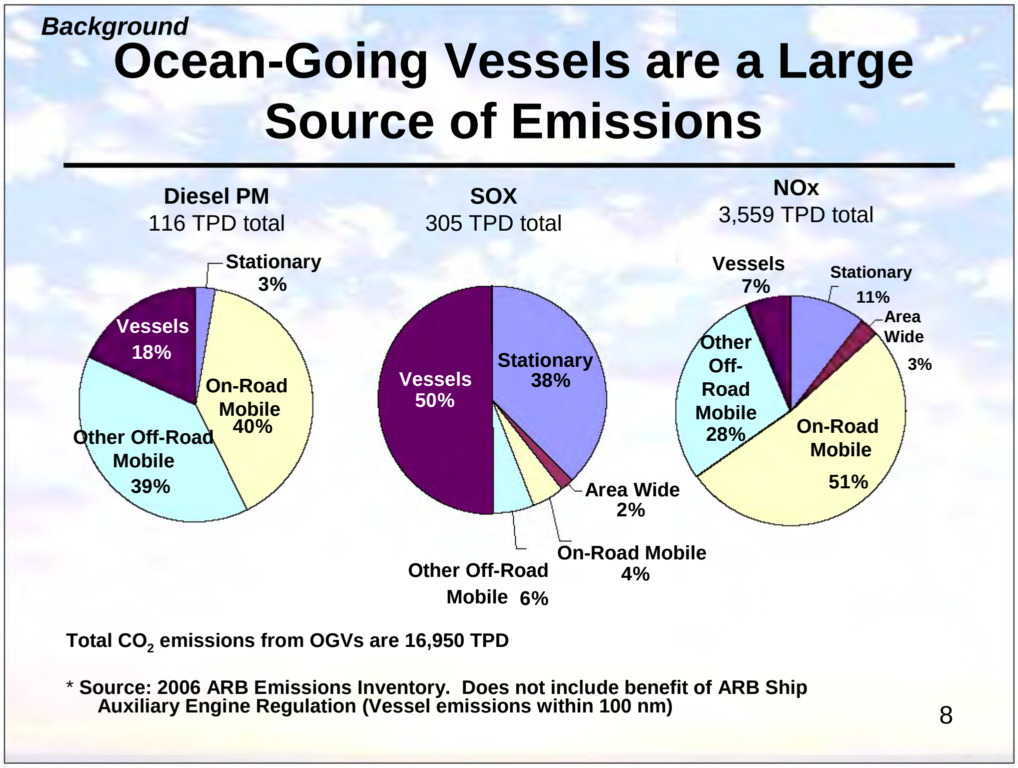
It is very important that we take steps to reduce emissions from Ocean-going vessels because they are a large and growing source of emissions and have been shown to have adverse health impacts regionally and in communities near ports. Exposure to directly emitted diesel PM and secondarily formed PM from SOx and NOx has been found to contribute to premature death and other cancer and non-cancer impacts.

VSR is also being evaluated as a Greenhouse Gas measure under AB 32. The Board has identified VSR as a potential area where CO2 emissions can be reduced.



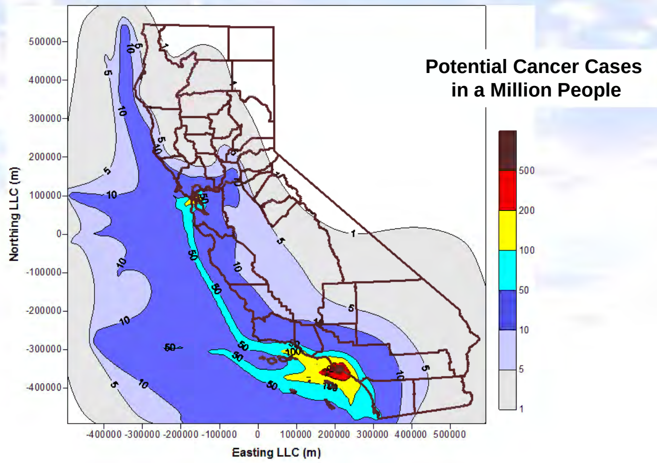
Just to give you some perspective on just how significant the emissions from ocean-going vessels are, we have put together some pie charts showing you the total tons per day of emissions from ships with comparison to other sources.

As you can see (in the dark purple area), in 2006 ocean-going vessel emissions accounted for about 18 percent of the overall statewide diesel PM emissions, about 50% of the SOx emissions and about 7% of the NOx emissions.

In addition, in 2006 ocean-going vessels accounted for an estimated total of about 17,000 tons/day of CO_2 emissions within the 100 nm zone off the California coast.

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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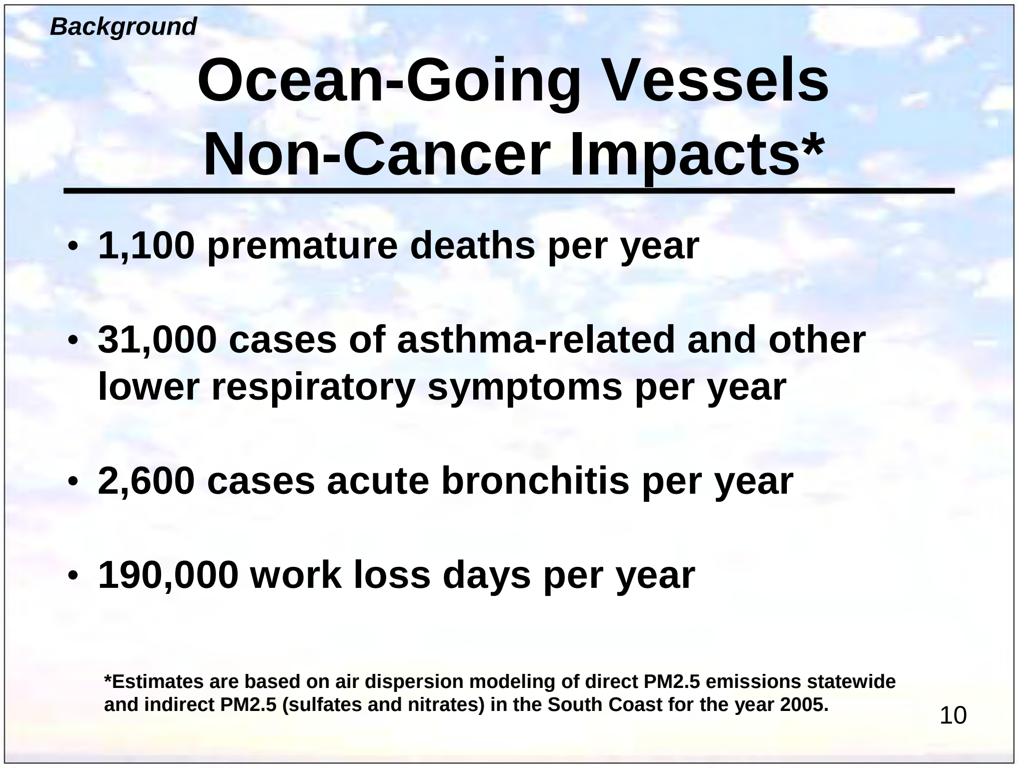
Ocean-going vessel emissions are a significant contributor to diesel PM exposure and cancer risk throughout California.

Results from our OGV modeling analysis done for the recent fuel sulfur regulation show large regions of risk, also called isopleths, due to exposures to diesel PM emissions from ships within the 100 nm zone off the California coast.

We estimate about 80% of California's population, or about 27 million people, are living in areas where the potential cancer risk from ocean-going vessels is at or above 10 chances in a million.

In areas near ports, the risk levels from OGVs are even higher – up to 500 chances in a million people.



As mentioned before, ocean-going vessel emissions also result in significant non-cancer health risks in California.

In 2005, ocean-going vessel emissions contributed to an estimated 1,100 premature deaths and high incidences of other non-cancer health impacts, such as 31,000 cases of asthma-related and respiratory symptoms, and 2,600 cases of acute bronchitis. In addition, there was a significant amount of work loss days.

These estimates are based on directly emitted PM and secondary PM from sulfates and nitrates.

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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Over the past several years, California has undertaken several key initiatives that outline the steps needed to improve air quality in the state.

Significant reductions in ship emissions are key to meeting the goals of these initiatives.

The Diesel Risk Reduction Plan adopted by ARB in 2000 set the goal of achieving an 85 percent reduction in diesel PM by 2020.

In April 2006 the Board approved the Goods Movement Emissions Reduction Plan that was designed to identify and initiate specific actions to reduce the emissions and health risk associated with pollution from ships, trucks, locomotives, harbor craft, and cargo equipment that operate at ports and move goods throughout the State.

In addition, in 2006 the Legislature passed Assembly Bill 32-The Global Warming Solutions Act of 2006. This initiative created a comprehensive multi-year program to reduce greenhouse gas emissions in California, with the overall goal of restoring emissions to 1990 levels by 2020.

ARB has taken significant regulatory actions to reduce emissions from ocean-going vessels. Here is a brief overview of measures approved by the Board.

In 2006 the Board approved the Onboard Incineration Regulation which prohibits ocean-going vessels from conducting onboard incineration within 3 nautical miles of the California coast.

On December 6, 2007, the Board approved the adoption of staff's proposed Shore-Power regulation. This regulation requires some vessels to turn off their auxiliary engines and receive their electrical power from shore while at-berth at California ports.

More recently, on July 24, 2008, ARB adopted the low sulfur fuel regulation. This regulation requires the use of cleaner fuels in the main propulsion engines, the auxiliary engines and auxiliary boilers.

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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As part of our efforts under the Diesel Risk Reduction Plan, and the Goods Movement Emissions Reduction Plan our goal is to evaluate the benefits of a vessel speed reduction measure that will work in conjunction with the current Board approved ship measures, to help provide the most significant emissions reductions of toxic air contaminants such as diesel PM, and reductions of criteria pollutants such as NOx, and SOx to nearby port communities.

In addition, as a result of AB 32 and the efforts to reduce greenhouse gas exposures where possible, vessel speed reduction has been identified as a source under the greenhouse gas transportation sector. Therefore, we will also be looking to provide additional reductions in greenhouse gas emissions from ships through a vessel speed reduction measure.

Proposed Approaches

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Proposed Approaches

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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As discussed earlier in the presentation, our technical assessment report will determine the need, the extent of, and structure of a VSR program. There are two types of approaches we are considering for a vessel speed reduction measure. The first type of approach is a voluntary program. This type of program would encourage shippers to slow to 12 knots at either 24 or 40 nm from shore. This type of program could be implemented at major ports or along areas such as the Santa Barbara channel where emissions are significant due to high volumes of ships transiting between northern and southern California. A voluntary program could also be incentive based, similar to the Green Flag Program at the Port of Long Beach. The Port of Long Beach provides financial incentives to ships who comply with the vessel speed limits. They currently have about a 90% compliance rate. A voluntary approach could also take the form of an agreement between the vessel operators and the ports or regulatory agencies such as the Memorandum of Understanding (MOU) done in 2001 with the POLA/POLB.

A VSR program could also be implemented as a regulatory measure at either 24 or 40 nautical miles. ARB would be the primary enforcing agency for a regulatory measure.

Impacts

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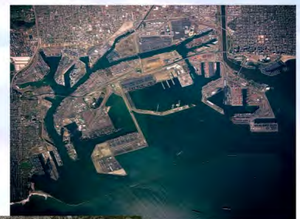
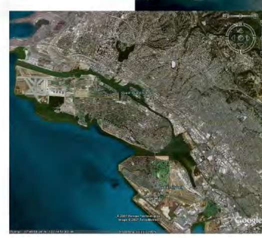
Impacts of VSR

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





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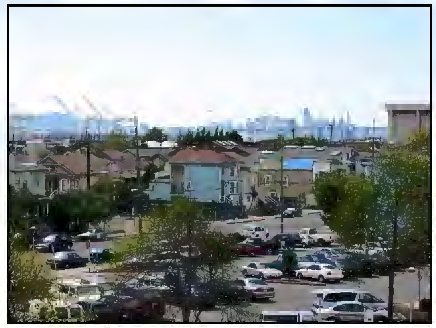
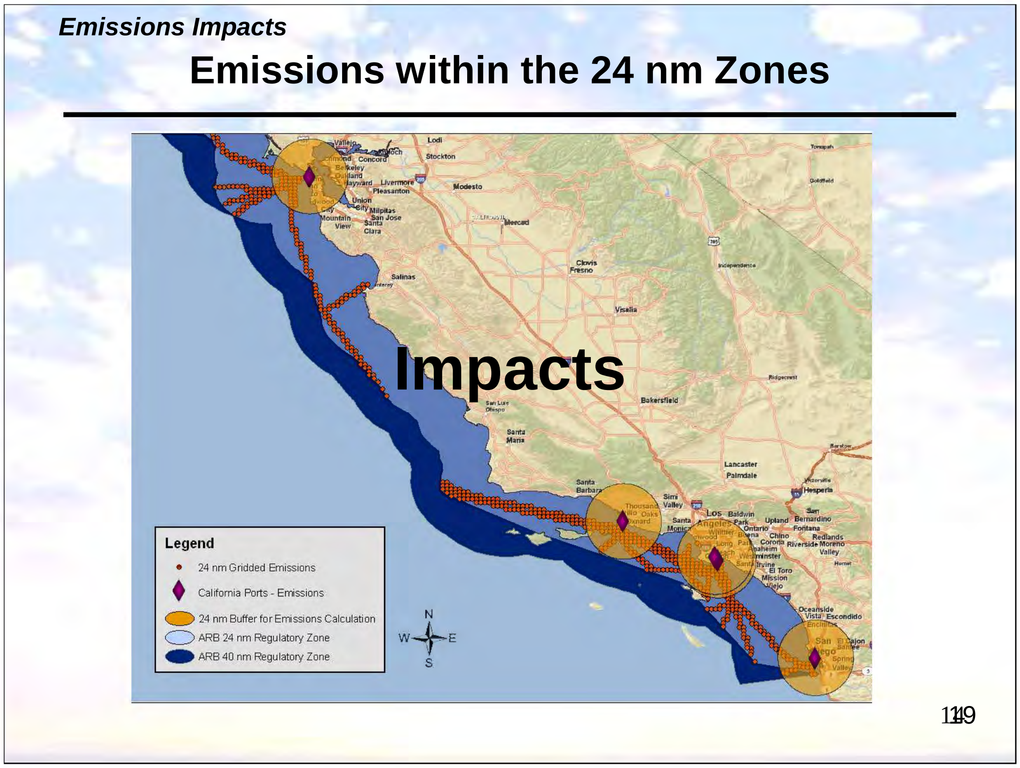
As part of our evaluation we are looking at the impacts that vessel speed reduction will have on emissions, on-shore pollutant levels, health benefits, and cost to the industry and the ARB. More detail on these impacts is discussed on the following slides.

Emissions Impacts





This slide illustrates the 24, and 40 nautical mile line along the California coast. The light blue region represents the 24 nm zone, and the darker blue region represents the 40 nm zone.

The gold circles highlight a 24 nm emissions zone that surrounds each of the five major ports where we have estimated OGV emissions. The purple diamonds represents the central location for each emission zone. Starting from the top of the slide, the Ports highlighted here include Bay Area Ports (includes all OGVs cross under the Golden Gate – e.g., go to San Francisco/Oakland/Richmond, etc.); Port Hueneme; POLA; POLB; and the Port of San Diego.

The lines of small orange squares represent the shipping lanes that fall within the 24nm zone. Each square represents a 4 square km cell where “gridded emissions” are quantified. These “gridded emissions” are used in the air dispersion modeling and will ultimately be used to assess the health impacts near coastal communities.

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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This table shows the emissions with and without VSR at 24 nm for 5 major ports for 2008. These ports include Los Angeles, Long Beach, Bay Area port complex, (which include San Francisco and Oakland and other smaller ports within the bay), Port Hueneme, and San Diego. This inventory is based on 2005 which was grown to 2008. This inventory assumes that, without VSR, all OGVs are transiting to and from the ports at average cruise speed depending on ship type. For example, average cruising speed for a containership is 23 knots. With VSR, the assumption is that speeds are reduced to 12 knots.

By implementing a VSR program at 24 nautical miles we expect emission reductions of 14 to 21 percent depending on the pollutant.

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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This table is similar to the previous table except for the year 2012. Note that the tons per day emissions of diesel PM and SOx drop significantly when compared to the tons per day emissions in 2008. This is due to the emission benefits of the recent regulation for low sulfur fuel which applies to main, auxiliary engines and auxiliary boilers. Even with the use of cleaner fuels in future years, the resulting emission reduction impacts for a VSR measure stay the same.

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

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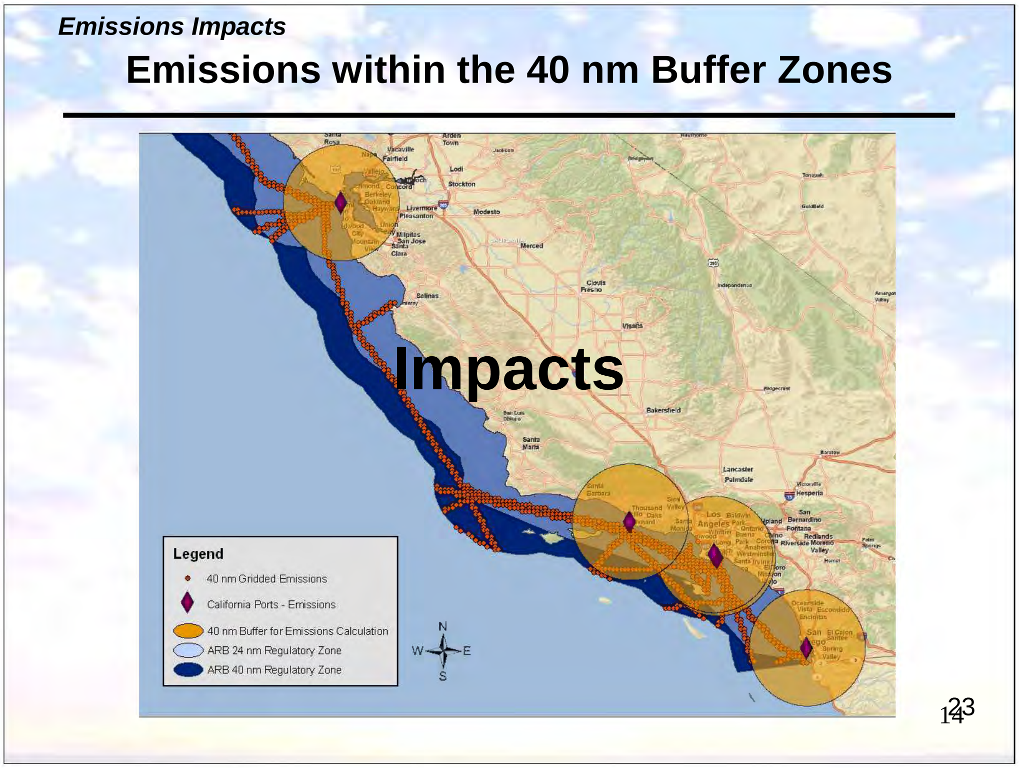
***Numbers are rounded**

This slide shows the emission reduction benefits for the 5 major ports for Diesel PM, NOx, SOx and CO2. These reductions show the benefits for major ports when ships slow to 12 knots 24 nautical miles from shore. Note that these reductions are based on 2005 emissions inventory grown to 2008 and 2012. For the Ports of Los Angeles and Long Beach we assume that 70% of the ships are already complying with their respective voluntary speed reduction programs. We understand that current compliance rates are around 90 percent at the Port of Long Beach and 80 percent at the Port of Los Angeles.

We are seeing the largest reductions in the Bay Area and Port Hueneme. Smaller reductions at LA/LB are due to the existing VSR program which has been accounted for in the inventory. San Diego also has less emission reduction benefit likely due to the types of ships coming into port which tend to have slower average speeds, such as tankers.



In addition to 24nm, we also estimated emissions out to 40 nm around the same five California ports and along the coastline. The legend is identical as the earlier slide shown for 24 nm.

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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This table shows the emissions with and without VSR for a VSR program that is implemented 40 nm from the coast line.

As you can see, emission reductions are almost 2 times that observed when implementing VSR at 24 nm.

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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This shows the 2012 emissions with and without VSR for a VSR program that is implemented at 40 nm from the coast line.

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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This is the same slide as we showed earlier, except that it is for 40 nautical miles. The majority of the reductions occur in the Bay Area and at Port Hueneme.

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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This slide compares the emission reduction benefits for a 24 and 40 nm VSR measure. As you can see, greater emissions benefits comes from a measure at 40 nm. In 2012, for Diesel PM and SOx the overwhelming majority of the emission benefits come from the assumption that vessels are using HFO from 24-40 nm. Slowing down with HFO provides significantly higher reductions on a tons per day basis as compared to slowing down with the cleaner MGO.

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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In 2006, the Legislature passed and the Governor signed Assembly Bill 32, the Global Warming Solutions Act of 2006, which set the 2020 greenhouse gas reduction goal into law. It directed ARB to develop and implement measures to reduce GHG levels to 1990 levels. Vessel Speed reduction has been identified in the draft scoping plan as a greenhouse gas measure under the Transportation Sector. We estimate that slowing vessel speeds to 12 knots at 24 nautical miles yields a reduction of about 0.3 MMtCO2E for 2020 and 0.8 MMTCO2E at 40 nm. These are the same CO2 reductions that were presented earlier in the presentation but we have converted them from tons per day to MMTCO2E.

Next, I'll discuss the methodology that we will be using for the air dispersion modeling and health impacts analysis for our technical assessment report.

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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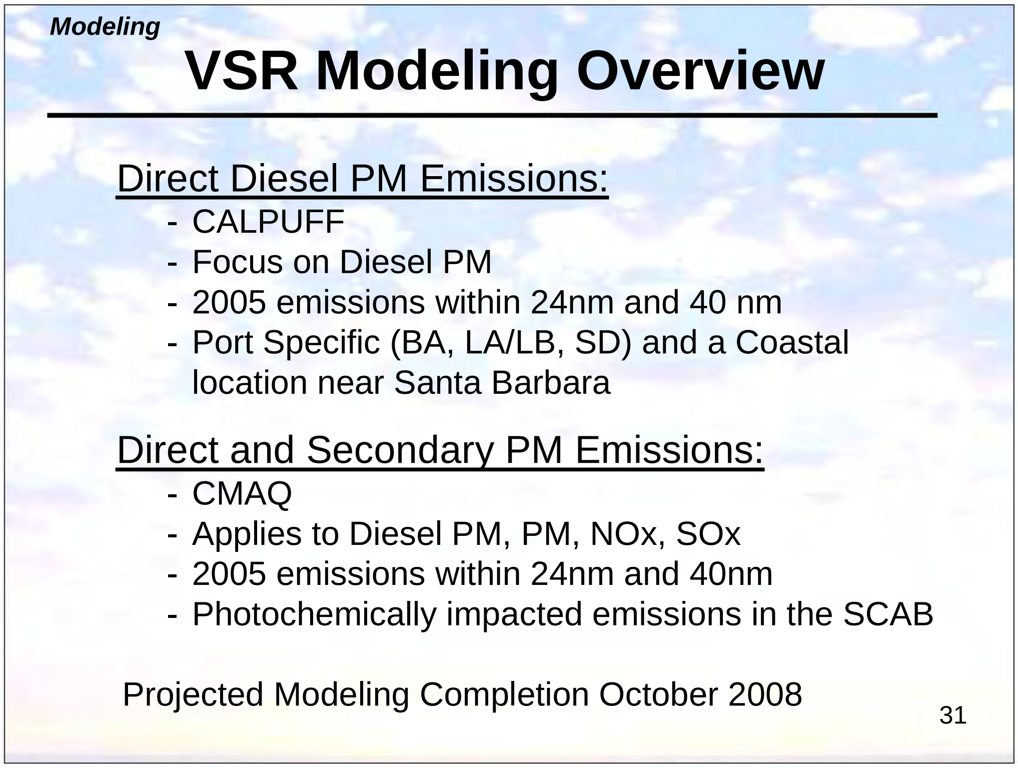
I will start with a brief introduction of air dispersion modeling and an overview of our modeling scenarios.

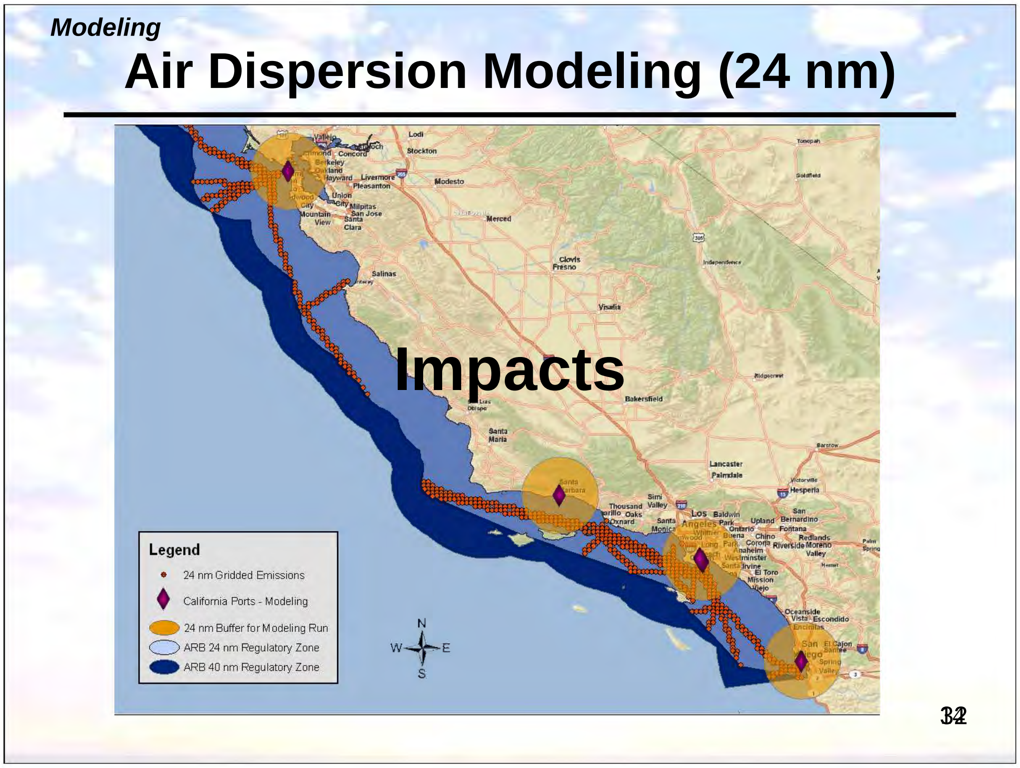
For VSR, air dispersion models are being used to estimate emissions impacts from Ocean Going Vessels on regional and local (near-source) coastal communities.

When possible, we will utilize modeling from the OGV fuel regulatory analysis and adjust or compare it to account for VSR measures.

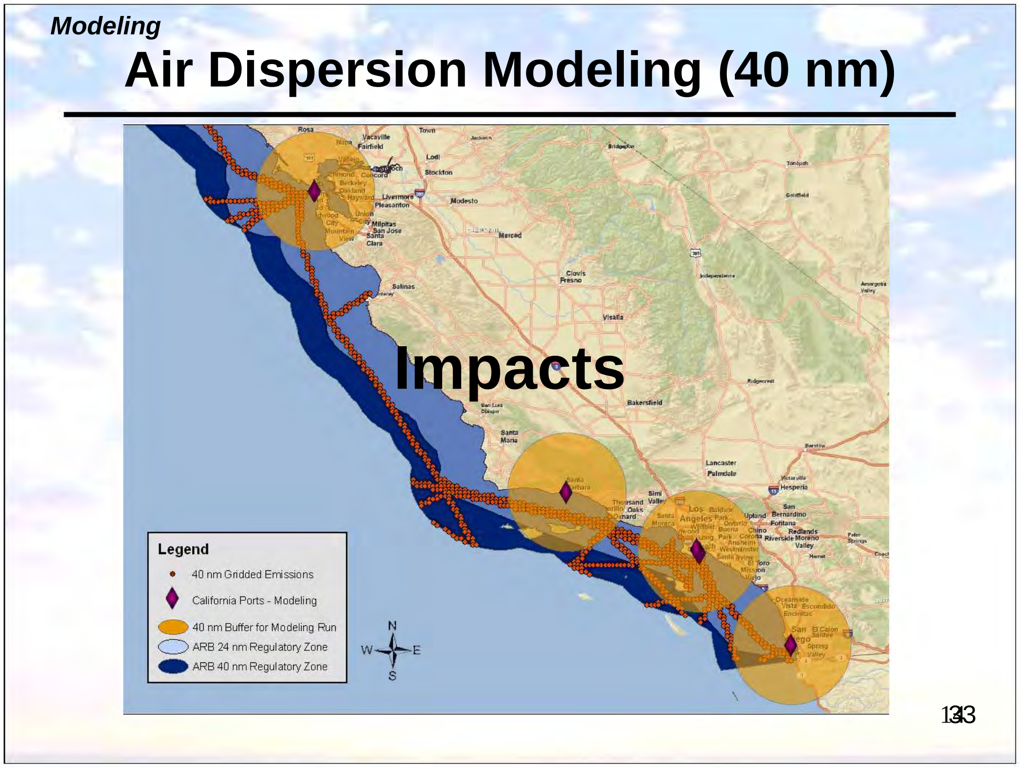


- For the VSR measures, we are looking at multiple modeling scenarios.
- These scenarios use models that will allow us to estimate the concentrations of directly-emitted and secondarily-formed, photochemically-reactive pollutants.
- The first set of scenarios focus on the impacts from diesel PM directly released from OGVs. These modeling scenarios will:
  1. Use the CALPUFF modeling system and focus on direct diesel PM.
  2. Evaluate emissions within 24 and 40 nm of each point of interest.
  3. Evaluate the impacts of VSR measures at three of the busiest ports or port complexes (BA; LA/LB; and SD):
  4. Evaluate the impacts of OGV (with and without VSR) along the coastline near Santa Barbara.

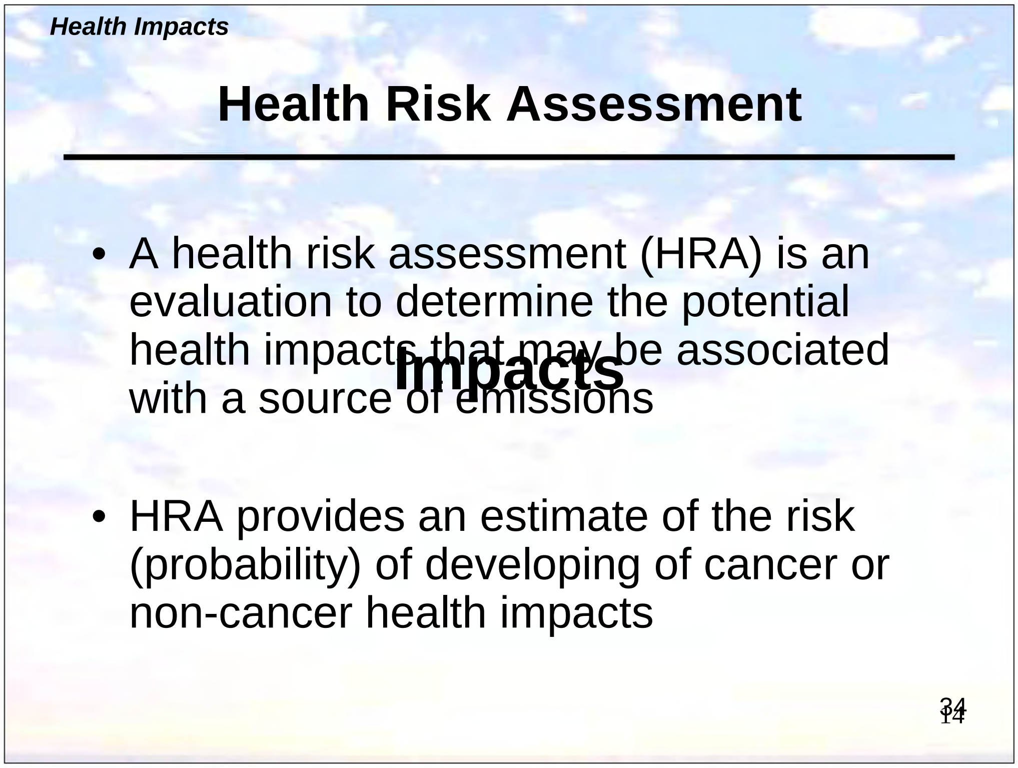
- The second set of modeling scenarios will look at direct and secondarily formed, photochemically-reactive pollutants (i.e., SOx) that result from OGV emissions. These modeling scenarios will:
  1. Use the CMAQ model. CMAQ is the Community Multi-scale *Air Quality* (*CMAQ*) Model.
  2. Focus on the SCAB (Point Conception to San Diego).
  3. Evaluate emissions within 24 and 40 nm.



This slide illustrates where we plan to model around the three California port complexes and at a coastal location near Santa Barbara. The legend is the same as the earlier slides, but the locations depict the emissions that will be used in our modeling analysis.



This slide illustrates where modeling will take place within **40nm** of the coastline around the three California port complexes and at the coastal location near Santa Barbara.



Within our technical assessment report we will be using the modeling results to estimate health impacts.

A heath risk assessment is an evaluation that describes the potential a person or a population may have of developing adverse health effects from the exposure to a source of emissions.

Some health effects of concern that can be presented in an HRA may include the ”risk” of developing cancer or various non-cancer impacts. Non-cancer impacts can include respiratory effects, and “premature” mortality.

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

Impacts

- 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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In this VSR health assessment, we are evaluating the impacts of vessel speed reduction on the emissions from Ocean Going Vessels. We will be presenting the potential health impacts from exposure to diesel PM, NOx, and SOx.

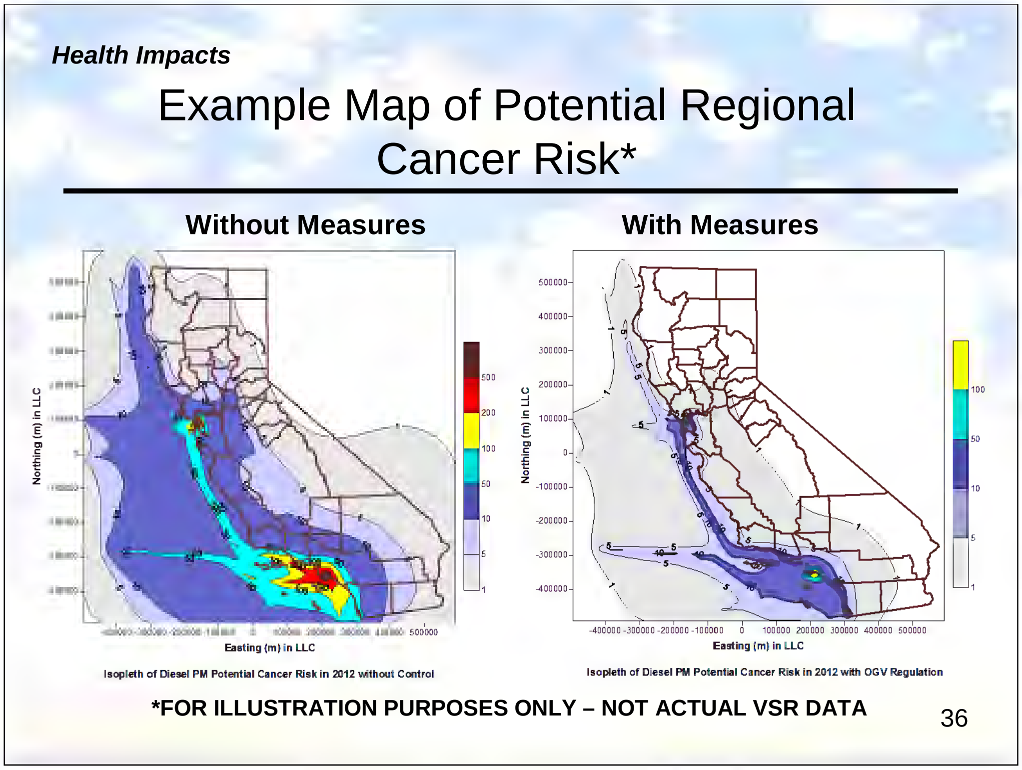
We will evaluate the impacts at the busiest ports/port complexes. We will also look at impacts at one coastal location. At these locations, we will look at OGV operating within 24 and 40 nm of the coastline.

We are using the gridded 2005 emissions inventory, the air dispersion models, and the modeling scenarios that we discussed moments ago. We will consider all benefits from current OGV fuel regulations and clearly present the emissions reductions attributed only to VSR activities.

We plan to present the potential health impacts from both a regional and local (near source) port-specific perspective.

We will evaluate the potential carcinogenic impacts of directly emitted PM from OGV diesel engines with and without the implementation of VSR measures.

We also will be presenting potential noncarcinogenic impacts from both directly-emitted and secondarily-formed PM. Examples of potential health impacts may include premature death (mortality), asthma, bronchitis, other respiratory impacts, work loss days, etc.



This is an **example** of how the impacts/benefits **may** be presented. These are **NOT** the actual results from the VSR evaluation. This slide simply illustrates a presentation concept that shows the **hypothetical** regional differences with and without a VSR measure. This map was presented in the low sulfur fuel staff report and represents the cancer risk impacts of diesel PM out to 100 nm with and without the low sulfur fuel regulation.

This slide shows a regional map with isopleths of projected potential health impacts before and after a proposed action. The isopleths are identified by the various colored zones/shapes.

Slides like these will illustrate the area impacted and magnitude of potential cancer risk to populations regionally and near port complexes.

We anticipate providing maps that show the potential impacts in the area surrounding the ports in the BA, LA/LB, and SD, and along the Santa Barbara Coast.

Economic Impacts

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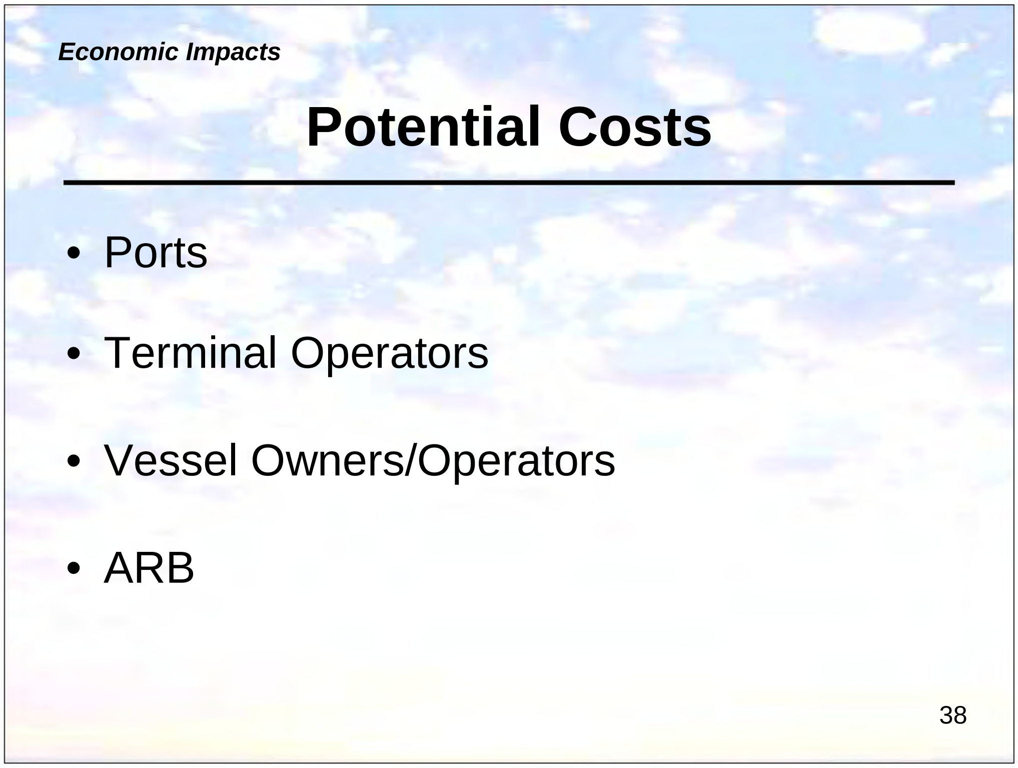

This slide shows the affected parties who could incur costs for a VSR program or measure, voluntary or regulatory.

Costs to the ports could include administrative costs, AIS receivers, and software to track and manage vessel speeds. In addition, outreach, technical support and assistance from the Marine Exchange could also be a cost.

Terminal operators may also incur costs when a ship is delayed.

Costs to vessel operators would include the cost for the time delay such as operating expenses for the ship. However, some of these costs could be offset by fuel savings.

ARB could also incur costs for enforcement, monitoring, and outreach.

Our overall goal in determining costs will be to compare the costs of a VSR measure with the potential emissions benefits associated with VSR. The next few slides will detail the costs I just mentioned.

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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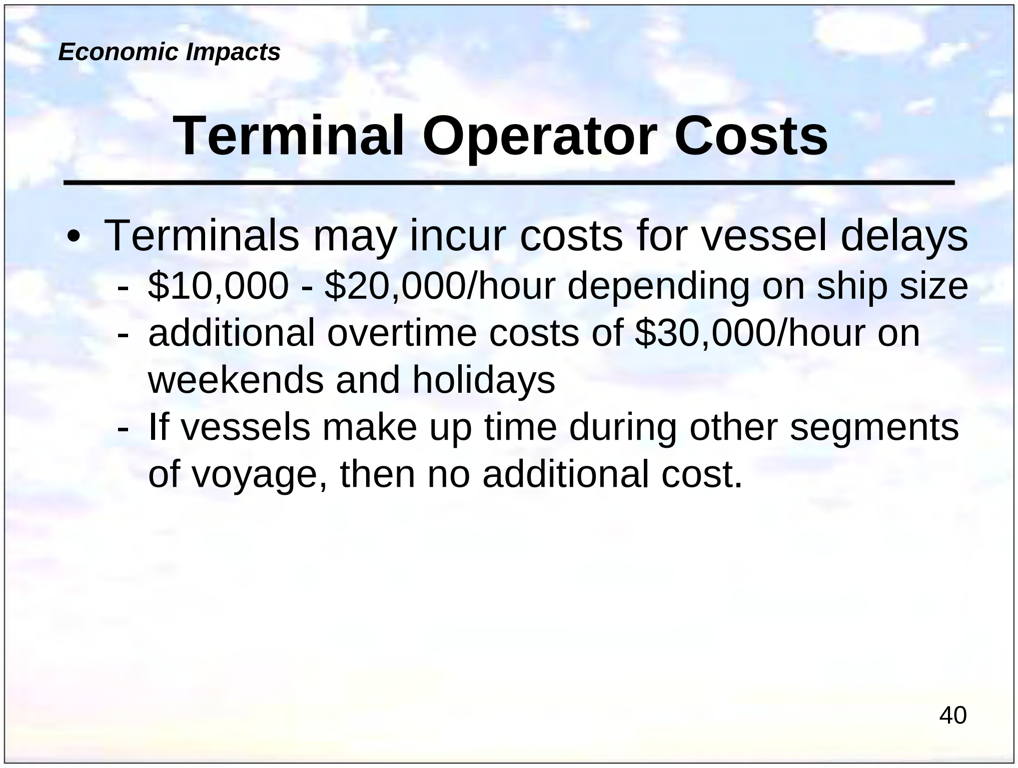
This slide details the typical costs that a port could incur when developing and implementing a VSR program or measure. This information comes from discussions with the Port of Los Angeles and Long Beach who have already successfully developed and implemented a VSR program.

Administrative costs to develop and implement a VSR program could range from $50,000 to $100,00 for staff time. There could be additional costs for computer software.   Each port requires at least one AIS receiver to monitor vessel speeds and it could cost about $2,000. These systems typically monitor out to 24 nm with consistency. Additional cost may occur if monitoring is required out to 40 nm.

The cost for outreach could range from about $10,000 - $15,000. These costs could include meetings with ship operators, and development of outreach materials and mailings. In addition, the Marine Exchange can provide monthly speed reports and technical support. These speed reports cost about $7,000 annually and technical support ranges from $5,000 to $15,000.



This slide outlines one cost scenario that terminal operators could incur if ships are delayed with a VSR program or measure.

Based on discussions with one terminal operator, ship delays to the terminal could cost about $10,000 to $20,000 per hour depending on the size of the ship. Additional costs would be incurred if delays occur on the weekends or holidays. However, if ships make up the delay prior to entering the VSR zone, then there would be no additional costs.

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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This slide shows the potential hourly cost for vessel operators. There is a lot of inconsistency among our sources as the costs range from $145 hour to $5,000 per hour. From what we have, it appears that each shipping company determines their operating costs differently. This is an area where we will be requesting information to help us determine a reasonable cost estimate to shippers for a delay. We plan to do this by distributing a cost survey to vessel owner/operators at the end of the month.

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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This slide gives an example of fuel costs and savings for an average size containership. This table shows the time and fuel costs for a ship coming in from the north into POLA/POLB with a precautionary zone at 6 nm from shore.

Using the average distillate price of $886 per metric ton, the ship with VSR that slows its speed to 12 knots in the VSR zone saves about $3,600 in fuel costs.

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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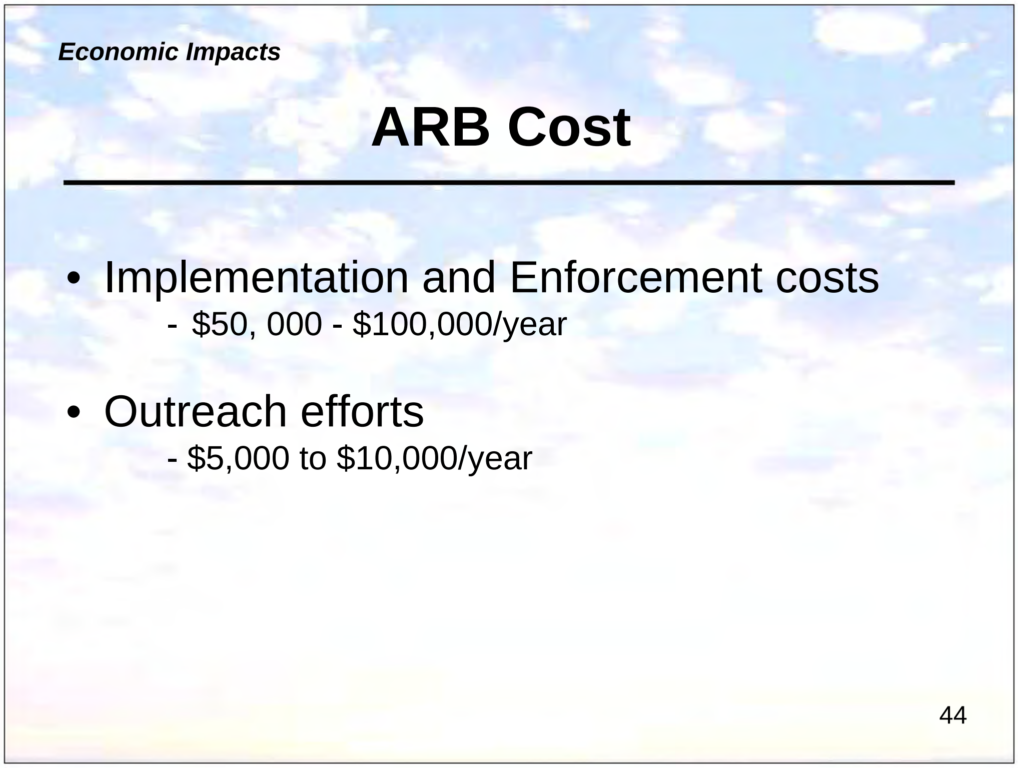
This slide shows the overall annual savings on fuel and fuel cost savings at five major ports for 2012 with and without a VSR measure at 24nm and 40 nm. These fuel reductions come from fuel reductions taken from the 24 and 40 nautical mile zones that we showed earlier.

The highest saving on fuel come from the Bay Area ports and port of Hueneme. Note that this is for 2012, therefore, we assume that for 0 - 24 nm all fuel used is clean marine distillate. For 40 nm we assume clean marine distillate is used from 0-24 and heavy fuel oil is used from 24-40 nm. The cost of the respective fuels were based on current prices.



This slide shows potential ARB costs for a VSR program or measure.

We estimated about $50,000 to $100,000 to implement and enforce a VSR measure. Outreach efforts would include brochures, advisories, and mail outs, and could run from $5,000 to $10,000.

Many of these costs will vary depending on whether the program is voluntary or regulatory.

Economic Impacts

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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As you can see we have significant data gaps in determining costs. Some of the specific information we need includes what type of costs will ports incur developing and implementing a VSR measure. We have received information from the Ports of LA and LB and have had some discussions with San Diego but we still need additional information on the other major ports.

We still need information costs for a delay to vessel owner/operators and for terminal operators.

And finally, how would these cost effect the overall cost of goods movement and what gets passed on to the consumer.

As discussed earlier, we plan on sending out a survey to vessel operators within the next few weeks to refine our cost estimates.

Potential Issues

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Now, I would like to go over some potential issues that we may encounter with a vessel speed reduction measure.

Potential Issues

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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As you may have heard at the July Board hearing on the low sulfur fuel regulation, The U.S. navy raised concerns with both a VSR measure and with the (recently approved) low-sulfur marine fuel regulation. The Navy believes that ships would avoid using the existing shipping lanes along the Santa Barbara Channel to save fuel costs associated with the requirement of using a higher cost low sulfur fuel. A VSR measure may also cause ships to transit outside the 24 nm zone to avoid ship travel delays. If the ships move outside the 24 nm zone in an attempt to avoid the measure, they potentially could travel through the Point Mugu missile test range. The Navy is concerned that the ships may interrupt military testing in designated areas.

Environmentalists have also expressed concern that ships may speed up in the Santa Barbara Channel to make up for time delay caused by slowing down in VSR zones during other parts of the ships voyage.

There have been ongoing concerns regarding ships traveling too fast and striking whales in the Santa Barbara channel. In Sept, 2007 the Center for Biological Diversity petitioned the federal government to set speed limits. NOAA and other agencies have sent advisories about this issue.

Potential Issues

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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Our preliminary analysis shows that speeding up ½ knot or more could negate the overall emission benefits. Ships speeding up to ¼ knot to make up delayed time would still show a slight overall emission benefit.

ARB staff will be running additional scenarios to see how speeding up impacts the overall emission benefits.

We will also be closely evaluating the CO2 emissions from a global perspective to see how speeding up at other segments of the voyage impacts overall CO2 emissions.

Next Steps

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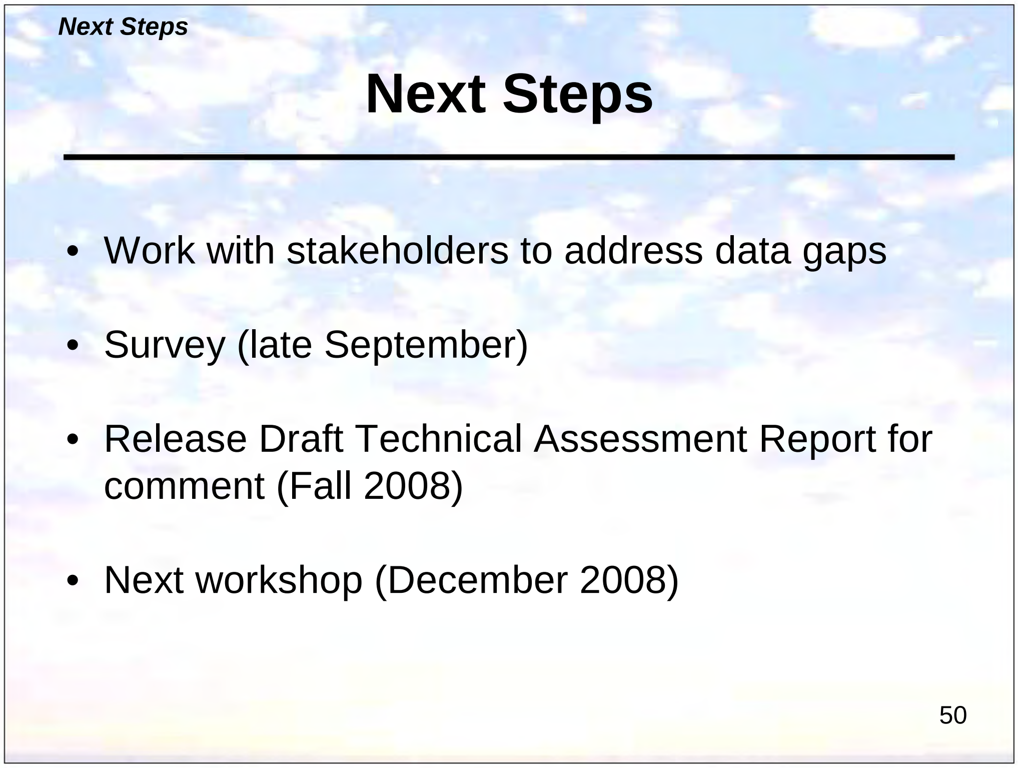
I will now discuss our planned future activities.



For our next steps, we intend to work with stakeholders to collect information to address any key data gaps needed to complete a thorough evaluation of Vessel Speed Reduction.

We will be sending out a survey to vessel owner/operators to get a better understanding on how VSR could affect their costs.

As mentioned earlier, we plan to release a Draft Vessel Speed Reduction Technical Assessment Report for your review and comment in the late Fall (end of year).

In addition, we plan to hold a workshop at the end of the year to discuss the report and have a more detailed discussion on the various approaches for a vessel speed reduction measure.

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http://www.arb.ca.gov/ports/marinevess/vsr/vsr.htm

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