Port City Human Health and Environment
Green freight and healthy supply chains

US-Taiwan Sustainability Symposium: Creating Sustainable Cities and Promoting Sustainable Ports in the Asia Pacific Region

Global and Regional
Kaohsiung, Taiwan

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Promote cost effective practices on sustainability of cities, marine ports and vessels, and goods movement in the US and Asia Pacific

Purpose

- Share expertise and experience in approaches, strategies, and practices to advance economic and environmental sustainability of marine ports, vessels, and goods movement
  - **Listen for great innovation in the Asia-Pacific region**
- Develop a network of to explore and promote cost effective practices on sustainability of cities, marine ports and vessels, and goods movement
  - **Catalyze innovation in sustainable goods movement**
- Support and strengthen strategic relationships, and promote consistent and complementary sustainability practices
  - **Support strategic relationships and practices**

Needed: *Bridge to transformation* that improves sustainable freight service

What?

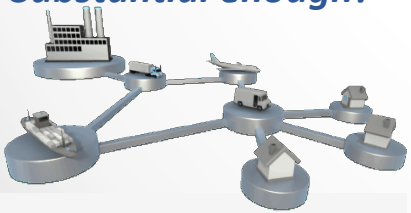
	Reinforce Positive Trends	Reverse Negative Trends
Existing Efforts	***Incremental*** - Do more good things - e.g., efficiency indexes	***Granular*** - Do fewer bad things - e.g., abatement, green-ops
New Efforts	***Integrated*** - Also considered Architectural - Disrupts status quo - New dominant system emerge - e.g., Eco-speeds changing freight networks, all modes adjust - Holy Grail (win-win-win)	***Radical*** - Usually disruptive to traditional benefit metrics - New dominant designs - e.g., Green ships, EMS plans, MARPOL VI emissions controls, ECAs, Fuel switching, etc.

Adapted from: http://www.franteractive.net/tech-push-market-pull.html

How?

Recognize tension between now and future…

Greening existing network:
Substantial enough?



Near-term Barriers?

Photograph/Puneet Dembla
http://betterphotography.in/2011/10/26/sketching-light/

Uncertain Destination?

Outline for discussion

- What are the public policy reasons for change?
- What are the business reasons for better performance?
- What synergies will make change attractive?

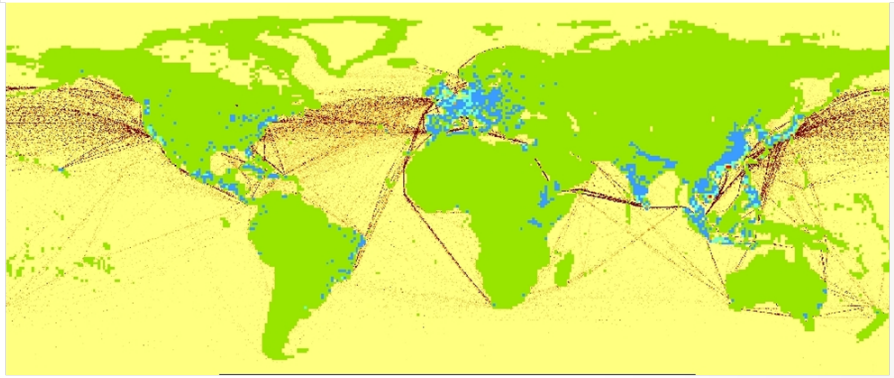
- **What can we do together?**
  - Discussion very welcome – the way forward

Port City Health for Humans and Environment

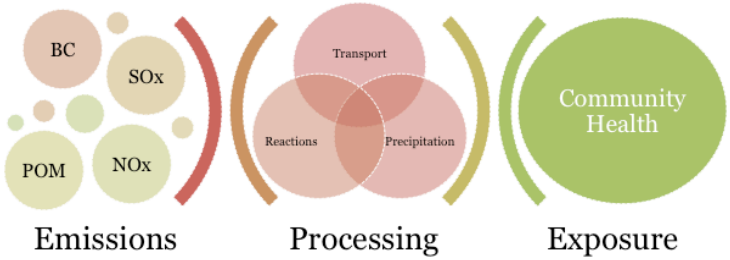
What can we improve?

- Reduce air emissions
- Improve air quality
- Avoid health impacts
- Shift to cleaner energy
- Improve energy efficiency
- Max operational performance
- Innovate technology
- Resilient urban planning
- Adapt to Climate Change
- Grow community wellbeing
- Protect ecosystems

Ships contribute to health impacts along major trade lanes

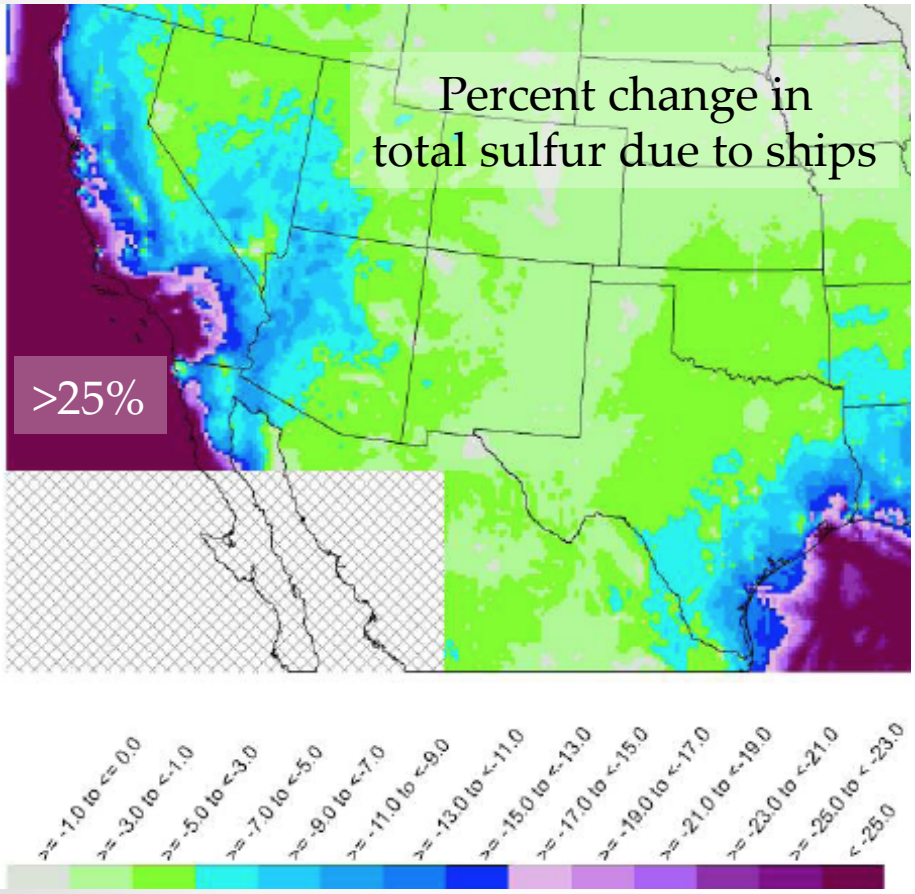


Brown shipping lanes where particulate (PM) emissions occur; blue regions where premature mortality occurs due to ship PM



Multiple endpoints for sustainability: e.g., Port-Coastal Acidification

High-sulfur fuel impacts water



Why shipping matters in Asia

Taiwan trucks: EU IV

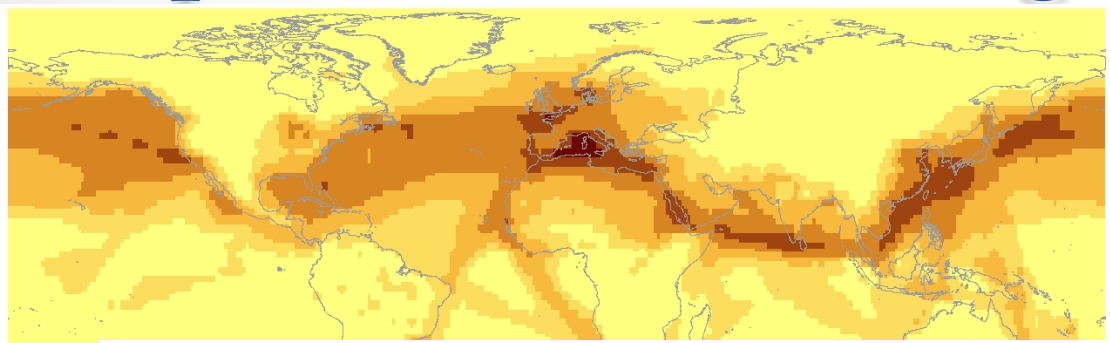
- Beginning 2007, Taiwan limited sulfur in diesel fuel to 50 ppm, equivalent to Euro IV standard
- http://en.wikipedia.org/wiki/Ultra-low-sulfur_diesel

Oceangoing shipping

- Uncontrolled 3.5% m/m Sulfur
- Potential control opportunity
  - All regions: 0.50% m/m Sulfur after 1 January 2020
  - Coastal: 0.10% m/m Sulfur after 1 January 2015

Sulfur deposition near Taiwan may be greater than US

How do we associate port operations and regional health?



Create Emissions Inventory → Model Concentrations → Calculate Health Impacts → Conduct Comparative Analysis

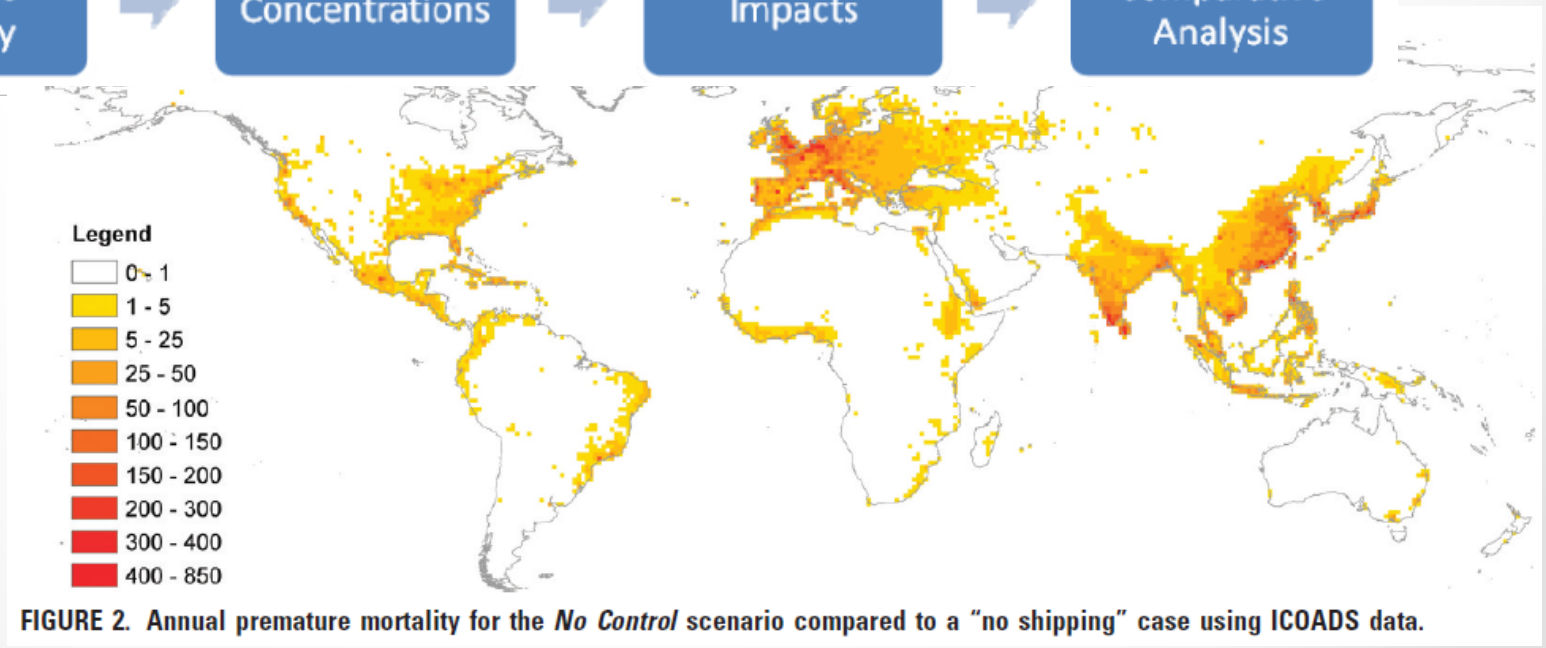


FIGURE 2. Annual premature mortality for the *No Control* scenario compared to a "no shipping" case using ICOADS data.

PM Exposure

Seafarer Studies

Seafarer studies crew Odds Ratio (OR) higher risk than general population:

...engine maintenance crews

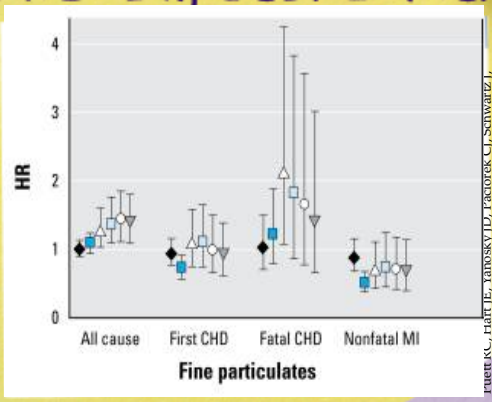
4 times greater risk (2.1 to 7.4);

...engine room workers

~2 times general risk (1.6 to 3.3)

Kaerley, L., et al. (2005), Cancer incidence among Danish seafarers: a population based cohort study, Occupational Environmental Medicine, 62, 761-765

Public Exposure Risk



ruett JC, Hart JE, Yanosky JD, Paciorek CJ, Schwartz J, Suh HH, Speizer FE, Laden F. Chronic fine and coarse particulate exposure, mortality and coronary heart disease in the Nurses' Health Study. Environ Health Perspect, Jun 2009; 117:1697-1701.

Rail Worker Studies

Railroad workers exposed to diesel exhaust have 1.4 times the risk (1.3 to 1.51)

Garshick, E., et al. (2004), Lung Cancer in Railroad Workers Exposed to Diesel Exhaust, Environmental Health Perspectives, 112 (15), 1539-1543.

Trucker Studies
Dockworker Studies

Risk to workers is proportional to exposure ...

Health Risk

Health impacts from goods transport: brief background

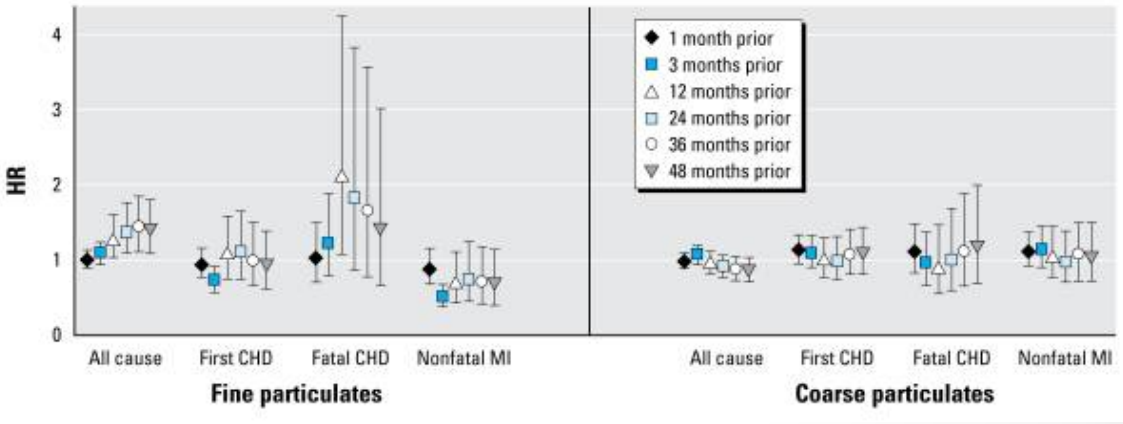
- Seafarers
  - The differences in risk pattern for lung cancer between the different job categories among men ranged in terms of SIR from 1.2 (95% CI 0.9 to 1.7) (engine officers) to 2.3 (1.6 to 3.3) (engine room crew), and 4.1 (2.1 to 7.4) among maintenance crew.

Kaerlev, L., et al. (2005), Cancer incidence among Danish seafarers: a population based cohort study, Occupational Environmental Medicine, 62, 761-765

- Rail workers
  - Adjusting for a healthy worker survivor effect and age, railroad workers in jobs associated with operating trains had a relative risk of lung cancer mortality of 1.40 (95% confidence interval, 1.30–1.51)... Lung cancer mortality was elevated in jobs associated with work on trains powered by diesel locomotives.

Garshick, E., et al. (2004), Lung Cancer in Railroad Workers Exposed to Diesel Exhaust, Environmental Health Perspectives, 112 (15), 1539-1543.

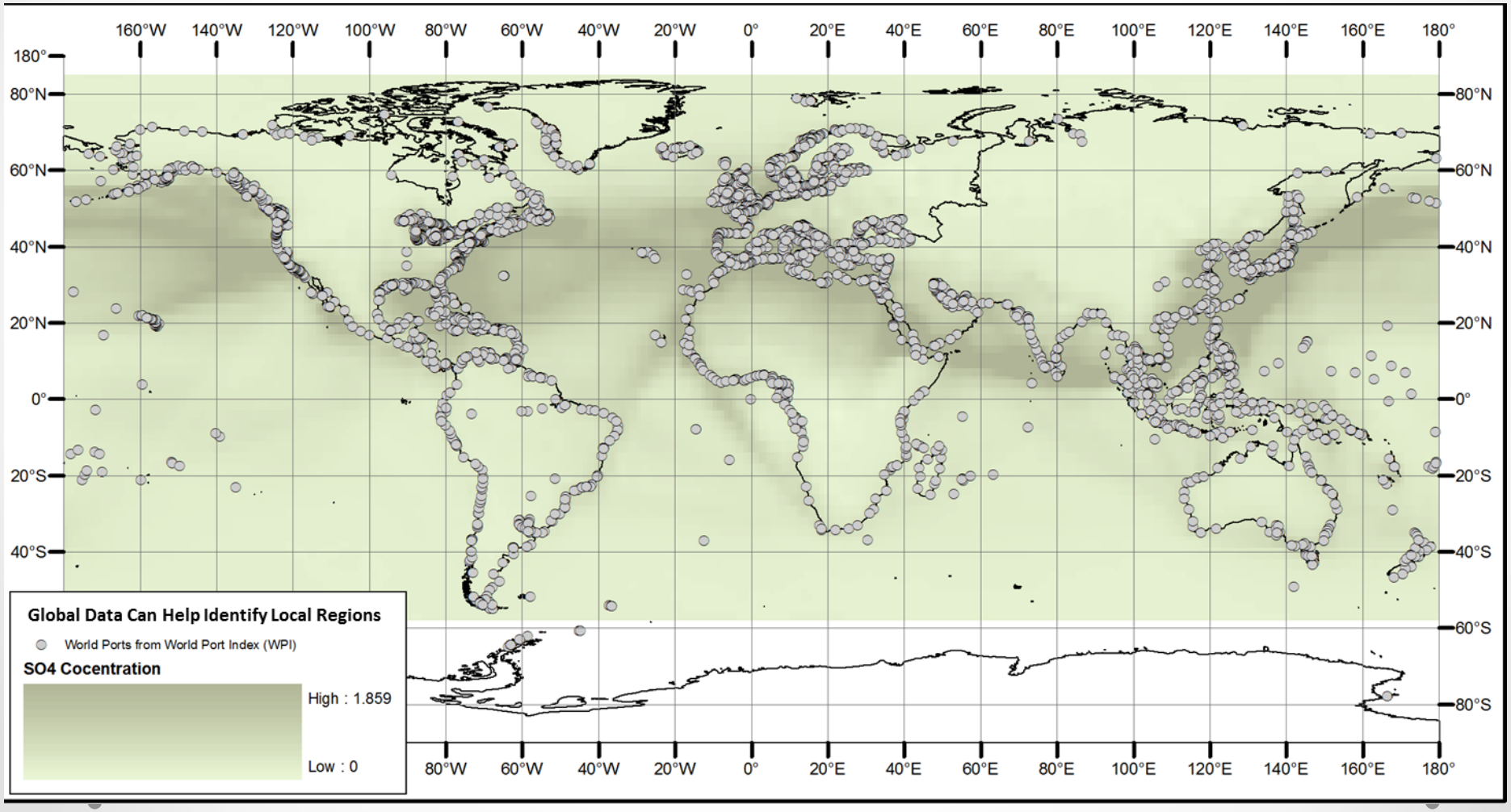
- General public exposure



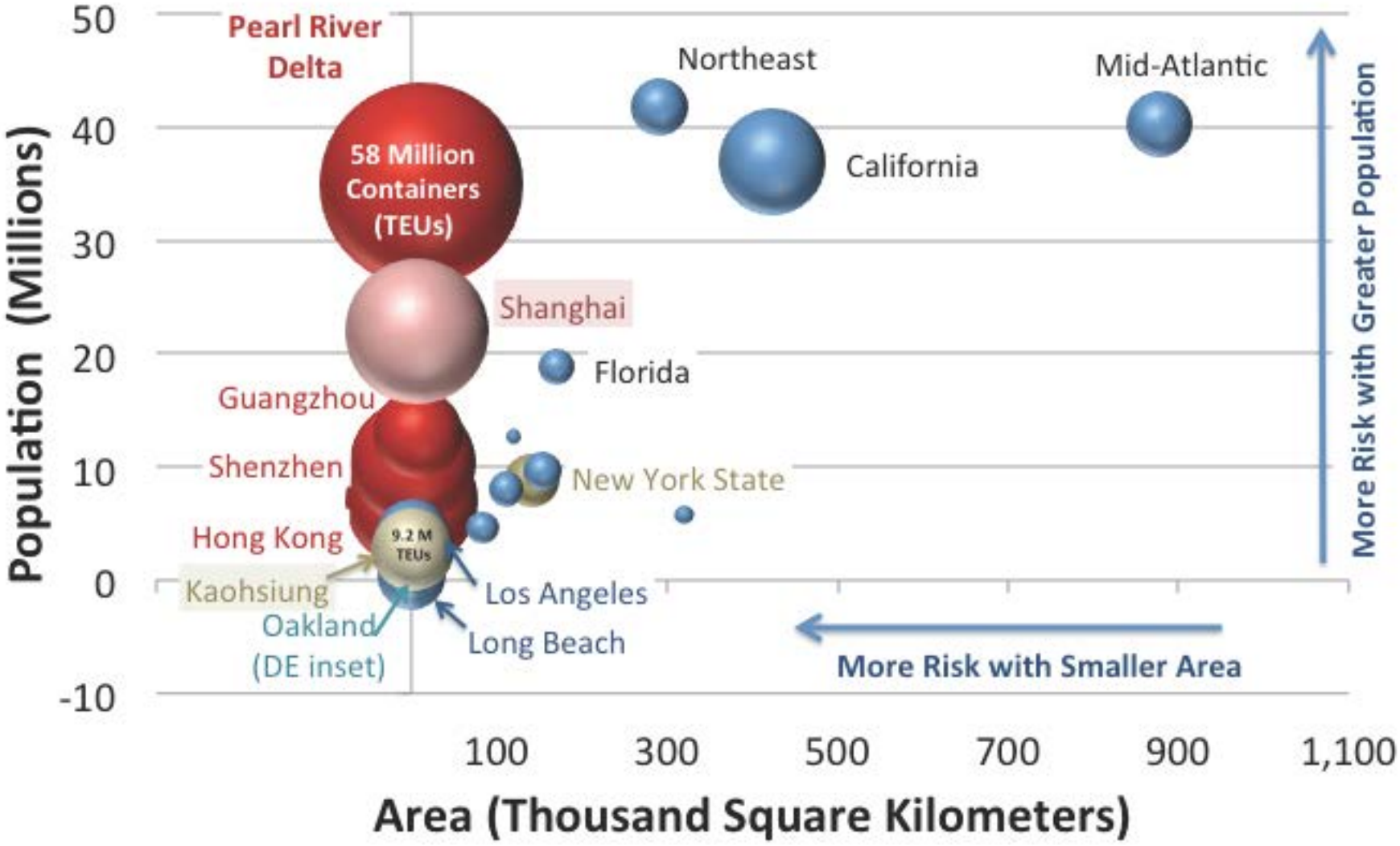
Category	Cases	Crude models	Fully-adjusted single pollutant	Fully-adjusted multi-pollutant
All-cause mortality	3,785	**1.45 (1.19-1.78)**	**1.26 (1.02-1.54)**	**1.29 (1.03-1.62)**
First CHD	1,348	1.19 (0.85-1.65)	1.11 (0.79-1.55)	1.10 (0.76-1.60)
Fatal CHD	379	**2.29 (1.26-4.18)**	**2.02 (1.07-3.78)**	**2.13 (1.07-4.26)**
Nonfatal CHD	854	0.76 (0.50-1.15)	0.73 (0.48-1.12)	0.71 (0.44-1.13)

Puett RC, Hart JE, Yanosky JD, Paciorek CJ, Schwartz J, Suh HH, Speizer FE, Laden F. Chronic fine and coarse particulate exposure, mortality and coronary heart disease in the Nurses' Health Study. Environ Health Perspect, Jun 2009; 117:1697–1701.

Where in the world might health risks be greatest?



Comparisons of Goods Movement with Attributes Affecting Public Exposure Risk



Why health as catalyst?

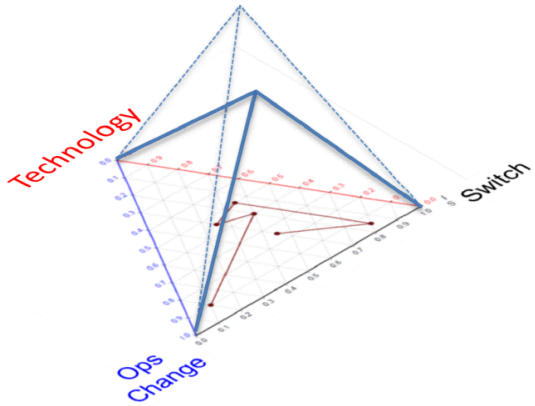
- First, there are other choices – climate, economy …
- Second, **goods movement can be a solution**
- Third, as energy and workforce become critical …
  - **New performance measures increase value advantages**

Coming decades of change

21st Century: Century of Stewardship?

New Routes

New Efficiencies



Levers for Action

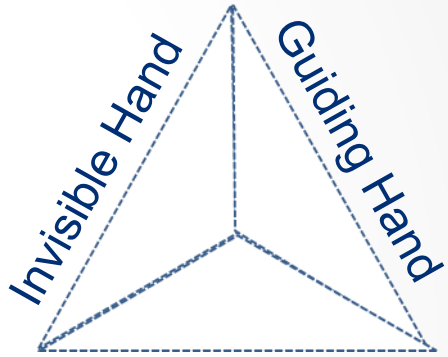
- *Infrastructure*
- *fuels*
- *technologies*
- *Operations*
- *logistics*
- *demand*

New Technology (e.g., Scrubbers)

Alternative Fuels (e.g., Low-Sulfur)

Eco-Speeds (e.g., Slow-steaming)

New Policies



Policy Options

may be part of the difference

Policy Options	I	F	T	O	L	D
	Intermodalism	Fuel	Technology	Operations	Logistics	Demand
Efficiency standards	•		•		•	
Taxes	•	•	•	•	•	•
Subsidies	•	•	•			
Technology mandates		•	•			
Infrastructure investment	•				•	
R&D investment		•	•			
Alternative/LC fuels		•	•			
Size/weight restrictions	•			•	•	
Demand management						•
Information/education	•	•	•	•	•	•

J. Winebrake, Clean Diesel 10.

Align Public-Private goals

Business path to scale?

Could start anywhere …

Technology path for results

Interventions at all scales

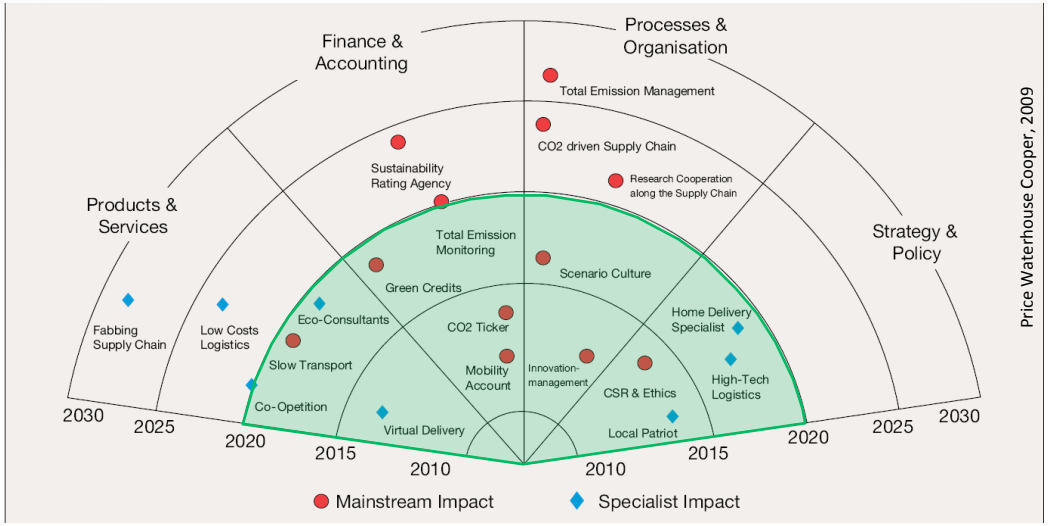
Port-based leadership

- Begin with ***Controlled***
- Expand to ***Contracted***
- Grow to ***Complete***
- Share with ***Competitors***

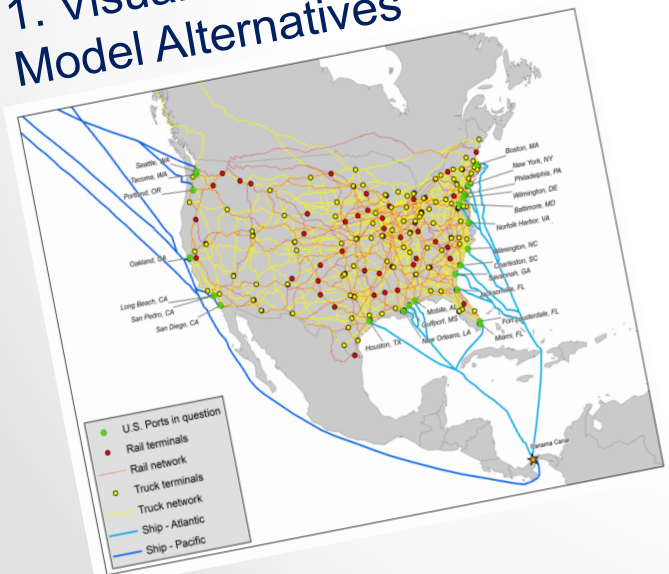
Sustainability innovation

- Report the bench
- Get off the bench
- Join the game
- Play to win

Concept: *Understand and adapt freight* to reduce emissions and redefine service



1. Visualize Goals Model Alternatives



2. Identify Useful Levers for Action

infrastructure
fuels
technologies
operations
logistics
demand

3. Apply incentives and signals for change

Policy Options	Intermodalism I	Fuel F	Technology T	Operations O	Logistics L	Demand D
Efficiency standards		•				
Taxes		•	•			
Subsidies		•		•		
Technology mandates		•	•			
Infrastructure investment		•	•	•	•	•
R&D investment		•	•			
Alternative/LC fuels		•				•
Size/weight restrictions		•	•			
Demand management		•	•			
Information/education			•	•		

J. Winebrake, Clean Diesel 10,

GIFT demonstration

- Time allowing

Finding interventions that align green freight goals with supply chains

Geospatial Intermodal Freight Transportation Model

*Decision makers can **explore tradeoffs** among alternative routes, across modes, and identify optimal routes for economic, energy and environmental objectives.*

http://webgift.rit.edu/webgift/

Thank you.

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