Shore Power Emission Calculator (SPEC)

Presentation to NASEO

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Shore Power Technology Assessment and Shore Power Emission Calculator *Overview*

- Characterizes shore power systems at U.S. ports
- Includes a new methodology for calculating emission reduction of shore power systems

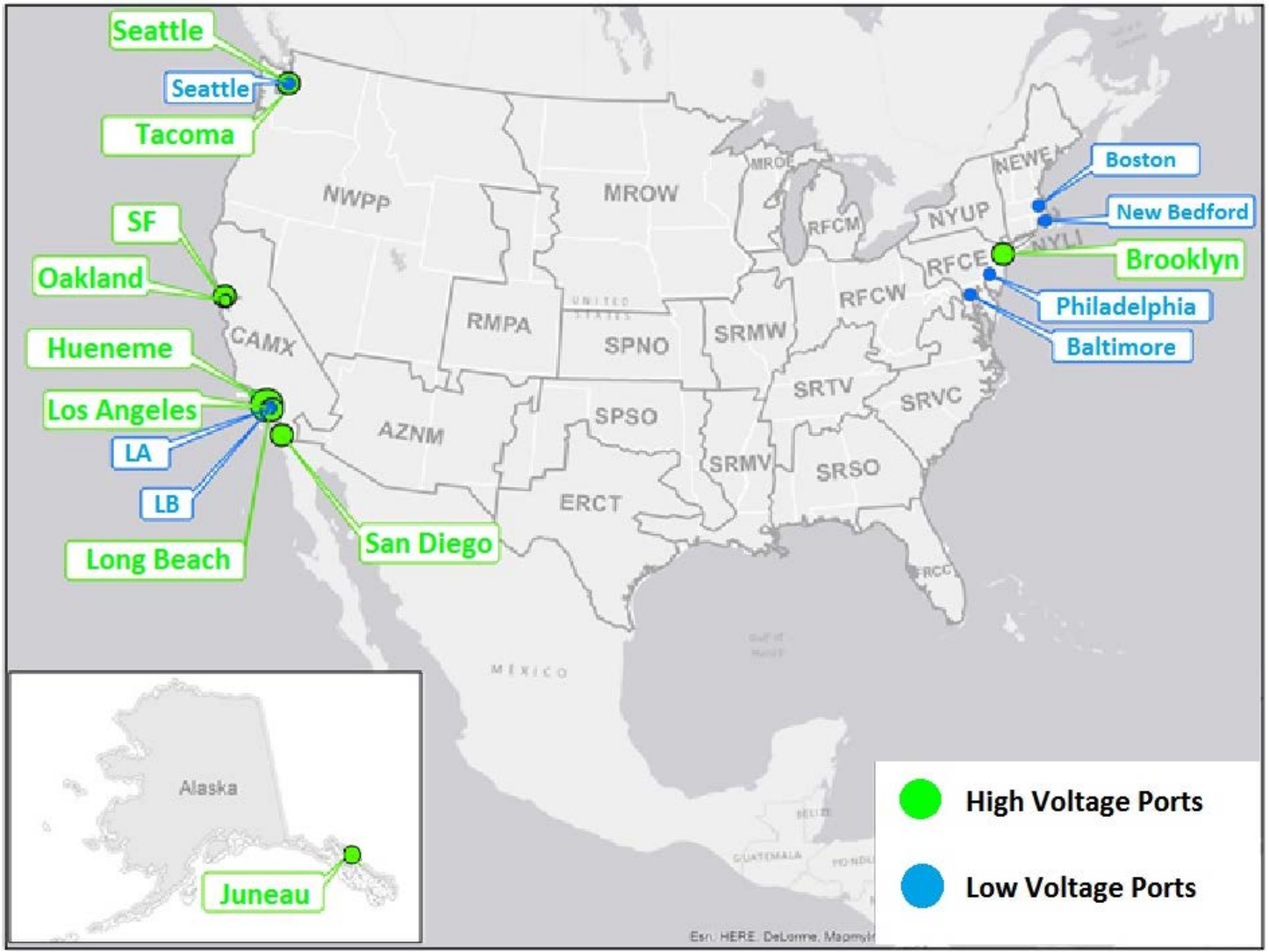
Shorepower Port Assessment Report prepared under contract by:
ERG/Energy and Environmental Research Associates (EERA):
Jim Corbett, Edward Carr, Bryan Comer and Jordan Silberman

Shore Power Assessment

Shore Power System ISO/IEC/IEEE Standards

Standard	**Capacity**	**Uses**
High Voltage Shore Connection Systems	6.6 kV and/or 11 kV	Cruise, Container, Reefer
Pre Standard- Low Voltage Shore Connection Systems	220-480 V	Fishing, Tug

Existing Shore Power Locations



Existing Shore Power Locations

	Port Name	Vessel Types using OPS	Year of Installation
High Capacity	Juneau	Cruise	2001
	Seattle	Cruise	2005-2006
	San Francisco	Cruise	2010
	Brooklyn	Cruise	2015
	Los Angeles	Container Cruise	2004
	Long Beach	Cruise Container Tanker	2011 2009 2000
	San Diego	Cruise Reefer	2010
	Oakland	Container	2012-2013
	Hueneme	Reefer	2014
Low Capacity	Seattle	Fishing	
	Boston	Fishing	
	New Bedford	Fishing	2011
	Philadelphia	Tug	
	Baltimore	Tug	
	Los Angeles / Long Beach	Tug	2009

Shore Power & Diesel Emissions Estimate

- **Vessel inputs**
  - Auxiliary engine load factor at berth, or "hoteling" (%)
  - Auxiliary engine emissions factors (g/kWh)
- **Activity inputs**
  - Vessel port calls per year
  - Hoteling hours per port call
- **Shore power inputs**
  - Electricity generation by facilities contributing to the shore power system (MWh)
  - Emissions by facilities contributing to shore power system
    - e.g., metric tons of SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2)
  - Electrical power generation emissions factor

- **Output**:
  Difference = Vessel Emissions - Shore Power Emissions

Example Emissions Calculator – General Model

Emissions Calculator: High Capacity Shore Power Connection (eGRID)

Example	eGRID Region	Vessel Type	Engine Size (kW)	Factor	Annual Vessel Calls	Hours/Vessel Call
Northeast	RFCE	Passenger/Cruise Sl	11000	0.64	26	10
	RFCE	General Cargo	1776	0.22	15	35
	RFCE	RORO	2850	0.3	20	25
Alaska	AKGD	Container Ship	6800	0.17	40	10
	AKGD	Passenger/Cruise Sl	11000	0.64	50	12
Florida	FRCC	Passenger/Cruise Sl	11000	0.64	100	10
	FRCC	Tanker	1985	0.67	24	20
California	CAMX	Passenger/Cruise Sl	11000	0.64	141	10
Input	Dropdown	Dropdown	Built in	Built in	Input	Input

INPUTS in Blue

OUTPUTS in Gray

			Vessel Power Emissions (MT)			Shore Power Emissions (MT)			Difference (MT)			Percent Difference		
Example	eGRID Region	Consumption (kWh)	NOx	SOx	CO2	NOx	SOx	CO2	NOx	SOx	CO2	NOx	SOx	CO2
Northeast	RFCE	1,947,234	27.07	0.78	1,343.59	0.78	1.80	776.56	-26.29	1.02	-567.03	-97%	131%	-42%
	RFCE	218,221	3.03	0.09	150.57	0.09	0.20	87.03	-2.95	0.11	-63.55	-97%	131%	-42%
	RFCE	454,787	6.32	0.18	313.80	0.18	0.42	181.37	-6.14	0.24	-132.43	-97%	131%	-42%
Alaska	AKGD	491,915	6.84	0.20	339.42	0.49	0.15	219.14	-6.35	-0.05	-120.28	-93%	-25%	-35%
	AKGD	4,493,617	62.46	1.80	3,100.60	4.45	1.35	2,001.84	-58.01	-0.45	-1098.75	-93%	-25%	-35%
Florida	FRCC	7,489,362	104.10	3.00	5,167.66	2.23	2.96	3,871.69	-101.87	-0.03	-1295.97	-98%	-1%	-25%
	FRCC	679,123	9.44	0.27	468.60	0.20	0.27	351.08	-9.24	0.00	-117.52	-98%	-1%	-25%
California	CAMX	10,560,000	146.78	4.22	7,286.40	1.22	0.20	2,887.19	-145.57	-4.02	-4399.21	-99%	-95%	-60%
		Sub-Total	**105.72**	**3.04**	**5247.98**	**5.98**	**3.92**	**3265.94**	**-99.74**	**0.88**	**-1982.04**			
		Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output

Example Emissions Calculator – User Input Model

Emissions Calculator: High Capacity Shore Power Connection (User Input Model)

eGRID Region	Generation Facility / Plant Name	Vessel Type	Vessel Fuel	Auxiliary Engine Size (kW)	Load Factor	Number of Annual Vessel Calls	Avg. Hotel Hours/Vessel Call	Transmission Losses
SRVC		USER ENTRY	MDO (0.1% S)	6758	1	68	10	0.06
	Hagood	USER ENTRY	MDO (0.1% S)	6758	1	68	10	0.06
USER ENTRY		Passenger/Cruise Sh	MDO (0.1% S)	6758	1	68	10	0.06
Dropdown	Dropdown	Dropdown		Input	Input	Input	Input	Input

INPUTS in Blue

Calculator:	Vessel Power Emissions (MT)						Shore Power Emissions (MT)						Difference (MT)						Percent Difference					
Consumption (kWh)	NOx	SOx	CO2	PM10	PM2.5	CO	NOx	SOx	CO2	PM10	PM2.5	CO	NOx	SOx	CO2	PM10	PM2.5	CO	NOx	SOx	CO2	PM10	PM2.5	CO
4,888,766	67.95	1.96	3,373.25	1.22	1.12	5.38	1.37	1.59	2,013.45	na	na	na	-66.59	-0.37	-1359.80	######	######	######	-98%	-19%	-40%	######	#VALUE!	######
4,888,766	67.95	1.96	3,373.25	1.22	1.12	5.38	2.88	0.07	2,484.41	na	na	na	-65.08	-1.88	-888.83	######	######	######	-96%	-96%	-26%	######	#VALUE!	######
4,888,766	67.95	1.96	3,373.25	1.22	1.12	5.38	1.78	5.86	2,663.60	1.05	0.79	0.46	-66.17	3.90	-709.65	-0.17	-0.34	-4.92	-97%	199%	-21%	-14%	-30%	-92%
Sub-Total	####	5.87	10119.75	3.67	3.37	16.13	6.03	7.52	7161.46				-197.83	1.65	-2958.29	#####	#####	#####						
Output	Output	Output	Output				Output	Output	Output				Output	Output	Output				Output	Output	Output			

OUTPUTS in Gray

For More Information

SPEC website

www.epa.gov/ports-initiative/shore-power-technology-assessment-us-ports

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Questions about the report or the calculator:

Tech_Center@epa.gov

or

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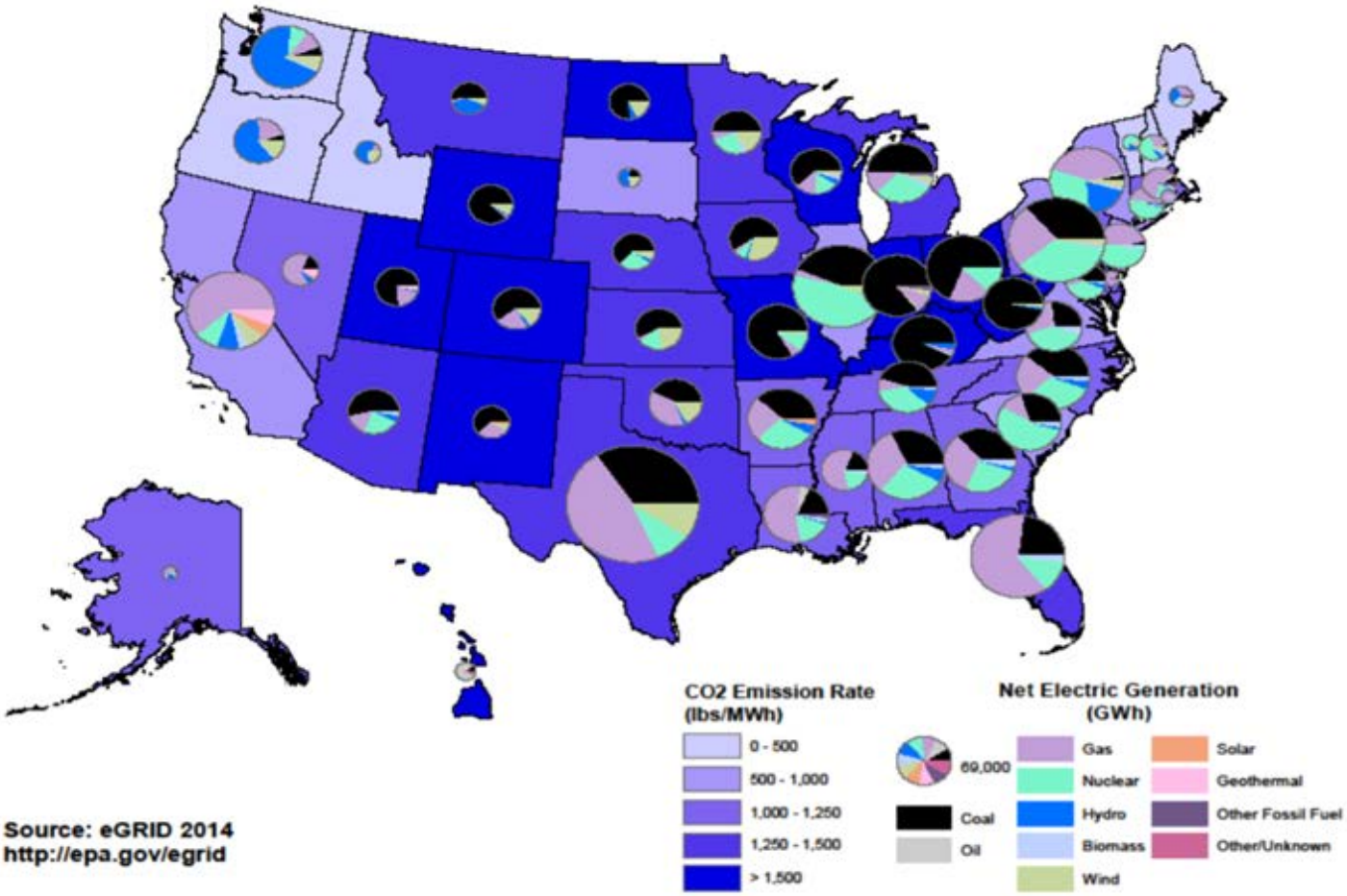
Appendix

Generation by Fuel Type and CO_2 Emission Rates (eGRID2014)



Source: eGRID 2014
http://epa.gov/egrid

(created 1/13/2017)