Best Practices to reducing air emissions from shipping and ports

2012 U.S.-Taiwan Sustainability Symposium:
Creating Sustainable Cities and Promoting Sustainable Ports in the Asia Pacific Region

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Kaohsiung, Taiwan

December 10-11, 2012

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The International Council for Clean Transportation

(India, 2012)

Countries present: China, Brazil, Canada, Europe, Germany, Russia, India, Mexico, Korea, United States.

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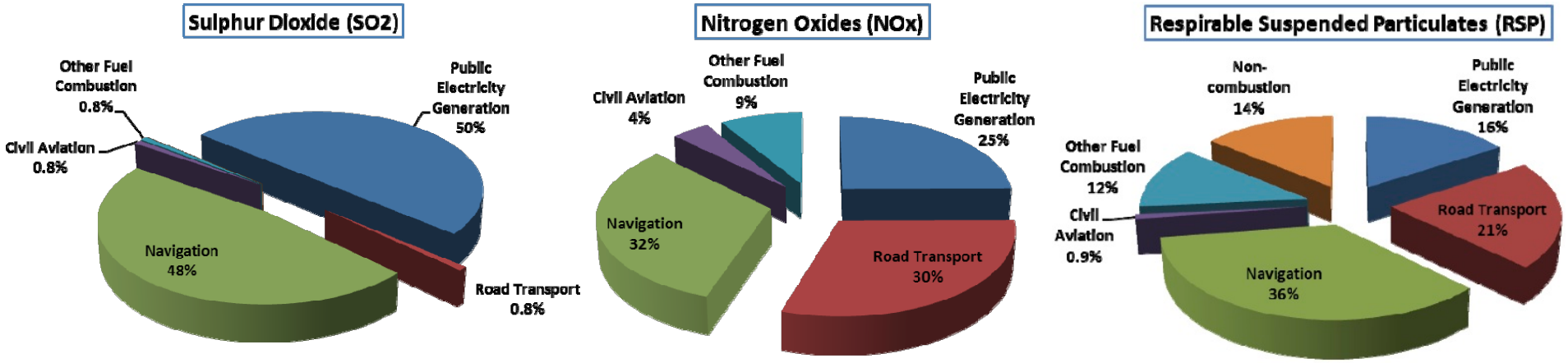
Outline

- Background
  - Contribution of shipping to urban air pollution
  - Health impacts of shipping
  - Complex business and operational structure of shipping and ports
- Examples of green port practices
  - North America
  - Europe
  - Asia
- Incentive analysis tool for ports

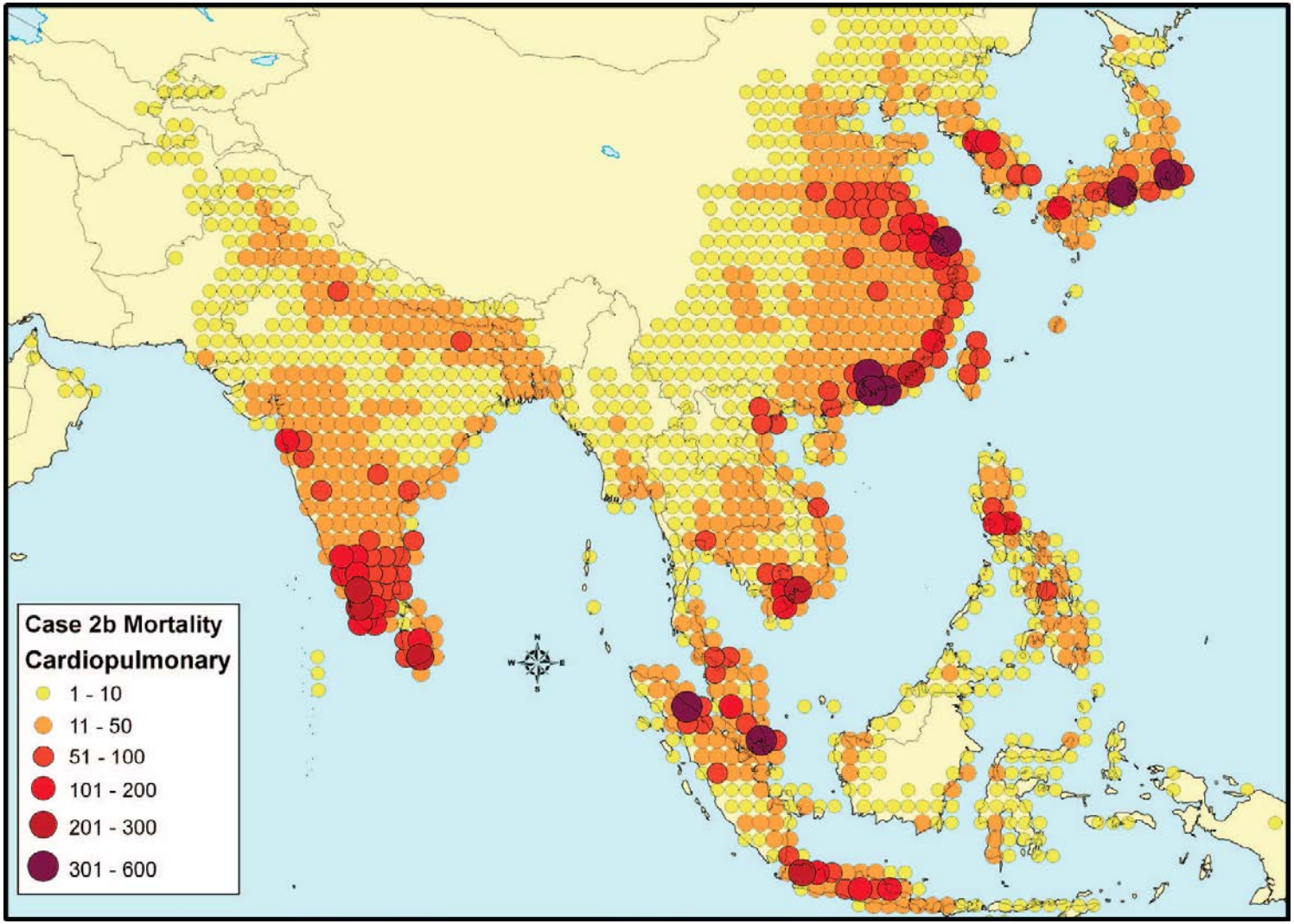
Air pollution from shipping

- Marine shipping has become one of the major contributors to urban air pollution in some coastal regions
- Its contribution to air quality, however, is not widely recognized
  - Note: 48%, 32% and 36% of Hong Kong SO_2, NO_x and respirable suspended particulates (RSP) are from marine navigation:



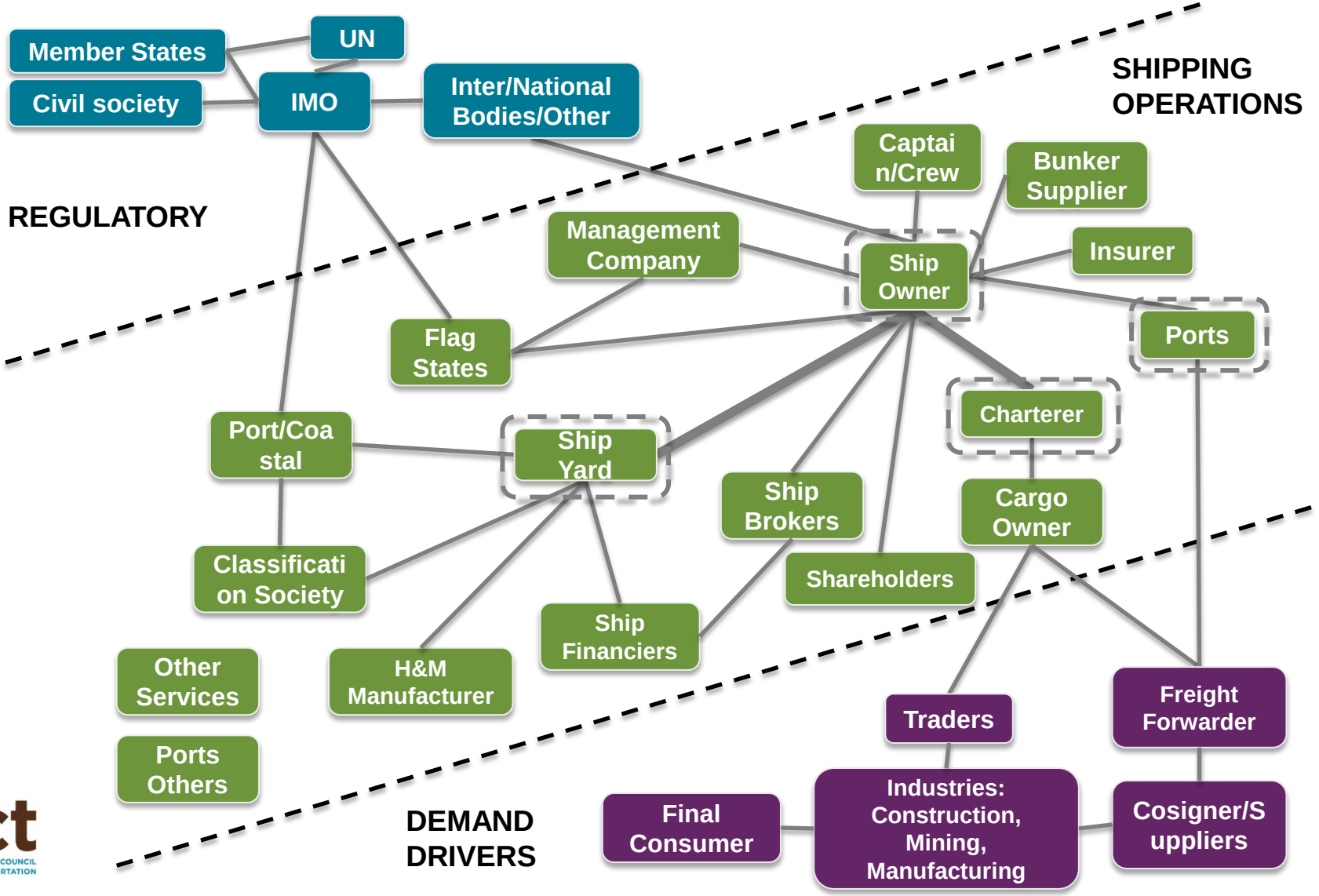
Source: Hong Kong Environmental Protection and Development (2012) "2010 Hong Kong Emission Inventory Report" http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html

Shipping is directly linked to human health



Source: Corbett et al (2007) Mortality from ship emissions: A Global Assessment

Intertwined operational structure of shipping makes it difficult to control emissions



North America

- Multi-ports approach
  - San Pedro Bay ports
  - Puget Sound ports
  - Gulf of Mexico ports
  - Port authority of New York and New Jersey
- A variety of emission mitigation measures
  - Voluntary vs. mandatory
  - Technology vs. operational
- Collaboration with other agencies
  - Federal: Environmental Protection Agency
  - State: California Air Resource Board
  - Local/Regional: Air Quality Districts
- Implementation of Emission Control Area (ECA)
  - Promote use of low sulfur fuel: 1% now, 0.1% in 2015
  - Tier III standard for engine

Example: San Pedro Bay

- Ports of Los Angeles and Long Beach
  - San Pedro Bay Port Clean Air Action Plan since 2006
- Ocean-going vessels and harbor crafts
  - Operational: vessel speed reduction
  - Technology: shore power
  - Fuel: fuel switching, hybrid assist tugs
  - Incentive: Environmental Shipping Index
- Heavy duty trucks, and other off-roads
  - Clean truck program
  - Electric drayage trucks
  - Locomotive upgrade

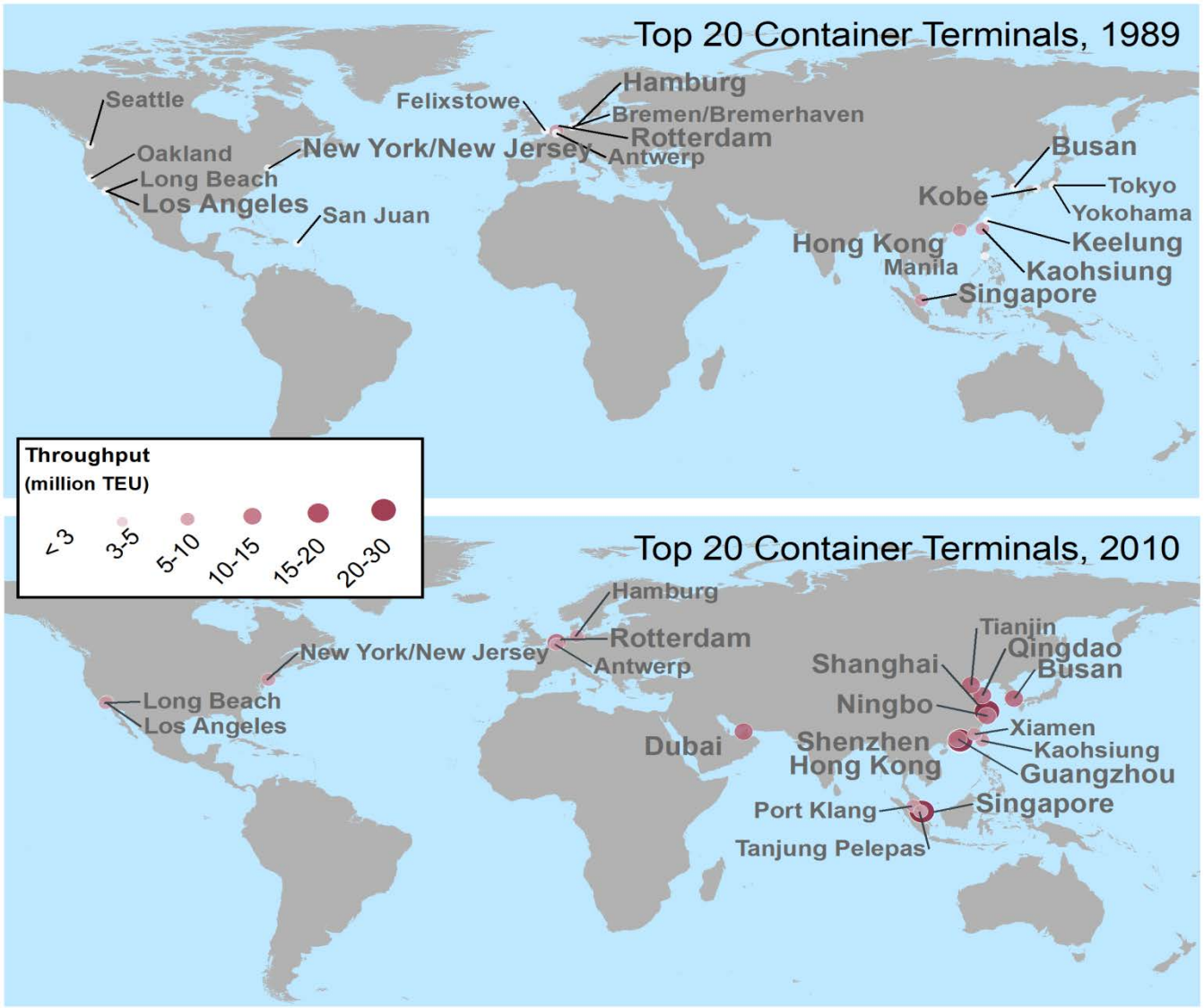
Europe

- A variety of mitigation measures
  - Liquefied natural gas (e.g., alliance of Ports of Rotterdam and Gothenburg)
  - Environmental shipping index
- Collaboration with other agencies and among different country state governments
  - Multiple trans-boundary rivers
  - Rhine-Danube network
  - Azov-Black-Caspian seas basin
- More efforts on inland shipping
  - Bigger share of inland shipping in Europe than in the U.S.
  - First to enforce ultra low sulfur fuel (10 ppm) regulation for inland waterway vessels
- Implementation of SOx ECA (Baltic Sea and North Sea)
  - Promote use of low sulfur fuel: 1% now and 0.1% in 2015

Example: Rijnmond Ports

- Port of Rotterdam
  - Regional Air Quality Action Program since 2004
- Ocean-going vessels and harbor craft
  - Shore power
  - Ultra low sulfur diesel for inland shipping
  - Environmental shipping index
  - Liquefied natural gas in collaboration with Port of Gothenburg
- Heavy duty trucks and other off-roads
  - Fleet management and modernization
  - Electrification of cargo handling equipment

Asia: Significant growth in shipping activities



Data source: The Economist. 2010. Trading Place – The world's largest container ports [cited 2012 May 2]; Available from http://www.economist.com/node/16881727 ; United Nations Conference on Trade and Development (UNCTAD). 2011. Review of Maritime Transport. New York and Geneva: United Nations.

Sustainable Port Development in the ASEAN Region

- Air emissions inventory
  - First step to understand major sources of emissions
  - Cover vessels, cargo handling equipment, vehicles and others
  - OGVs the dominant source of NOx, PM and SOx
- Recommended measures
  - Use alternative energy or better energy efficiency equipment
  - Reduce congestion
  - Improve port management

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http://www.sustainableport.org/

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Incentive Analysis Tool for Ports

- Environmental Shipping Index (ESI)
  - Index for ship environmental performance relative to IMO Rules
  - Serve as ranking tool for governments/ports to reward clean ships
  - Covers NOx, SOx, and CO_2 (emphasis on NOx, shore power bonus)
- Cost estimation
  - Based on a ESI incentive structure, estimate costs, NOx, SOx, CO2 reductions, benefits, incentives
- Air quality toolbox
  - Identifies mitigation options at ports' disposal
  - Aids in design of clean air program for ports
- Goal:
  - Allow regulators and ports to analyze costs and benefits, make improved decisions

Air quality toolbox

- Groups of technologies and operational strategies to reduce air emissions from ports
  - Developed by the International Association of Ports and Harbors
  - ICCT commissioned Starcrest to update the toolbox in 2012
- Goal: Help regulators and port authorities identify available measures to reduce air emissions
  - Address major air pollutants
  - Cover most transportation modes in and around the port

Common Emissions Control Technologies

- Many proven, cost-effective technologies for port/ship equipment

Technology Type	General Emissions Control Technologies				
Name	Diesel Oxidative Catalysts (DOC)	Diesel Particulate Filters (DPF)	Selective Catalytic Reduction (SCR)	Exhaust Gas Scrubbers	Shore power
Application	Trucks CHE (>750hp) Marine & CHE (<750hp) Locomotives	Truck CHE (>750hp) Marine Locomotive	Truck CHE (>750hp) Marine Locomotive	CHE Marine Locomotive	Marine
Targeted Air Pollutant	PM 20-30% HC 50-90% CO 70-90%	PM up to 90% HC, CO 60-90%	NOx 70-90%	SOx 90-99% PM 60-80%	Net emissions reductions
Cost	$1,000-4,000	$6-18K (Truck) up to $40K (Marine)	$36K (Truck & CHE) $60K-120K (Marine)	$5M (Marine)	$1-15M

Table based on data from Starcrest (2012) "Developing Port Clean Air Programs" prepared for the ICCT CHE – Cargo handling equipment

Common Technologies and Operational Improvements

- Many proven, cost-effective strategies for port/ship equipment

Technology Type	On-Engine Modification			Diesel Fuel Alternatives		Operational Strategies	
Name	Exhaust Gas Recirculation (EGR)	Engine Replacement, Repower, Rebuild	Slide Valves	Ultra Low Sulphur Diesel (ULSD)	Emulsified Diesel Fuel (EDF)	Vessel Speed Reduction (VSR)	Landside Operational Improvements
Application	Truck Marine Locomotive	Truck CHE Marine Locomotive	Truck CHE Marine Locomotive	Truck CHE Marine Locomotive	Truck CHE Marine Locomotive	Marine	Truck CHE Marine Locomotive
Targeted Air Pollutant	NOx 40-50% PM 70% (with DPF)	NOx up to 90% PM up to 90%	PM 10-50% NOx 10-25%	PM 5-15% SOx 99%	NOx 10-20% PM 15-60%	net reductions in NOx, PM	Net emissions reductions
Cost	$12K (Truck) $10M (Marine)	$0.5-1.5M	$1.5-16K (Marine)	Surcharge: $0.05-0.15/gal	Surcharge $0.25-0.40/gal	net negative cost over time (fuel savings, travel time)	Multi-million/billion dollar improvements

Table based on data from Starcrest (2012) "Developing Port Clean Air Programs" prepared for the ICCT
CHE – Cargo handling equipment

Conclusions

- Shipping can have profound adverse impacts on urban air quality and human health, especially in coastal areas
- Shipping pollutant emissions are challenging to control due to complex business and operational structure
- Ports in North America and Europe have made significant progress in addressing air emissions from shipping and ports
- Ports in Asia are catching up
- A wide variety of technologies and operational measures have proven successful and cost-effective to reduce port-related emissions
- Inventory development offers a powerful way to prioritize actions
- Tools are available to guide regulators and ports to analyze costs and benefits, make informed decisions

Thank You

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