Approaches to control air pollution from ports and ships

Green Ports: New Front for China’s War on Pollution and Climate Change Mitigation

Dan Rutherford, Ph.D.
Haifeng Wang, Ph.D.
Xiaoli Mao
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Outline

- Why should we care?
- Case study: Shore power and fuel switching in Shenzhen
- Next up: Emission control areas
- Looking forward
- Conclusions
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Why should we care?
Air pollution from ports and vessels pose a serious public health challenge

- Three quarter of the world’s major cities and 50% of the global population lives on the coast exposed to pollution from shipping and ports
- Estimated 60,000 premature cardiopulmonary and lung cancer deaths in 2002 related to particulate emissions from shipping.

Annual premature mortality from ship emissions

Ships air pollution become relatively more important as cities clean up

Emissions by source in Hong Kong, 2010

Source: Hong Kong Environmental Protection Department
Shipping is also important for black carbon control

- Shipping responsible for 8~13% of diesel-related black carbon emissions in 2010, with 80% of those emissions in the Northern Hemisphere.
- Interest in Arctic shipping via Russia’s Northern Sea Route is high.
- Increased vessel traffic through the Bering Strait could increase air pollution 150 to 600% in the US High Arctic by 2025 using today’s fuels.

http://www.theicct.org/air-pollution-marine-vessels-us-high-arctic-2025

Figure 1. Comparison of the potential reduction in emissions with the application of 0.5% and 0.1% fuel for Arctic vessels assuming the low growth scenario.
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Shore power and fuel switching at the Port of Shenzhen
Assessment of shore power and fuel switching at the Port of Shenzhen

- SOx and PM emissions are of great concern in China
- Shenzhen is a key port linking PRD feeder routes to many international container routes
- August 2015 MoT action plan for port and ship emissions
- Mature technologies with existing infrastructure/ regulatory support
  - Fuel switching subsidies
  - California shore power mandate
Shore power background

- Port electrification strategy to replace ship auxiliary engine use at berth
- Requires shoreside and shipside capital investments
  - Shoreside (~$5,000,000/berth): distribution switchgear, circuit breakers, safety grounding, underground cable conduits, electrical vaults, power and communications receptacles and plugs.
  - Shipside retrofits ($300,000 to $2,000,000/ship): power cable receptacles plus electrical management system
- International, although not uniform, standard: ISO 80005-1
Examples of fuel switching requirements

- Global standards 2015 - Heavy Fuel Oil: 35,000 ppm
- ECZ proposed marine fuel: 5,000 ppm
- 2015 Marine fuel, North America, Baltic and North Sea: 1,000 ppm
- Onroad Diesel (China National Standards): 350 ppm
- Onroad Diesel (Shanghai): 50 ppm
- Onroad Diesel (Beijing): 10 ppm

Emission factors for Shenzhen shore power

Source: Costs and benefits of shore power at the Port of Shenzhen, ICCT and WWC, 2015.
Cost effectiveness of Shenzhen shore power

Particulate matter

- Improved berth utilization

NOx

- Leverage network effects

Source: Costs and benefits of shore power at the Port of Shenzhen, ICCT and WWC, 2015.
Case study conclusions

- Shore power is an effective means of reducing air pollution at berth, providing 88%, 94%, 95%, and 37% reductions in SOx, NOx, RSP, and CO$_2$ respectively in 2020.
- Relatively expensive compared to at berth fuel switching ($13,000/tonne SOx, $310,000/tonne PM)
- Cost effectiveness improves as utilization rate increases, through network effects and with greater incorporation into new build ships
- Policy recommendations
  - Prioritize 0.5% to 0.1% sulfur fuel switching
  - Consider incentives to attract shore power capable ships
  - Work with other Pacific Rim ports to take advantage of network effects
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Existing Emission Control Areas (ECAs)
Domestic Emission Control Areas (D-ECA)
Comparison of ECA requirements

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Benefits of going the extra step

- Greater geographic coverage:
  - <200 nm coverage, vs. 12 nm for D-ECAs
  - Full coast, rather than current D-ECAs only

- Greater emission reductions:
  - Additional, cost effective SOx and PM reductions
  - Potential for NOx control as well

- Leverage international experience with compliance and enforcement

- Accelerated investments in control technology could stimulate international competitiveness
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Looking forward
The flow of policy and technology
What will we be discussing in 5 to 10 years?

- Exacting fuel quality standards as a key enabling strategy
- Near-zero emission standards for engines
- Soot free goods movement
- Where possible, alternative and sustainable fuels (including electrification)
- Managing the impacts of Arctic shipping
- Integrating environmental considerations into supply chain management
- Compliance and enforcement!

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Conclusions

- Shore power is an effective means of reducing air pollution in Shenzhen
  - Additional (MDO to MGO) fuel switching could be prioritized
  - Additional measures to increase shore power utilization and leverage existing investments are recommended

- IMO ECA system provides a potential vehicle for expanded air quality benefits

- Studying other modes may provide clues as to where future work will lead us
Thank You

www.theicct.org/marine

Dan Rutherford, Ph.D.
dan@theicct.org