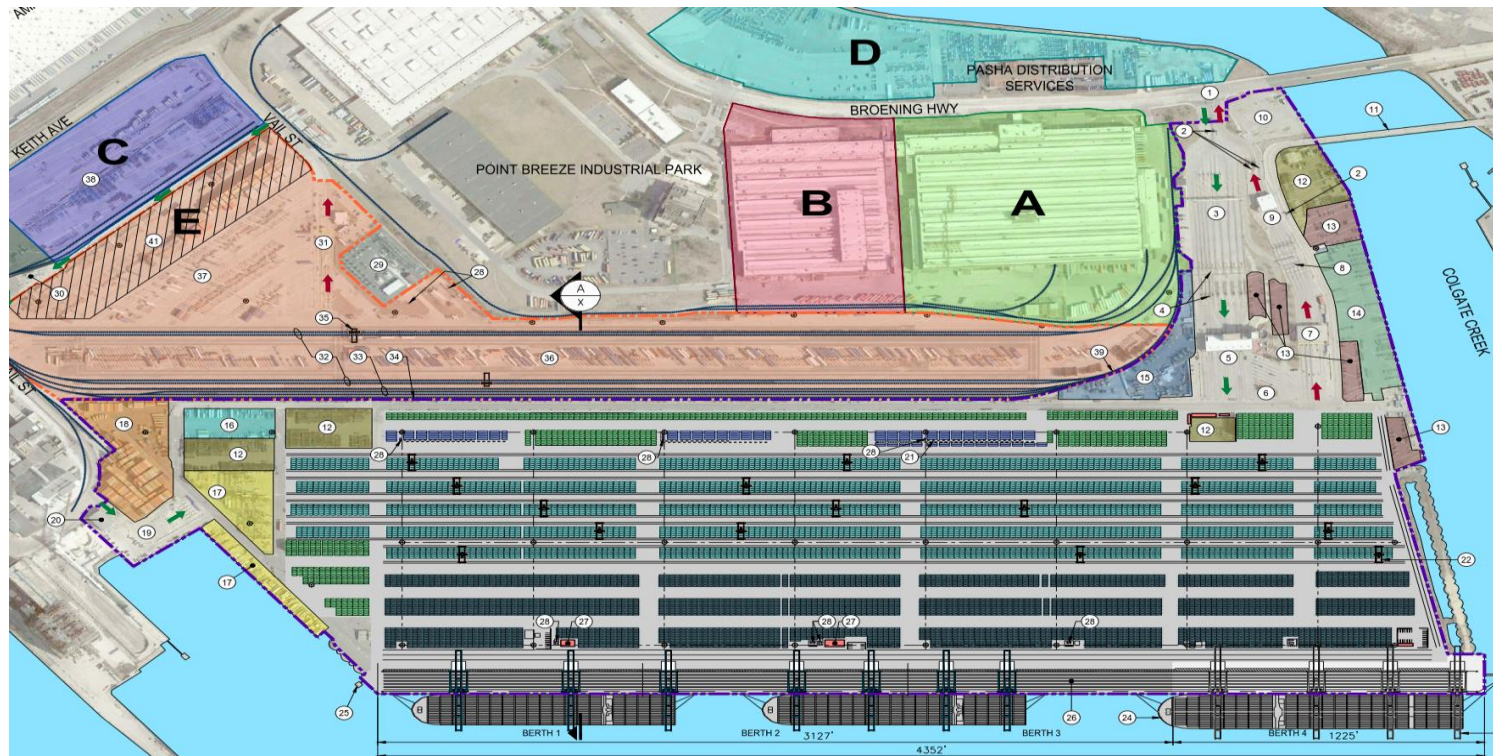

Seagirt Marine Terminal – Container Yard Electrification Plan

Maryland Grid Modernization Retreat
November 07, 2019

Seagirt Marine Terminal

- 2010 Successful PPP with the MPA -> Long Term Concession
- Since start of concession container volumes have almost doubled.
- Equivalent to a $> 8\%$ CAGR

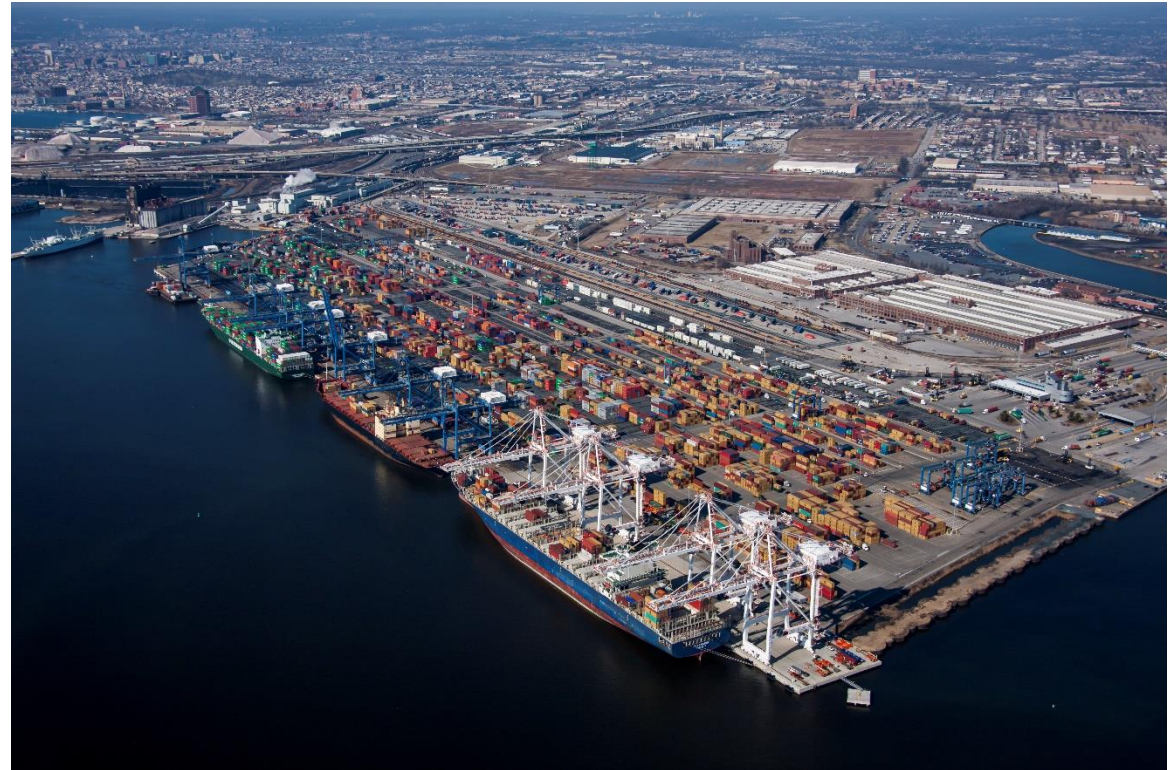
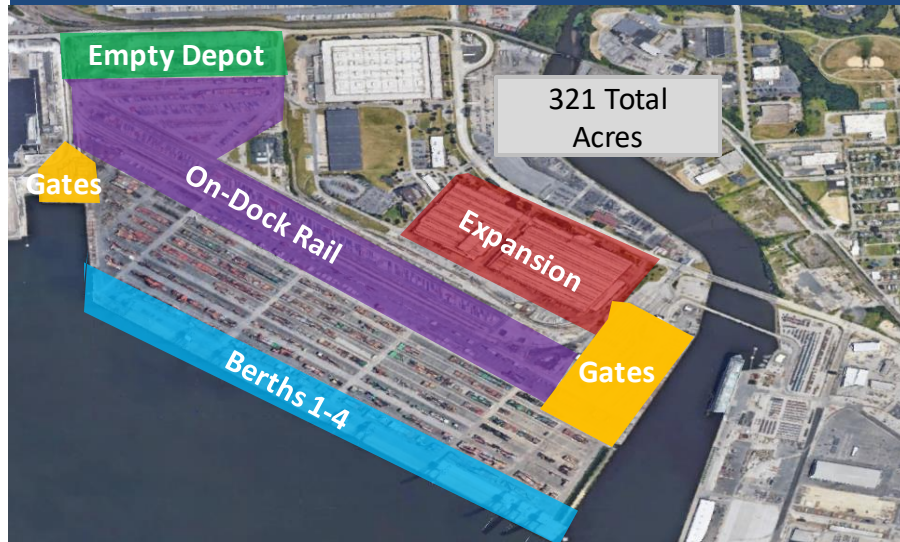


Terminal Specifications

Terminal Specifications

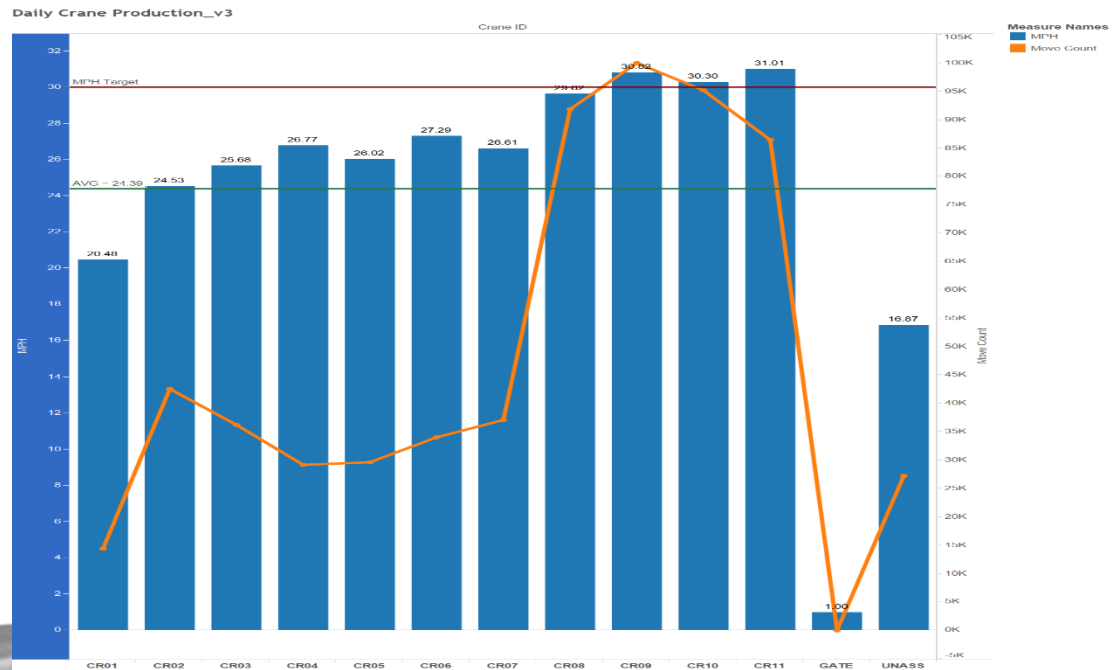
- 50' (15.2m) channel, berth and turning basin
- 185' (56.4m) of air draft
- Four berths totaling 4,352' (1,326m) of linear wharf
- 11 Cranes (4 super post-Panamax and 7 post-Panamax)
- Crane productivity averaging 33 moves per hour
- Available berth, gate, and yard capacity
- 14,000 TEU ship ready

Seagirt Marine Terminal



Seagirt Electrical Master Plan

- In 2012 Seagirt Installed 4 new SPPX Electric Quay Cranes on Berth 4
- Total Number of QC increased to 11
- In 2018 the new cranes moved 63% of all containers
- With the addition of the new cranes utility company indicated that capacity of main electrical substation was close to capacity → improvements may be required to add more electrical equipment



Seagirt Electrical Master Plan

- Seagirt is ordering 4 new SPPX Cranes to arrive 2021.
- In 2018 PAC commissioned an Electrical Master Plan study to better understand existing capacity and future demand which should include the new QC and additional terminal electrification
- This results of this study show:
 - The measured peak electrical demand for entire site in 2018 (provided by BGE) is 2.9 MVA
 - In 2010, prior arrival of new cranes measured demand was 5.1 MVA
 - Site Peak Demand went down with introduction of new cranes (at double the terminal cargo throughput)
 - The new QC are highly efficient
 - Due to new electrical efficiencies, there's enough headroom in the current substation to allow additional electrification of the terminal (container yard)

eRTG Cranes – Container Yard Electrification

WHY
using eRTG cranes

ECONOMIC

Reduction of OPEX

- Fuel
- Maintenance
- Downtimes



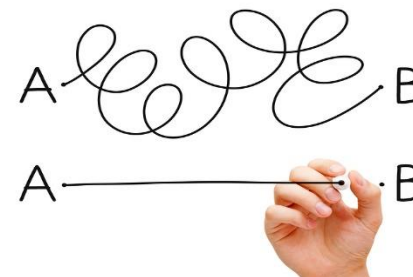
ENVIRONMENTAL

Reduction of Diesel Emissions
Reduction of Noise Pollution
Reduction of chances of spills



FUNCTIONAL

Work Simplification
Better Resource utilization
Safer



Electrification of eRTG's By 2028

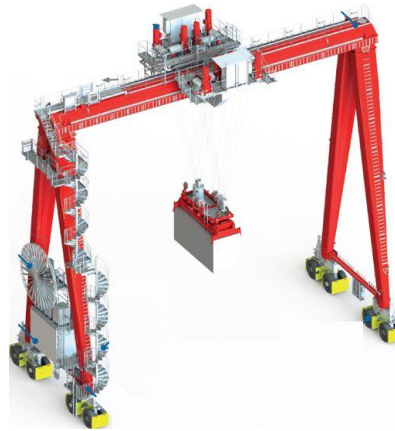
Today's Operation

- 22 Diesel RTG's
- 0 Electric RTG's

2019 Diesel RTG

Capacity:

- 1,200,000 TEU Year



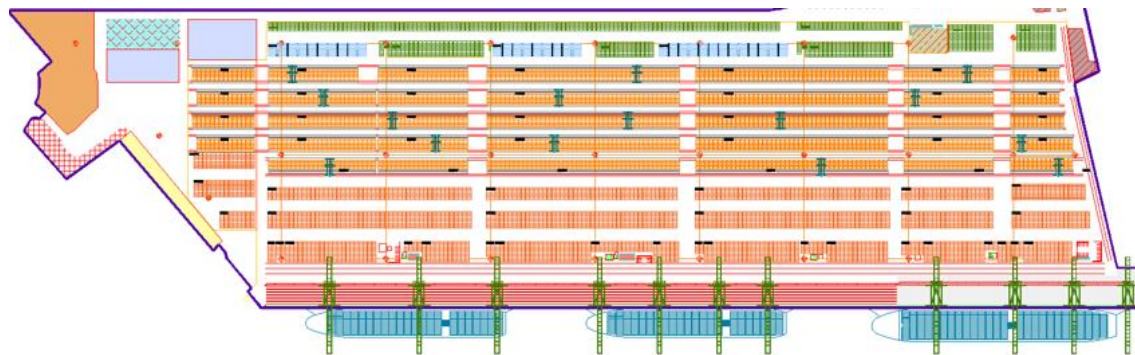
The 2028 Operation

- 54 Electric RTG's
- 0 Diesel RTG's

2028 eRTG

Capacity:

- 2,400,000 TEU Year



Strategy to keep Seagirt Commercially Sustainable

Volume is trending up...

- PAC is has developed a nine stages strategy to stay ahead of this trend
- Significant infrastructure changes will be required for the immediate four phases
- Electrification of yard cranes, trucks and future shuttle carriers should be part of this strategy

RTG Emissions Profile by Phase

NOx

# of units in service	Phase 1			Phase 2			Phase 3			Phase 4
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Tons per year NOx			Tons per year NOx			Tons per year NOx			Tons per year NOx
0										0
1	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
2	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
3	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
4	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
5	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
6	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
7	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
8	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	
9	2.97	2.97	2.97	2.97	2.97	2.97				
10	2.97	2.97	2.97	2.97	2.97	2.97				
11	2.97	2.97	2.97	2.97	2.97	2.97				
12	2.97	2.97	2.97	2.97	2.97	2.97				
13	2.97	2.97	2.97	2.97	2.97	2.97				
14	2.97	2.97	2.97	2.97	2.97	2.97				
15	2.97	2.97	2.97	2.97	2.97	2.97				
16	2.97	2.97	2.97	2.97	2.97	2.97				
17	2.97	2.97	2.97	2.97	2.97	2.97				
18	2.97	2.97	2.97	2.97	2.97	2.97				
19	2.97	2.97	2.97							
20	2.97	2.97	2.97							
21	2.97	2.97	2.97							
22	2.97	2.97	2.97							
TOTAL Annual	65.32	65.32	65.32	53.45	53.45	53.45	23.75	23.75	23.75	0
TOTAL Per Phase	195.97			160.34			71.26			0
Percentage Reductions				18%			56%			100%

Co2

# of units in service	Phase 1			Phase 2			Phase 3			Phase 4
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Tons per year CO2			Tons per year CO2			Tons per year CO2			Tons per year CO2
0										0
1	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
2	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
3	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
4	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
5	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
6	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
7	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
8	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	103.50	
9	103.50	103.50	103.50	103.50	103.50	103.50				
10	103.50	103.50	103.50	103.50	103.50	103.50				
11	103.50	103.50	103.50	103.50	103.50	103.50				
12	103.50	103.50	103.50	103.50	103.50	103.50				
13	103.50	103.50	103.50	103.50	103.50	103.50				
14	103.50	103.50	103.50	103.50	103.50	103.50				
15	103.50	103.50	103.50	103.50	103.50	103.50				
16	103.50	103.50	103.50	103.50	103.50	103.50				
17	103.50	103.50	103.50	103.50	103.50	103.50				
18	103.50	103.50	103.50	103.50	103.50	103.50				
19	103.50	103.50	103.50							
20	103.50	103.50	103.50							
21	103.50	103.50	103.50							
22	103.50	103.50	103.50							
TOTAL Annual	2277.00	2277.00	2277.00	1863.00	1863.00	1863.00	828.00	828.00	828.00	0
TOTAL Per Phase	6831.00			5589.00			2484.00			0
Percentage Reductions				18%			56%			100%

eRTG Equipment Cost to Migrate

Freerider eRTG Cost:

- Phase 1: \$27,500,000 (11 eRTG's)
- Phase 2: \$17,500,000 (7 eRTG's)
- Phase 3: \$45,000,000 (18 eRTG's)
- Phase 4: \$45,000,000 (18 eRTG's)

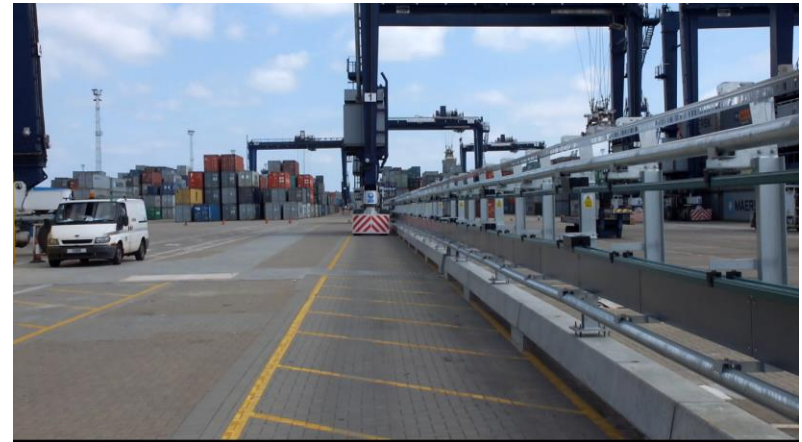
Total eRTG (54 Units) investment: \$135,000,000

eRTG Phase 1 Migration & Beyond

Phase 1 Electrification Cost Estimates

- Large scale civil and electrical infrastructure investment of ~\$15 million
- Additionally, we will make IT infrastructure investment of ~\$5 million and ~\$3 million in stack infrastructure
- eRTG equipment procurement of \$27.5 million for eleven cranes
- Phase 1 investment is ~\$51 million

Phases 1 – 4 will be an investment of ~\$200 million



Four Phase Cost

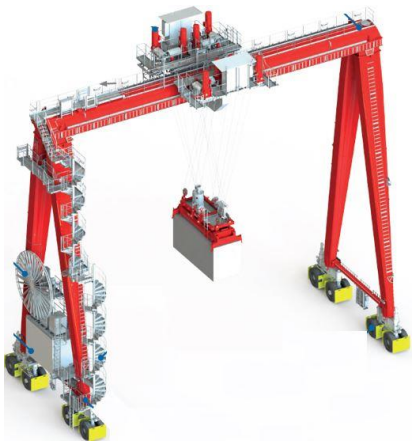
The cost of this project will be ~\$200 million

- The Civil, IT & Medium Voltage components are ~\$65 million
- The equipment cost to enable the migration from Diesel to eRTG's are \$135 million
 - This includes 54 new electric RTG's with a unit cost of \$2.5 million, totaling \$135 million
 - A Diesel RTG alternate unit cost is \$2.24 million, with 54 units totaling \$121 million with significantly less Civil, IT & Medium Voltage cost

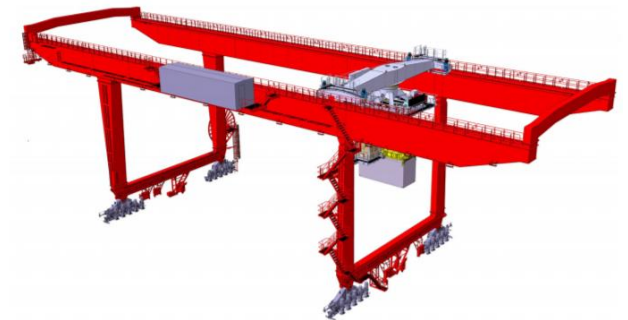
PATH TO CONTAINER TERMINAL ELECTRIFICATION

The migration of Marine Terminal Electrification:

eRTG's



RMG



eShuttle Carriers



eTerminal Trucks



Electrified Horizontal Transport

As the eRTG Phases are realized-

PAC will begin utilizing electrified terminal trucks and shuttle carriers for transport inside the terminal. ---> Less emissions, fumes & noise

Battery Electric Terminal Trucks are being successfully tested in marine terminal environments



Fully Electric Shuttle Carriers and fast charging stations are being tested in marine terminals



Conclusions and comments

- Electrification presents incredible opportunities
- PAC is ready to start terminal electrification
- Will allow expansion of terminal capacity minimizing our environmental footprint
- Electrification requires a huge initial capital investment.
- Key component of this electrification includes additional efficiencies of container handling equipment
- How do we ensure reliability of the supply?
- What mechanism exist to streamline the process of increasing capacity and resiliency of the Grid?
- Are micro-grids the solution?
- Who should pay for this?