

Evaluating Solar Energy at the Port of Seattle

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Overview

- Port goals
- Solar analyses
 - Maritime
 - Aviation
- Comparing costs and benefits among environmental strategies
- Staff recommendations



Approach shows trade-offs and opportunity to consider new goals

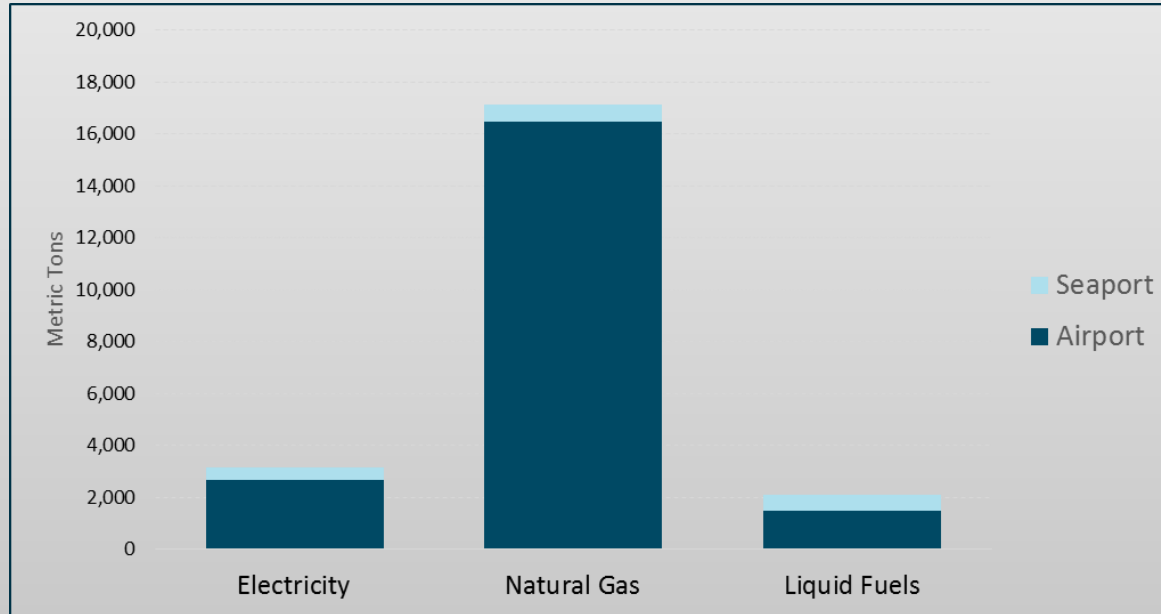
Port Goals

- Century Agenda
 - Reduce port-owned carbon emissions by 50%
 - Meet all increased energy needs through conservation and/or renewables
 - Support local business growth and workforce development (within solar industry)
- New Policy Values?
 - Reduce reliance on hydropower and impacts on salmon/marine life
 - Demonstrate Port leadership?
 - Energy Resilience?



Seeking Commission guidance on renewable electricity strategies

Port Direct and Indirect Carbon Emissions



Heating and cooling are significant portion of Port carbon emissions

Carbon Reduction Strategies

- Energy efficiency
 - Stage 3 Mechanical
 - Lighting upgrades
- Convert CNG buses to electric
- Renewable natural gas
- Purchase renewable diesel
- Green Fleet
- PSE's Green Direct



Port is pursuing multiple carbon reduction strategies

Electricity and Carbon at Port Facilities



Aviation

- Served by BPA, PSE, and SCL
- Act as own utility
- Costs and carbon content vary among three utilities



Maritime

- Served by SCL (\$0.09/kWh)
- Low carbon electricity

Location and utility influence project costs and carbon reduction

Electricity at Sea-Tac

Puget Sound Energy

- 2% of electricity
- 40% carbon free
- \$0.10/kWh

BPA

- 97% of electricity
- 98% carbon free
- \$0.04/kWh

Seattle City Light

- 1% of electricity
- 98% carbon free
- \$0.09/kWh



Maritime Solar Analyses

- Evaluated 9 locations
 - Fishermen’s Terminal: Net Shed 5
 - Pier 69 Building
 - Large scale array at CEM (conceptual)
 - Preliminary assessment on 6 other building retrofits



Net Shed 5 Solar Demonstration project underway

Costs of Solar at Maritime

Location	Estimated Project Cost (\$)	Net Present Value (NPV) (\$)	% Carbon Reduced /yr. (for location)	Carbon Cost (\$/MT)
FT Net Shed 5	\$250K	-\$201K	2%	\$22K
Pier 69	\$383K (\$700K less \$317K grant)	-\$255K	4%	\$5K
CEM near T5	\$19M	-\$12.6M	15%	\$6.4K

Solar projects show negative NPV but with environmental benefits

Pier 69 Solar

- Received \$317K grant award from WA Department of Commerce
- Grant provides:
 - Project payback 33 years
 - Carbon reduction cost per metric ton is comparable to SBM lighting project.
 - Grant improves financial return, but NPV is still negative
- Evaluating alternative project delivery methods to manage construction costs
 - ESCO (energy service company)
 - Port-led project
 - Engineered system

Pier 69 project with grant provides better financial returns and carbon reduction

Airport Solar Analyses

- Conducted by nation-wide firm HMMH
- Identified 8 locations
 - All constrained due to limited footprint
 - All avoid glint and glare for pilot/aircraft safety
- Locations differ in cost and carbon reduction due to:
 - Ground vs. roof mount
 - Different electricity rates and carbon emissions
 - Glare standards restrict panel orientation and reduce generation potential



Airport property has locations but potential challenges

Costs of Airport Solar Projects

Location	Upfront Cost Range (Million \$)	Net Present Value Range (Million \$)
Main Parking Garage (BPA)	\$7.3 to \$20	-\$5 to -\$18
South Sat Roof (BPA)	\$0.90 to \$3.0	-\$0.50 to -\$2.6
Tank Farm Ground	\$0.56 to \$2.3	-\$0.28 to -\$2.0
Rental Car Wash Roof (SCL)	\$0.82 to \$2.7	-\$0.46 to -\$2.3
Airfield South (PSE)	\$4.5 to \$13	-\$1.8 to -\$11

All airport solar projects have negative NPV, even before including Port soft costs

Carbon Benefit from Airport Solar Projects

Location	% Carbon Reduced/yr.	Carbon (\$/MT)
Main Parking Garage (BPA)	0.27	\$2,800 to \$10K
South Sat Roof (BPA)	< 0.001	\$2,200 to \$11K
Tank Farm Ground	< 0.001	\$1,800 to \$12K
Rental Car Wash Roof (SCL)	< 0.001	\$2,400 to \$12K
Airfield South (PSE)	0	N/A

All airport solar projects provide minimal carbon reduction

Key Uncertainties

Assumptions
Construction costs
Lifespan of PV
Availability/magnitude of grants and incentives
Roof condition and applicability for solar
Future electricity costs

Uncertainties regarding project costs

Initial Findings

- Financial returns vary across locations
- In all locations, cost to produce electricity from solar are greater than costs to buy
- Modest to small GHG emission reductions
- Can leverage Washington-based industries and workers
- Grants/tax rebates/electricity incentives may significantly reduce costs
- Reduces reliance on hydro electricity



Solar projects show negative financial returns but advance some Port goals

Consider Solar in Eastern WA

- Projects more cost-effective due to:
 - Economies of scale
 - ~25% “more sun” in eastern WA
 - Power purchase agreements (PPAs)
- Opportunities for partnerships



Off-site projects likely meet Port goals at lower cost

Comparing Costs Among Strategies

Strategy	Approximate Cost/MT Carbon	% Carbon reduced/year
AV Solar: Main parking garage	\$10,000	0.3
Maritime Solar: P69	\$5,000	4
SBM lighting upgrade	\$4,000	1.4
Renewable Natural Gas	\$400	70
Convert buses to electric	\$350 to \$900	10
Stage 3 Mechanical Conservation	\$300	4
Renewable Diesel (fleet)	\$125	2
Green Direct – Wind	\$61	5

Solar projects result in relatively high cost per ton of carbon reduced

Comparing Strategies to Goals

Strategy	Increase conservation and renewables	Cost/MT Carbon	Promote workforce development (WA)	Reduce Reliance on hydro-power
AV Solar: Main parking garage	✓	\$10,000	✓	✓
Maritime Solar: P69	✓	\$5,000	✓	✓
SBM lighting upgrade	✓	\$4,000	✓	✓
Off-site Solar	✓	TBD	✓	✓
Renewable natural gas	✓	\$400		
Convert buses to electric	✓	\$350 - \$900		
Stage 3 Mechanical	✓	\$300	✓	✓
Renewable Diesel (fleet)	✓	\$125		
Green Direct – Wind	✓	\$61	✓	✓

Renewable energy projects advance multiple goals/values

Staff Recommendations

- Continue project development for Pier 69 solar
- Pursue off-site renewable energy projects for Airport, including both solar and wind
- Continue to pursue cost-effective strategies with environmental and economic benefits (e.g., RNG, energy efficiency).



Results show a range of renewable energy projects can advance Port goals and values