Shore Power at Port of Seattle

A viable solution to curb emissions at berth
Agenda

• Introduction to Port of Seattle (PoS)
• Cruise Industry at PoS
• Shore power at PoS
• Alternatives to Shore power
• Future shore power deployment
• Summary
Introduction to Port of Seattle

- Formed 1911
- Located on the Puget Sound in Washington State
- 1,800 Employees
- 2017 operating revenue US-$ 630.4 million
- Maritime division manages 30 Port properties along the Duwamish River and Puget Sound
Introduction to Port of Seattle

Lines of business

- Cruise
- Fishing & Commercial Operations
- Recreational Marinas
- Real Estate
- Airport 10\textsuperscript{th} busiest

➢ Cargo operations are run by North West Seaport Alliance (NWSA) 3.7M TEUs (5\textsuperscript{th} largest US port)
Cruise Industry at Seattle

Seattle-Alaska Cruises

- 9 cruise lines call to the Port of Seattle
- $17.5M annual business revenue
- 4029 jobs
- $18.9M annual state and local taxes
- 1 Cruise call =$2.7M to local economy
Pier 66 Bell Harbor Cruise Terminal

• Commissioned in 1999
• One berth
• Recent upgrades to accommodate newest NCL vessels

Norwegian Bliss is the largest cruise vessel on the west coast with a length > 1000 ft
Smith Cove Cruise Terminal – Terminal 91

• Commissioned in 2009
• 2 berths
• Accommodates cruise and fishing vessels
• Home to

Carnival
Holland America Line
PRINCESS CRUISES
Royal Caribbean
Celebrity Cruises
Cruise Industry at PoS

Continuous Growth

– more vessel calls, more passengers since 1999

On average, a cruise ship calling to the Port of Seattle carries 4,916 passengers.
Hoteling Energy Demand of Cruise Vessels

- Cruise vessels hoteling load - power systems, lights, refrigerator and air-conditioning etc.

- Power demand – 12MV /berth

- New vessels more efficient - pollute less for each hour of operation but vessel size increasing requiring more energy for passengers and entertainment options
Vessel Emissions – Elliott Bay, Seattle

- 2016 Puget Sound Emissions
  Inventory North Harbor + Cruise
  Ocean Going Vessels = 181,418 tpy CO2e
- 65% containers (NWSA)
- 35% cruise

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<th>NOx</th>
<th>SO2</th>
<th>DPM</th>
<th>CO2e</th>
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<td>4084</td>
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Impact of Hoteling on Emissions

- Approximately 14,000 tpy CO2e related to cruise hoteling.
- 7% of Elliott Bay Maritime Emissions
The Power of Shore Power

- Shore power eliminates 80% of all emissions at berth – reducing GHG emissions and other hazardous emissions
- Electricity in Seattle is largely hydro-based making it low-carbon and comparably cheap
- Shore power saves ~104t CO2 per cruise vessel call
Implementation of Shore Power

- First shore power system launched in 2005-06 at Terminal 30
- In 2009, relocation of cruise terminal to Terminal 91
- No shore power at P66
Cost & Funding

• $7M to upgrade electrical service & install equipment at 2 berths at T91

• In 2006, installation of shore power at Pier 66 was estimated at $14.9M due to extensive off-site improvements to the distribution system

• Add. cost to cruise operators to retrofit vessels for shore power compatibility
# Environmentalist view of reducing GHG emissions

## Vessel Calls 2016

<table>
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<tr>
<th>Terminal</th>
<th># Vessel Calls</th>
<th>SP Capable</th>
<th>Actual Hookups</th>
<th>CO2 reduced (tpy)</th>
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<td>149</td>
<td>81</td>
<td>68</td>
<td>7072</td>
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<tr>
<td>P66</td>
<td>54</td>
<td>40*</td>
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<td>0</td>
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<td>203</td>
<td>121</td>
<td>68</td>
<td>7072</td>
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</table>

Provide for service at P66

Increase usage from 84% to 100% at T91

= 5512 tpy more CO2 reduced
CFO View

• Costs for SP installation at downtown location - $16 Million
• Conversion costs for vessels - $2M
• Cost per ton of carbon avoided = $3.5M
T91 Increase Use

• Why are 26% of shore power capable vessels not hooking up
  — analysis of cost SP hookup vs fuel - should be cost neutral

• Opportunities coming to incentivize or influence environmental practices at T91
Alternatives to Shore Power

Cleaner Burning Fuels

• Within ECA fuel sulphur content may not exceed 0.1%

• Vessels have several options:
  - Purchase low sulphur fuel
  - Switch systems to LNG
  - Utilize scrubbing technology
  - Switch to renewable fuels

Lower sulphur emissions but does not reduce GHG emissions
Gas Exhaust Scrubbers

Cruise vessels utilize scrubber technology that removes sulphur from their gas exhaust to stay within the allowable limit of emissions.

Exhaust scrubbers require major investment, but are cheaper than clean fuels long-term.
Shore Power Use at Container T5

- Challenges
- Install Shore Power
- Maximize Shore power use
Summary

• High capital costs of shore-side electrical infrastructure are a challenge

• Different vessel designs, scrubber technology hinder maximum adoption of shore power

• Advantageous electricity mix in Seattle allows significant emissions reductions at low electricity rate

• Shore power eliminates 80% of all emissions at berth — reducing GHG emissions and other pollutants

• Clean fuels with shore power are complementary