

Estimating Commercial Ship Life Cycle Cost & Required Freight Rate (3-Port Model)



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This is another of SPAR's *ESTI-MATE* Cost Models. It focuses on life cycle costs for commercial ships and estimating the required freight rates for a user-defined trade route and operational characteristics.

For the life cycle costs, annual estimates are generated for

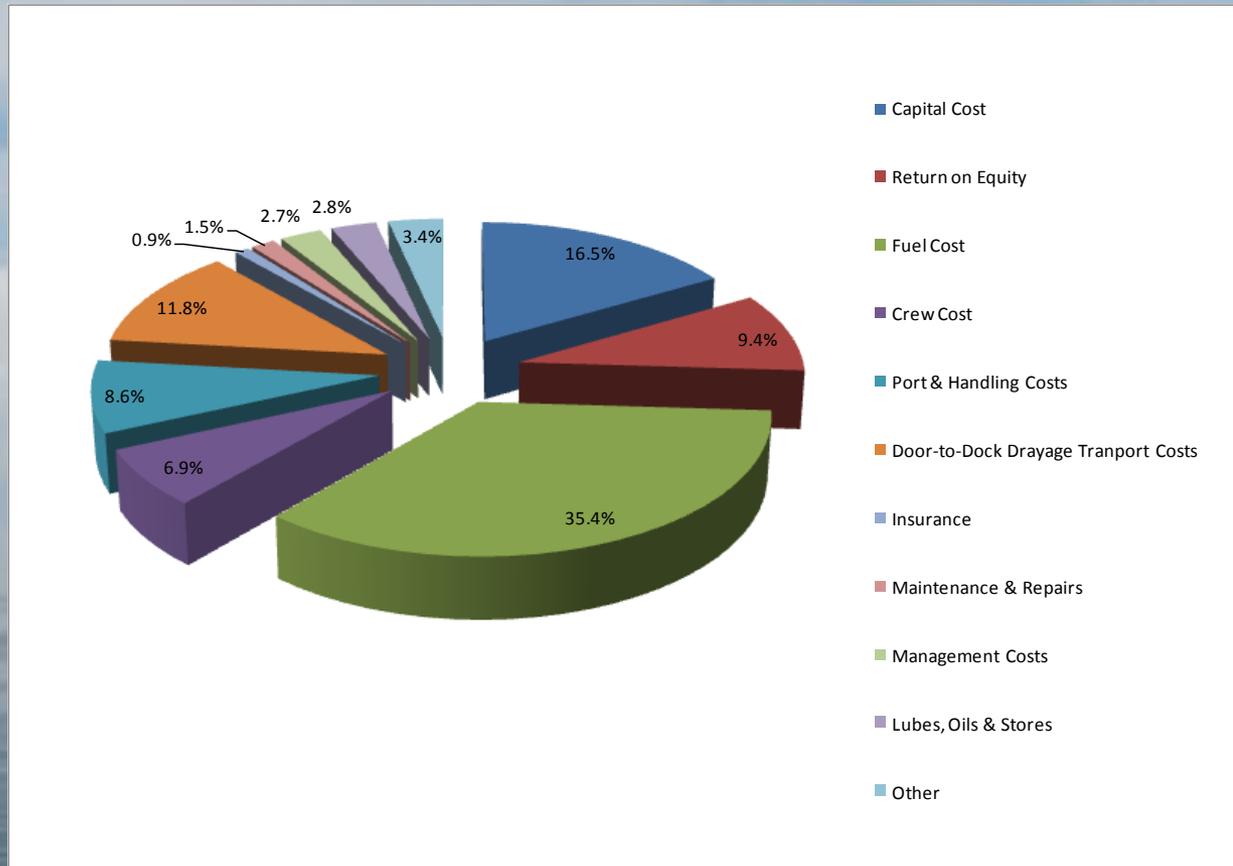
- Capital financing and return on equity;
- Salvage/resale
- Insurance
- Administration
- Supplies and crew

When the user defines details of the trade route (average voyage scenario of speeds and distances), the Cost Model estimates costs for

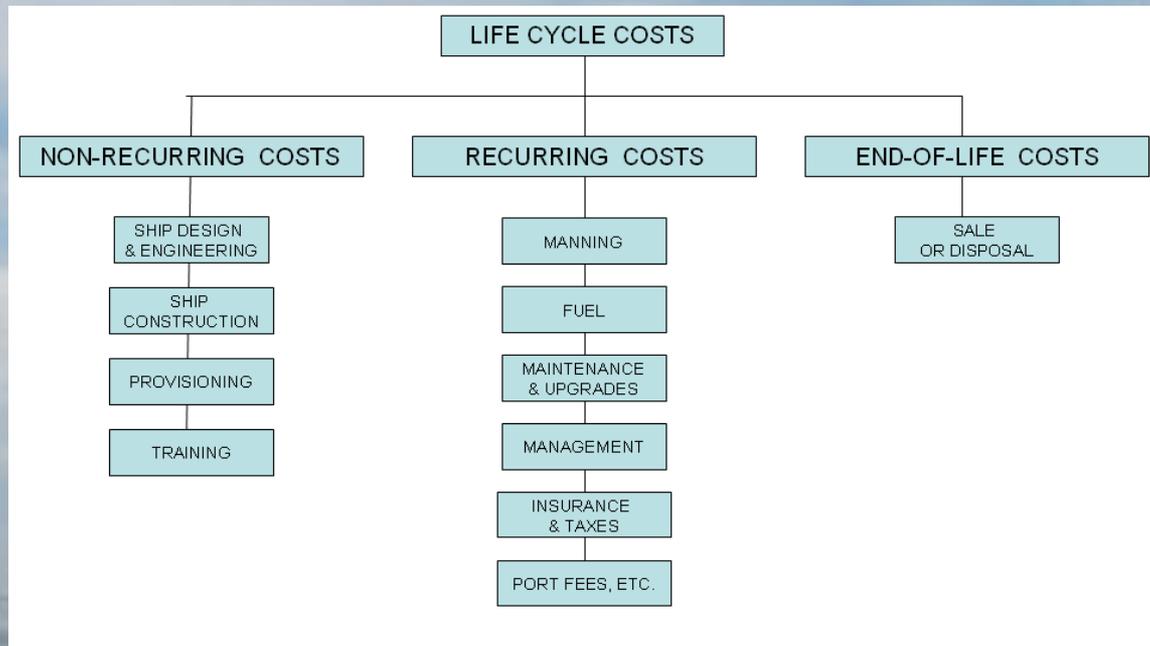
- Fuel
- Port & drayage.

The Cost Model develops the Required Freight Rate (RFR) on the basis of unit (trailer, TEU, passenger, etc.) voyage cost, tonnage, and/or equivalent statute land miles (if applicable).

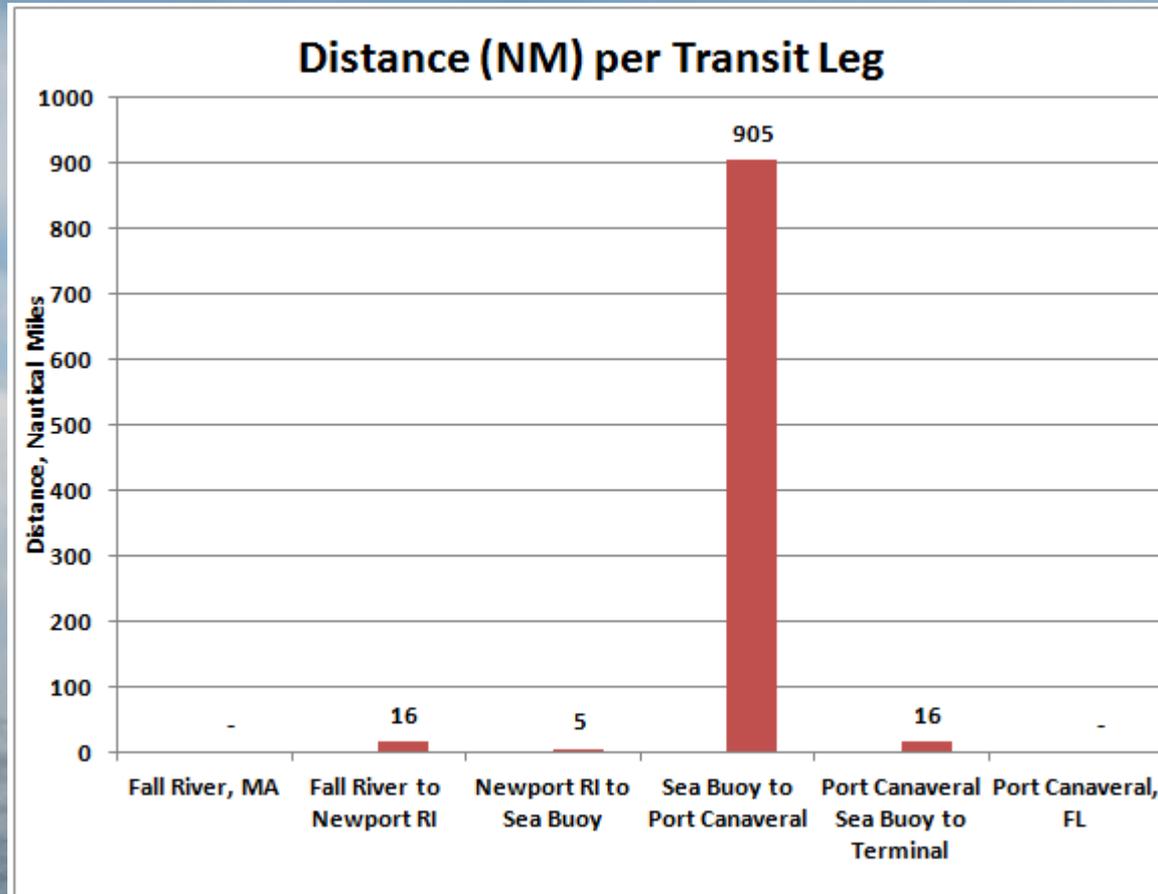
Typical Breakdown of Annual Costs for a High-Speed Commercial Trailer Ship



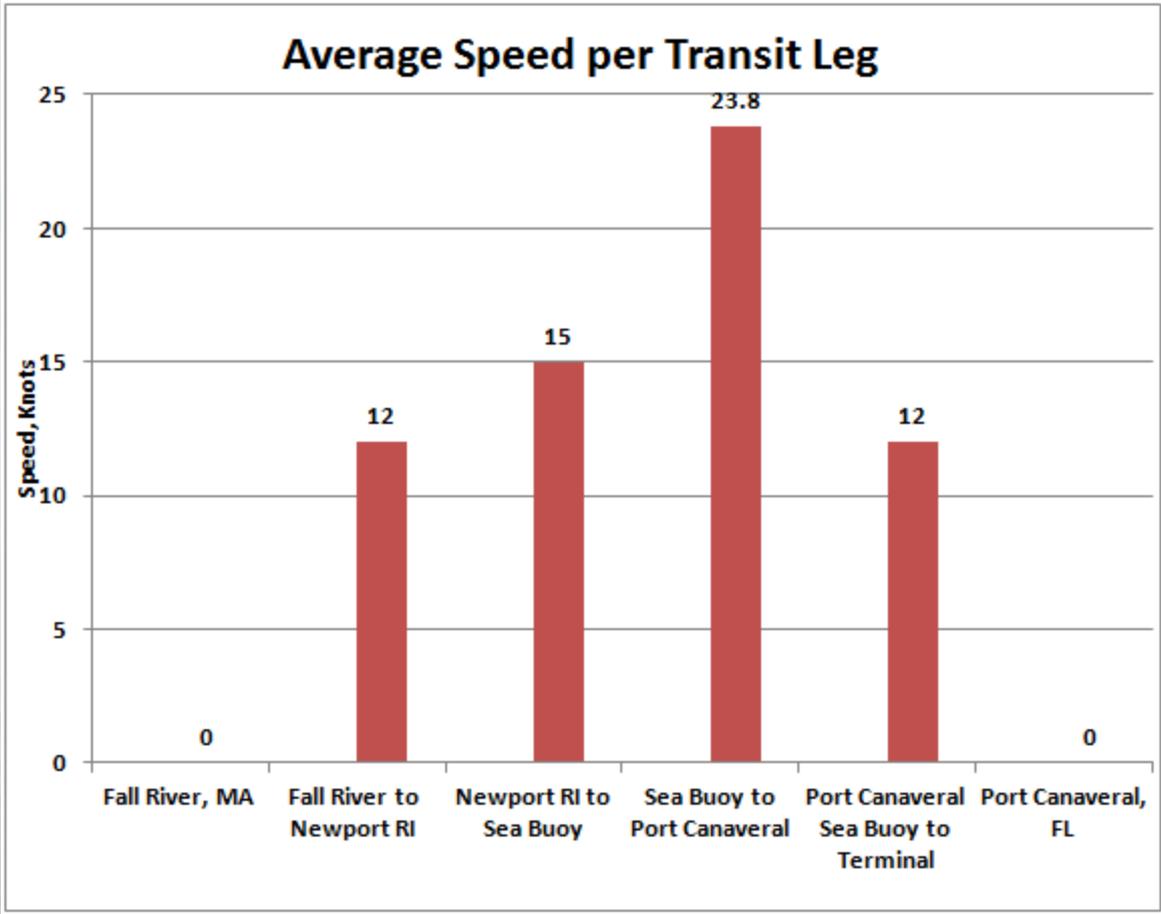
Basic Hierarchy of Life Cycle Costs



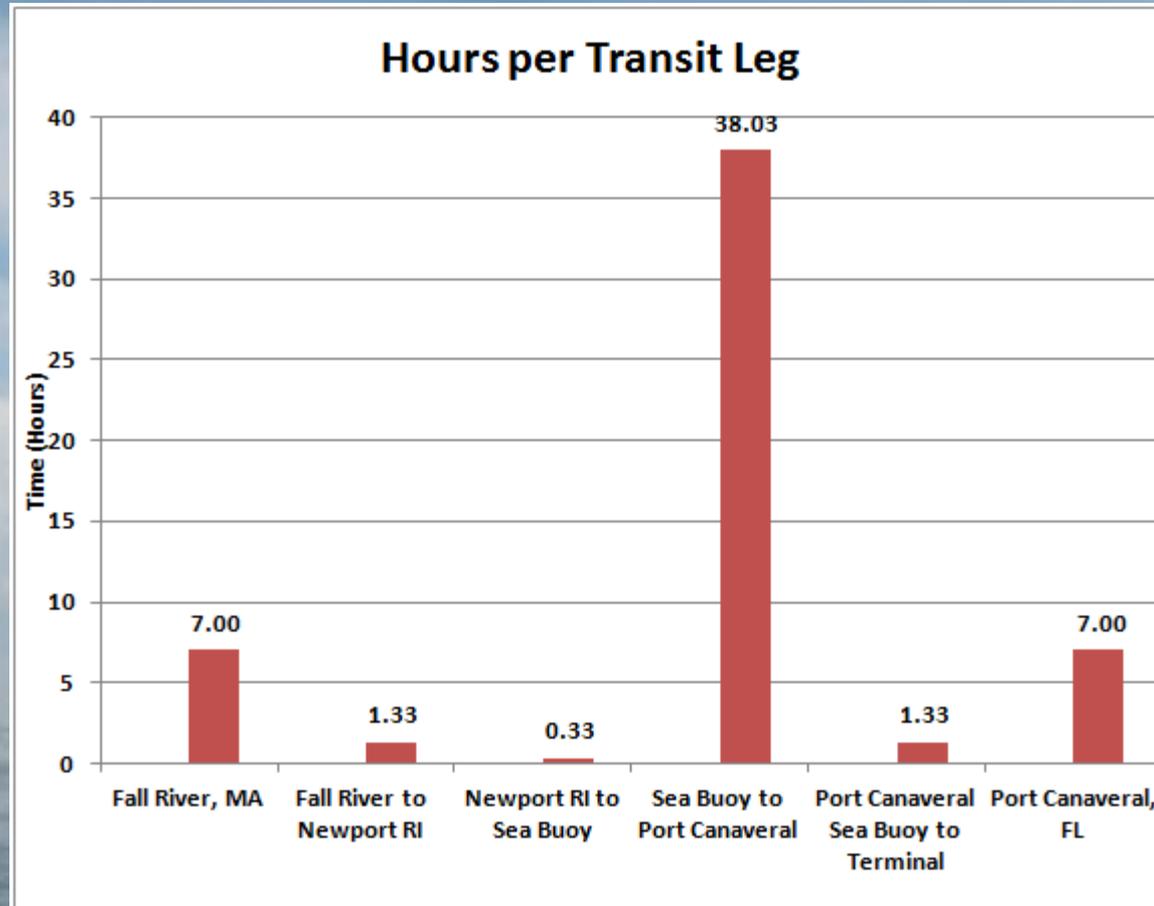
Defining Transit Route Distance per Leg of the Route



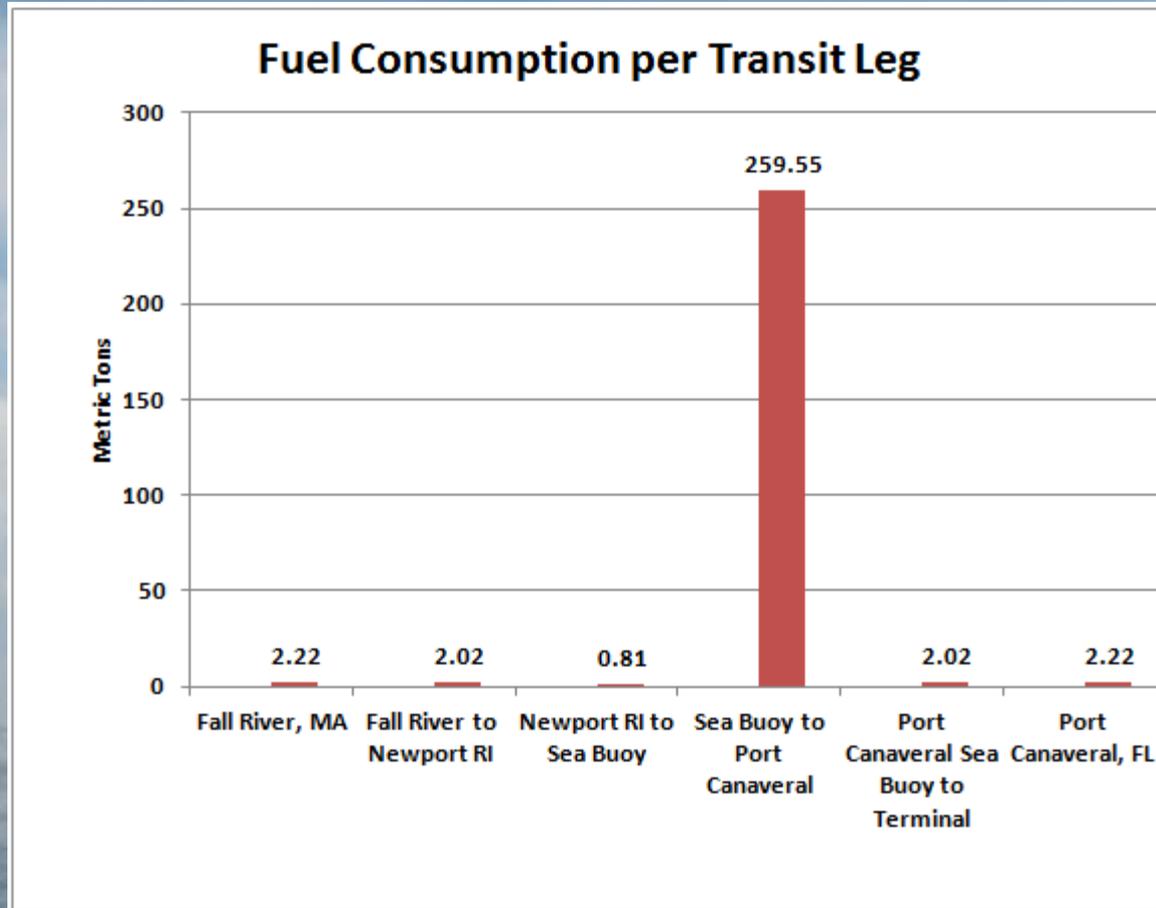
Defining Transit Route Speed per Leg of the Route



Defining Transit Route Time in Hours per Leg of the Route



Defining Transit Route Fuel Consumption per Leg of the Route



Defining Basic Components of Capital Cost

Special Note: User may enter/modify gray cells with bold red characters:

Example:

This worksheet, "Central Data" provides general route & operations specifications.

The worksheet "Route Specs" defines operations parameters per leg and port of call for each train car.

User input to "Route Specs" defines for each train car cargo loading/unloading & total port time at each port only.

Enter Ship Name/Description: **13,000 TEU LNG-Fueled Containership (U. of Mich)**

LOA	366.00	m
Draft	15.20	m
GRT		mt
DWT	129,500	mt

Number of like ships built for train (max 8):	1
Total Price per Ship:	\$ 246,668,576
Total Price + Risk per Ship:	\$ 246,668,576
% Risk Allowed	0%

General Trade Route Specifications

General Trade Route Specifications												
		Port Names										
		Port A	Port NY Container Terminal									
		Port B	Panama Canal									
		Port C	Shanghai, China									
		Nominal		SouthBound		NorthBound		Drayage		Pilot		
Routes	NM	Kts	Fuel mt/Hr	Hours	Hours	Fuel mt fuel	Fuel mt fuel	RT Miles	\$/Mile/Traile	\$/8-hr Day	Tug \$/Leg	
Port NY Container Terminal			2.409	108.00		260.21					4320	
Leg 1 - Local River Transit						-	-			\$ 2,000.00		
Leg 2 - River/Sea Buoy Transit	10.0	5	17.880	2.00	2.00	35.76	35.76					
Leg 3 - Ocean Transit	1,952.0	24	17.880	81.33	81.33	1,454.24	1,454.24					
Connect/Disconnect						-	-					
Leg 4 - River/Sea Buoy Transit	10.0	5	17.880	2.00	2.00	35.76	35.76					
Leg 5 - Local River Transit	46.0	5	17.880	9.20	9.20	164.50	164.50			\$ 2,000.00		
Panama Canal						-	-					
Leg 6 - Local River Transit	10.0	5	17.880	2.00	2.00	35.76	35.76			\$ 2,000.00		
Leg 7 or Bypass Ocean Transit	11,823.0	24	17.880	492.63	492.63	8,808.14	8,808.14					
Leg 8 - Ocean Transit						-	-					
Leg 9 - River/Sea Buoy Transit	10.0	5	17.880	2.00	2.00	35.76	35.76					
Leg 10 - Local River Transit						-	-					
Shanghai, China			2.409		108.00		260.21					
NOTE: Above fuel rates may be entered as function of kts.				699.16	699.16	Total mt:	21,660.24					
Port fuel consumption rates must be entered only as mt/Hr				Hrs RT	1,398.32		10,830.12	mt one-way				
NOTE: Make sure at-sea fuel rate includes any fuel for generators running at sea				Days RT	58.26		11,649.00	mt capacity (26,000 m3)				
	LNG Est. 2012	Fuel Cost	\$ 725.00	\$/mt	CargoValue	\$75,000	/Unit					
		Wt Trailer	20.43	MT/Trailer	HMT	0.125%	only applies to import, not export					
		Wt Water	1	ST		100.00%	% Non-Empty					
		Wt TEU	9.96	MT/TEU								

General Cargo Specifications

South Bound	Load at Port				Un-Load at Port				Statute Miles from Prior Port	Nautical Miles from Prior Port	Trailers Unload	Containers Unload	Trailers Left Onboard	Containers Left Onboard	
	Trailers	Full Containers	Empty Containers	Total Containers	Trailers	Full Containers	Empty Containers	Total Containers							
Port NY Container Terminal		13000		13000		13000		13000			-	13,000			
Panama Canal											-	-	-	13,000	
Shanghai, China		13000		13000		13000		13000			-	13,000		-	
Panama Canal											-	-	-	13,000	
Port NY Container Terminal															
TOTALS	0	26000	0	26000	0	26000	0	26000						<i>left onboard= left over from last port + tot</i>	
NET (LOAD-UNLOAD)	0	0	0	0		1 x HMT			<i>= (Trailers + Full Containers)/(Total Trailers + Containers) Assumes all trailers are full</i>						
	-	Total Trailer Miles/RT			0	Trailers/RT			-	Trailers/annum					
	-	Total Container Miles/RT			26000	Containers/RT			158,419	Containers/annum					
	<i>If containers are stored on board on cassettes, enter numeric number of containers per cassette.</i>				0	<i>If cassettes are not used, enter zero</i>									

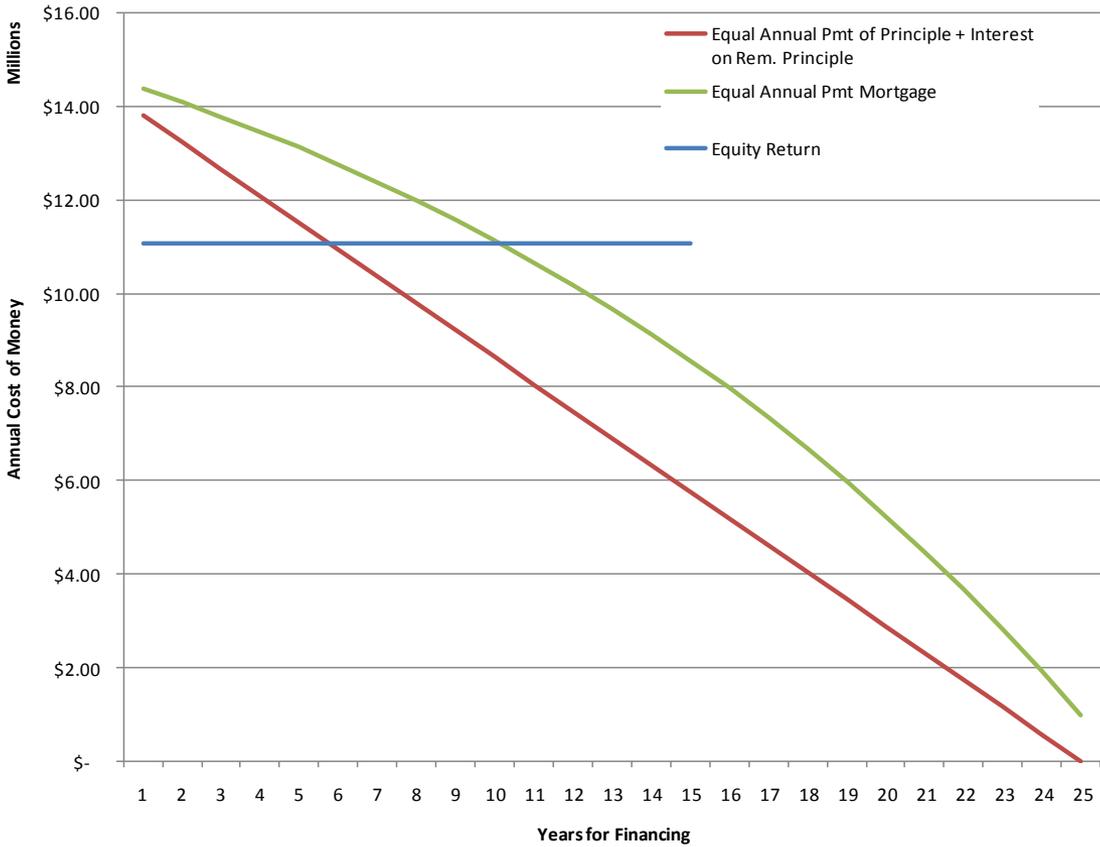
South Bound	Prior Leg Stat Miles	Trailer Miles	Container Miles	Passed Thru Trailers Miles	Passed Thru Containers Miles	Trailer Miles/RT	Container Miles/RT	
Port NY Container Terminal	-	-	-	-	-	-	-	
Panama Canal	-	-	-	-	-	-	-	
Shanghai, China	-	-	-	-	-	-	-	
Panama Canal	-	-	-	-	-	-	-	
Port NY Container Terminal				-	-			
TOTALS	<i>all loaded last port - total unloaded this port</i>						-	-
NET (LOAD-UNLOAD)								

Equity & Financing Terms

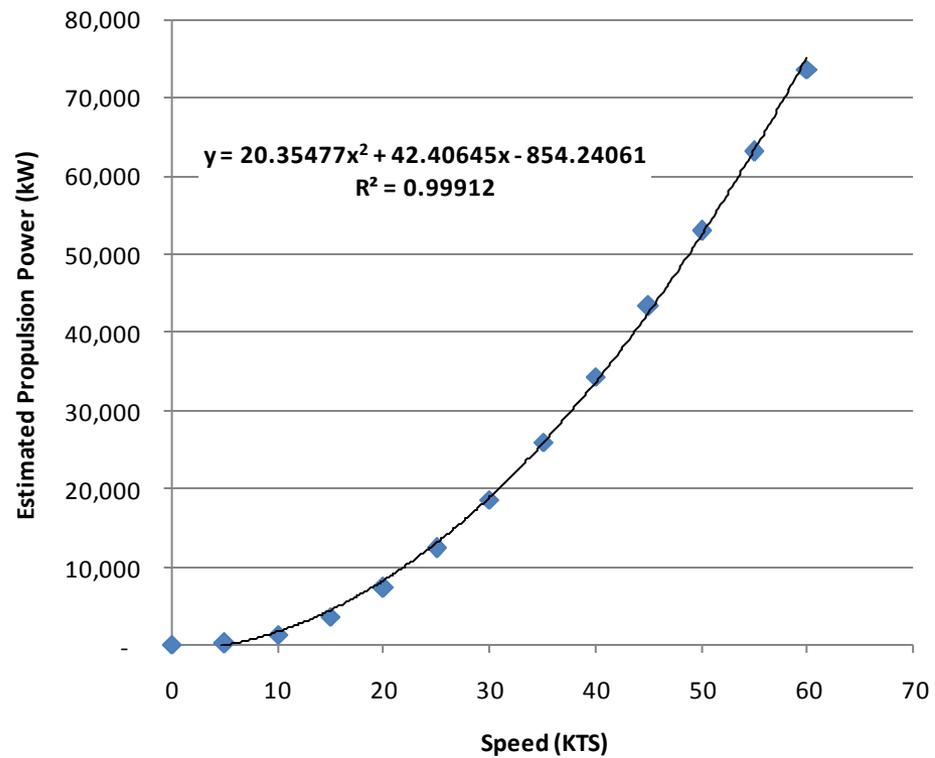
Financing Design & Construction								
	Years		Years	Weighted Average Cost of Capital (WACC)	15.00%	Optional		
	Rate		per annum	Number of Years	25			
Owner's Equity Portion:	20.0%			Estimated Tax Rate	35.00%	Optional		
Anticipated Life of Ship:	25		Years					
Salvage/Sale Value at Life End:	0.33%		or					
Salvage/Sale Value at Life End:	\$ 5,000,000							
Return on Equity	28.00%	25	Years					
Financing Interest Rate	8.00%	25	Years					
Financing Option:	0	Equal Annual Pmt Mort.						

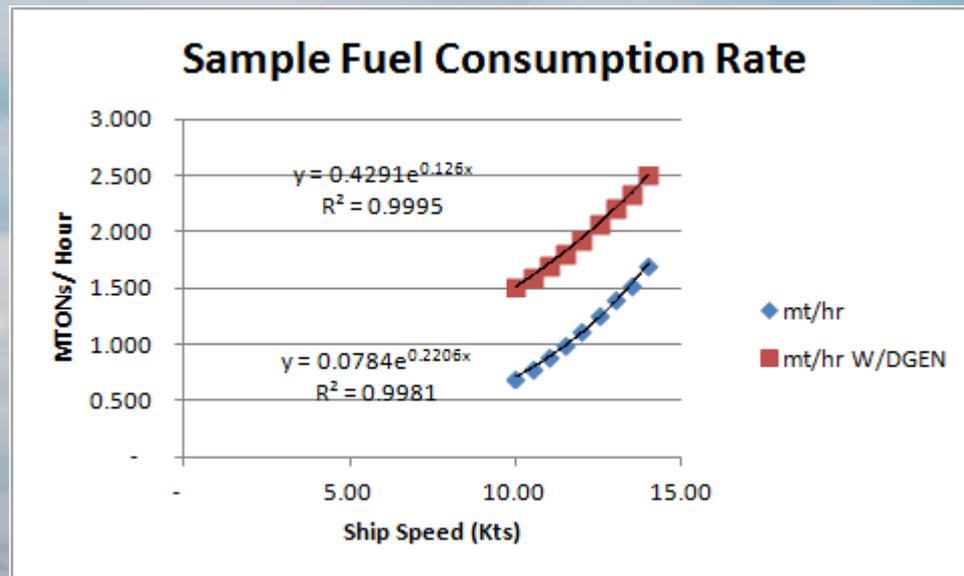
Financing Options: Enter
 "0" = Equal Annual Payment Mortgage
 "1" = Annual Principal Payment + Interest on Remaining Principal.

Comparing Financing Terms



Estimating Propulsion Power Curve





			NORTH BOUND							
PORT A Fees			\$ 41,734	Rate	Rate	Rate	Rated	Minimum	Total	
Port Ship Services & Fees			Variables	(Manual)	Default	UoM	Used	Cost	(Manual)	\$ Cost
Pilotage based on Draft	FT Draft	21.98	-1	\$ 12.50	FT Draft	\$ -	\$ -			\$ -
Pilotage based on GRT	GRT	33,000.00	-1	\$ 0.0280	GRT	\$ -	\$ -			\$ -
Tugs	FT LOA	591.54	-1	\$ 2,025.00	Annual Fee ¹	\$ -	\$ -			\$ -
Handling Lines In & Out	Trailers	144.00		\$ -		\$ -	\$ -			\$ -
Mooring Fee	STONS/Trailer	22.05	-1	\$ -		\$ -	\$ -			\$ -
Dockage	Containers	155.00		\$ 9.77	FT LOA/Day	\$ 9.77	\$ 5,777.93			\$ 5,777.93
Tolls	Round Trips/Yr	41.16		\$ -		\$ -	\$ -			\$ -
Sanitary Waste Removal	Days/Port Call	1.00		\$ 1,125.00	Annual Fee ¹	\$ 1,125.00	\$ 27.33			\$ 27.33
Oil Waste Removal	Hrs/Port Call	8.00		\$ 1,125.00	Annual Fee ¹	\$ 1,125.00	\$ 27.33			\$ 27.33
Stevedoring Services				\$ 1,700.00	Annual Fee ¹	\$ 1,700.00	\$ 41.30			\$ 41.30
Fresh Water	STON Water	1.00		\$ 4.70	STON Water	\$ 4.70	\$ 4.70	\$ 69.20		\$ 69.20
Fresh Water Hookup	Equiv.CUFT Water	31.20		\$ 50.66	Port Call	\$ 50.66	\$ 1,580.59			\$ 1,580.59
	Equiv.GALs Water	239.81								
Cruise Ships			Cruise Ship							
Harbor Master Cruise Ships			-1	\$ 26.52	GRT	\$ -	\$ -			\$ -
Agency Fees			-1	\$ -		\$ -	\$ -			\$ -
Cargo Ships - Trailers			Trailer Cargo							
Harbor Master Cargo Ships			-1	\$ 26.52	GRT	\$ -	\$ -			\$ -
Cargo Warfage - Trailers				\$ 2.48	STON/Trailer	\$ 2.48	\$ 357.12			\$ 357.12
Loading/Unloading Costs - Trailers				\$ 78.65	Trailers	\$ 78.65	\$ 11,325.60			\$ 11,325.60
Outside Storage Trailers (2 days)				\$ 3.60	Trailers	\$ 3.60	\$ 518.40			\$ 518.40
Security Surcharge				\$ 2.90	FT LOA/Day	\$ 2.90	\$ 1,715.47			\$ 1,715.47
Customs Inspections including Warehousing			-1	\$ -		\$ -	\$ -			\$ -
Cargo Ships - Containers			Container Cargo							
Harbor Master Cargo Ships			-1	\$ 26.52	GRT	\$ -	\$ -			\$ -
Cargo Warfage - Containers				\$ 23.20	Container	\$ 23.20	\$ 3,596.00			\$ 3,596.00
Loading/Unloading Costs - Containers			-1	\$ 100.00	Container	\$ -	\$ -			\$ -
Loading/Unloading Costs - Container Cassettes				\$ 150.00	2 Container Casset	\$ 150.00	\$ 11,625.00			\$ 11,625.00
Outside Storage Containers (2 Days)				\$ 2.50	Container	\$ 2.50	\$ 387.50			\$ 387.50
Security Surcharge				\$ 5.75	Container	\$ 5.75	\$ 891.25			\$ 891.25
Customs Inspections including Warehousing			-1	\$ 187.50	Container	\$ -	\$ -			\$ -
Other Port Expenses			Miscellaneous							
				10%	Total Port \$	10%	\$ 3,794.00			\$ 3,794.00
TOTAL COST OF PORT CALL									\$ 41,734	

NOTE:

1. Manually enter port rates (& minimums) in gray cells only.
2. To turn off a port cost item, enter a -1 in the manual rate cell.

Panama Canal Fees						
http://www.agenco.com/html/TransitCostCalculator.aspx						
ESCAP Study Data						
Shanghai						
	TEUs	2000 US\$	2000 US\$/TEU			
3000	1000	\$ 84,033	\$ 84.03	40,000	GRT	
1100	600	\$ 44,054	\$ 73.42	98,000	GRT	
		Average	\$ 78.73	69,000	GRT	
		Year	2012/Year Esc.			
		2000	1.4021			
		Estimated 2012\$	\$ 110.38	per TEU		
			\$ 2,869,948			

There are three methods for determining fuel consumption in metric tons for each leg of the trade route.

1. The first method allows entries of estimate kW expended each leg (including electric generation in port) for each (if multiple) propulsion system for the ship. The cost model computes the tons of fuel consumed by multiplying the kW by the leg hours and the specific fuel consumption coefficient (SFC).
2. The second method estimates the propulsion kW based on the speed. The “Power Curve” worksheet builds an approximate second order speed-power curve (Figure 3.1-4) using the ship design’s maximum kW propulsion power versus maximum hull speed. This method most likely cannot develop an accurate kW for the transit leg speed if there are multiple propulsion systems in use. A manual entry for the specific fuel consumption coefficient is required for the model to compute tones consumed over the hours of operation over the transit leg period of time.
3. The third method allows the tons of fuel consumption to be computed off-line from the cost model and entered in the gray cell labeled “Manually Entered Propulsion Fuel MTONs.”

Summary of Cargo Transfers

		Total	Total	Net Onboard
		Trailers-L	Trailers Unloaded	Trailers
North Bound				
	Port A	-	-	-
	Port B	-	-	-
	Port C	-	-	-
South Bound				
	Port C	-	-	-
	Port B	-	-	-
	Port A	-	-	-
		-	-	-
				Remaining Onboard
		Total	Total	Net Onboard
		Containers	Containers Unload	Containers
North Bound				
	Port A	13,000	13,000	-
	Port B	-	-	-
	Port C	-	-	-
South Bound				
	Port C	13,000	13,000	-
	Port B	-	-	-
	Port A	-	-	-
		26,000	26,000	-
				Remaining Onboard



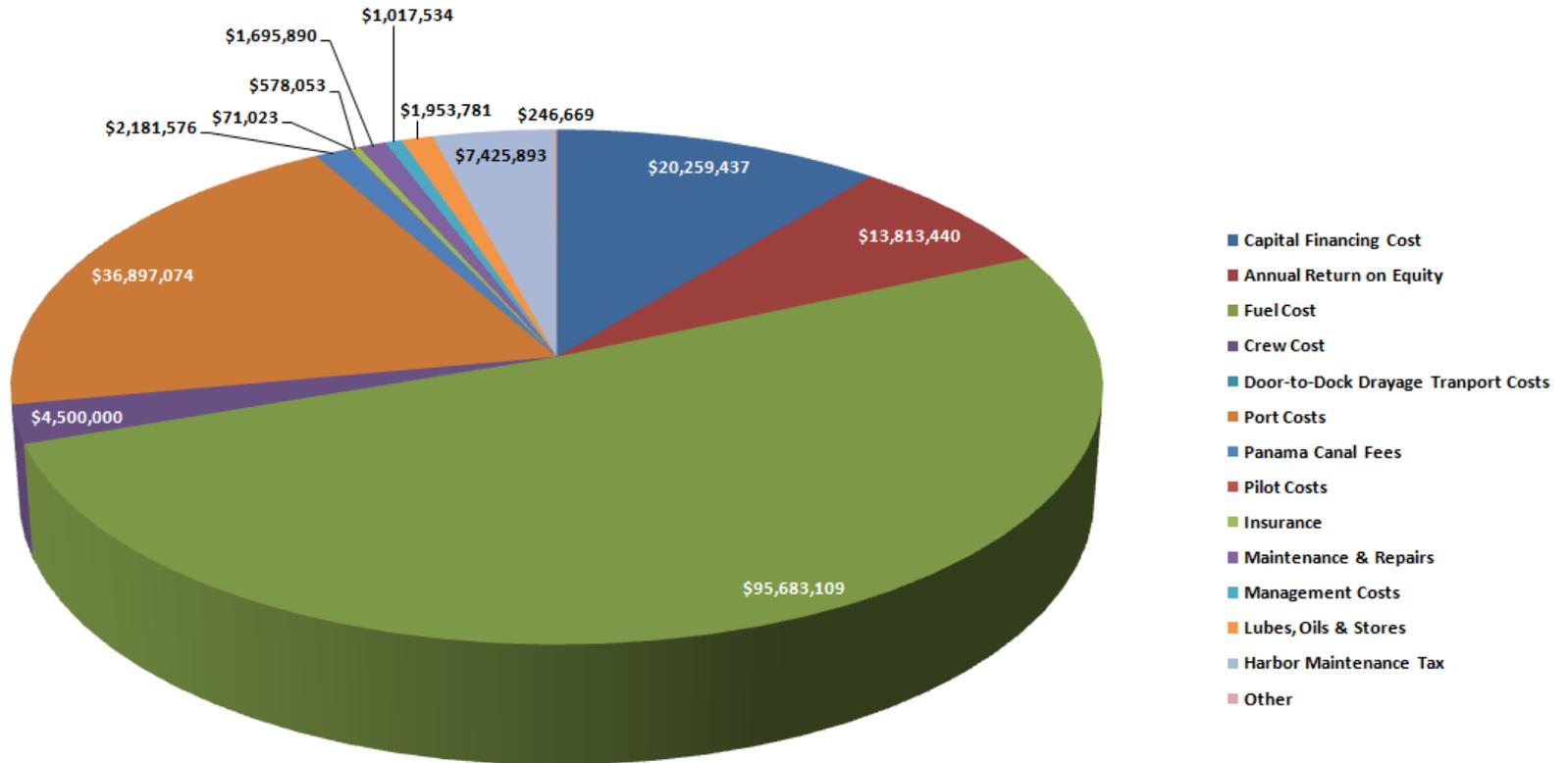
The Cost Model Generates a Variety of Tabular & Graphical Reports

Report Indicating Required Freight Rates per Type of Cargo Transported

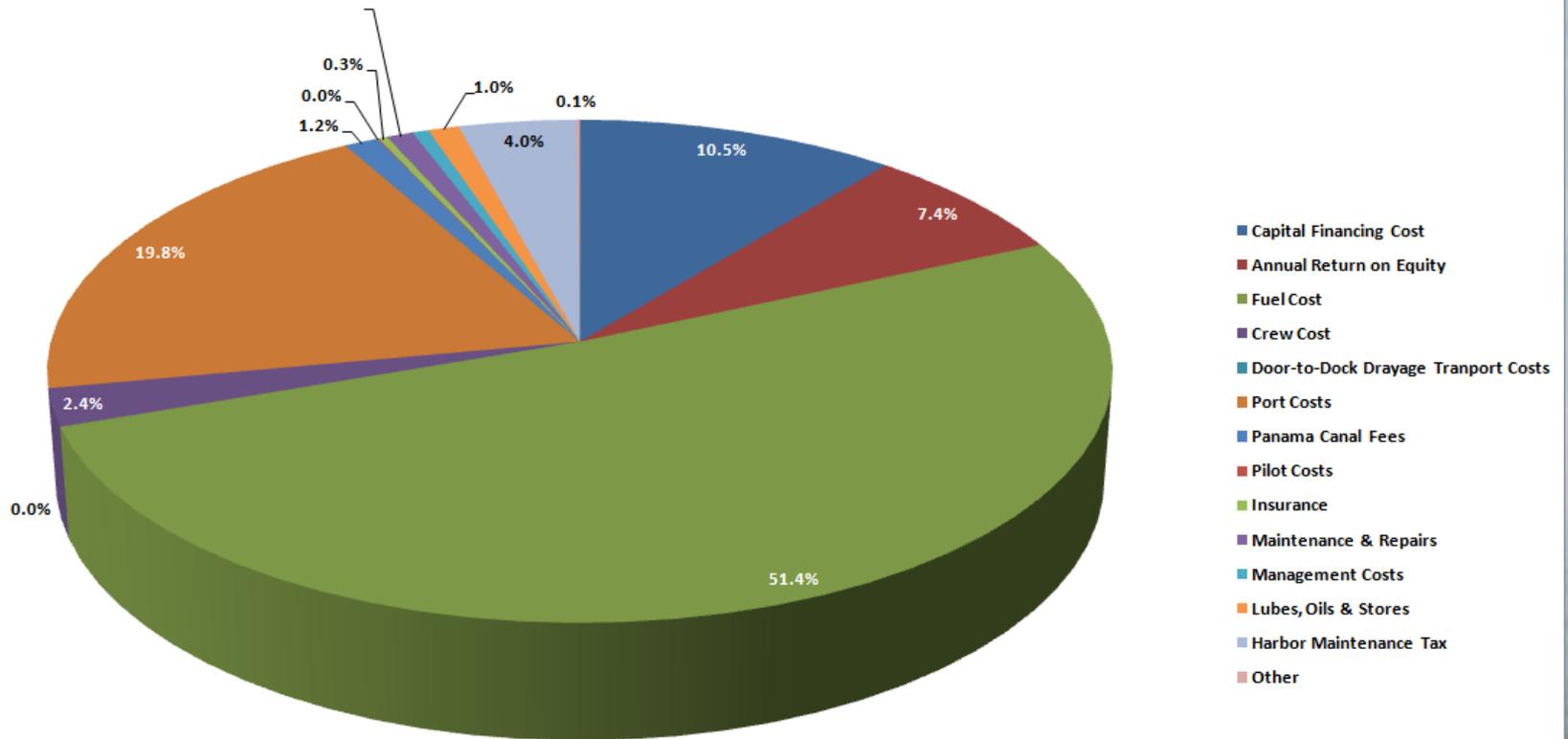
SHIP SPECS					
LOA		366.00	m		
Draft		15.20	m		
GRT		-	mt		
DWT	\$ 129,500	129,500.00	mt		
Total Price per Ship:	\$ 246,668,576	246,668,576.00			
Total Price + Risk per Ship:	\$ 246,668,576	246,668,576.00			
% Risk Allowed		0.00%			
Net Owner's Asset Value	\$ 246,668,576	\$ 246,668,576			
Owner's Equity Portion:	\$ 49,333,715	\$ 49,333,715			
Financed Portion:	\$ 197,334,861	\$ 197,334,861			
Finance Interest Rate		8.00%		Equal Annual Pmt Mort.	
Financing Years		25			
Total Cost of Money per Ship:	\$ 264,817,360	\$ 264,817,360			
Asset Value + Cost of Money:	\$ 511,485,936	\$ 511,485,936			
Anticipated Life of Ship:		25	Years		
Salvage/Sale Value at Life End:		\$ 5,000,000			
Average annual capital cost over life of the ship:	\$ 20,259,437	\$ 20,259,437			
Crew Size		20			
Crew Sets		2			
Av. Crew Cost/Annum		\$ 112,500			
Total Crew Cost per Annum:	\$ 4,500,000	\$ 4,500,000			
<p>If MARAD Title XI, Owner's Equity must be a minimum of 100%-87.5%=12.5%; otherwise banks may require 20%. Financing w/Title XI loan guarantees will lower interest rate (try 5.5%). Higher Owner's Equity, lower the interest rate charged.</p>					
<p>\$ 118,757 Average from MARAD 9-11 Study Use of foreign crew, wages will be lower.</p>					
Ship's Summary:					
Laydays & Repair Days per Annum	10	Days			
Total Hours per Round Trip	1,398	Hours			
Total Days per Round Trip	58.26	Days			
Total Round Trips per Annum:	6.09	Trips			
Trailers/Round Trip	-	Trailers			
Trailers per Annum:	-	Trailers	0.0%	Total Units	
Payload MTONs Trailers per Annum:	-	MTONs	0.0%	Total Units	
Containers/Round Trip	26,000	Containers			
Containers per Annum	158,419	Containers	100.0%	Total Units	
Payload MTONs Containers per Annum:	1,578,097	MTONs	100.0%	Total Units	
Units (Trailers + Containers) per Annum:	158,419	Units			
Payload Units per Annum:	1,578,097	MTONs			
Trailer Miles per Round Trip:	-	Trailer Miles			
Trailer Miles per Annum:	-	Trailer Miles			
Container Miles per Round Trip:	-	Container Miles			
Container Miles per Annum:	-	Container Miles			
Payload Units Miles per Annum:	-	Unit Miles			
Metric Tonnes Fuel per Round Trip:	21,660.24	MTONs			
Metric Tonnes Fuel per Annum:	131,977	MTONs			

					Trailers&Containers) Freight
Annual Cost Breakdown:		% Annual Exp.	% Build Cost	per Unit	per Unit MTO
Capital Financing Cost	\$ 20,259,437	10.9%	8.2%	\$ 127.89	\$ 12.84
Annual Return on Equity	\$ 13,813,440	7.4%	5.6%	\$ 87.20	\$ 8.75
Fuel Cost	\$ 95,683,109	51.4%	38.8%	\$ 603.99	\$ 60.63
Crew Cost	\$ 4,500,000	2.4%	1.8%	\$ 28.41	\$ 2.85
Door-to-Dock Drayage Transport Costs	\$ -	0.0%	0.0%	\$ -	\$ -
Port Costs	\$ 36,897,074	19.8%	15.0%	\$ 232.91	\$ 23.38
Panama Canal Fees	\$ 2,181,576	1.2%	0.9%	\$ 13.77	\$ 1.38
Pilot Costs	\$ 71,023	0.0%	0.0%	\$ 0.45	\$ 0.05
Insurance	\$ 578,053	0.3%	0.2%	\$ 3.65	\$ 0.37
Maintenance & Repairs	\$ 1,695,890	0.9%	0.7%	\$ 10.71	\$ 1.07
Management Costs	\$ 1,017,534	0.5%	0.4%	\$ 6.42	\$ 0.64
Lubes, Oils & Stores	\$ 1,953,781	1.0%	0.8%	\$ 12.33	\$ 1.24
Harbor Maintenance Tax	\$ 7,425,893	4.0%	3.0%	\$ 46.88	\$ 4.71
Other	\$ 246,669	0.1%	0.1%	\$ 1.56	\$ 0.16
Total Annualized Costs (Non-DCF)	\$ 186,323,478	100.0%	75.5%	\$ 1,176.14	\$ 118.07

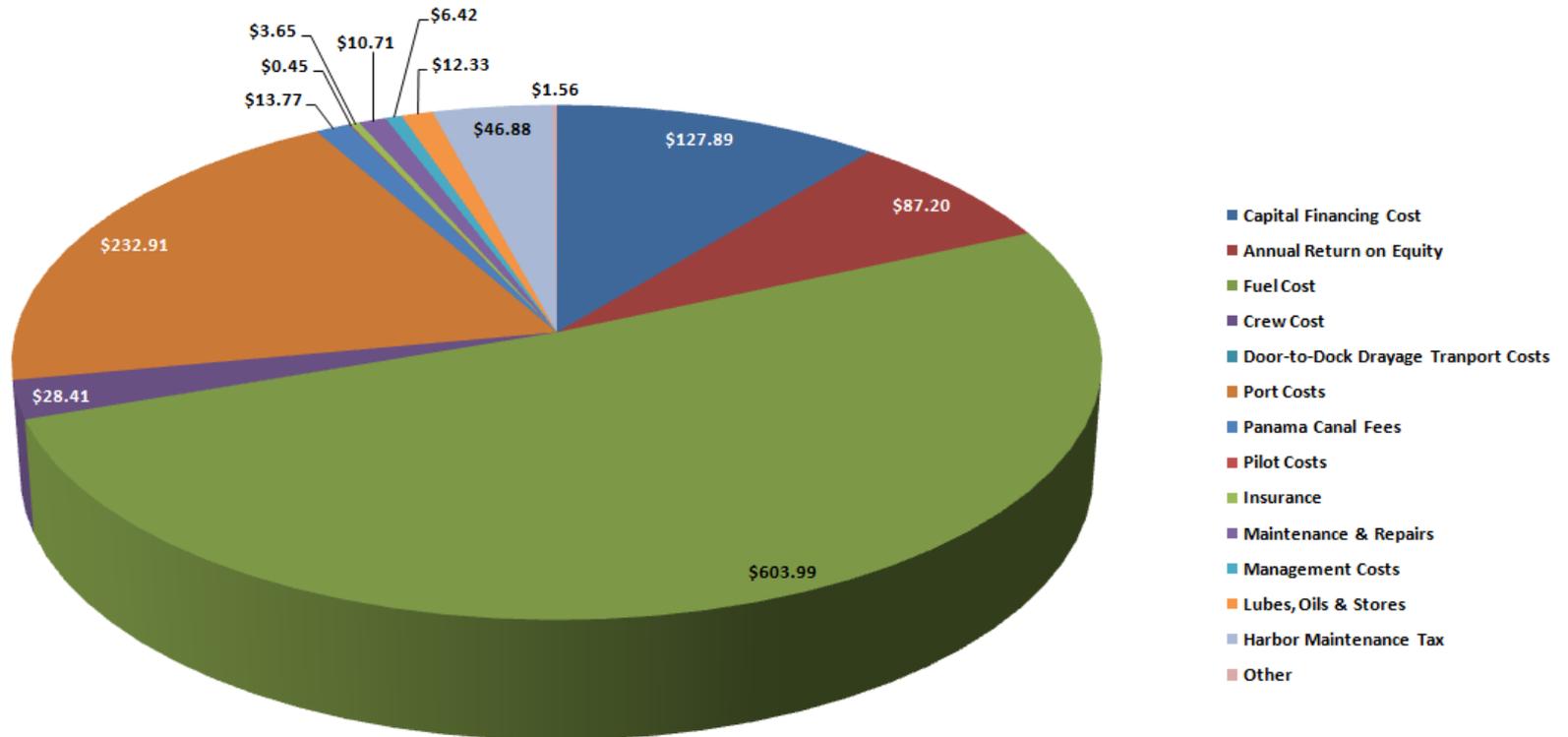
Annual Maintenance & Operations Cost: \$186,323,478.



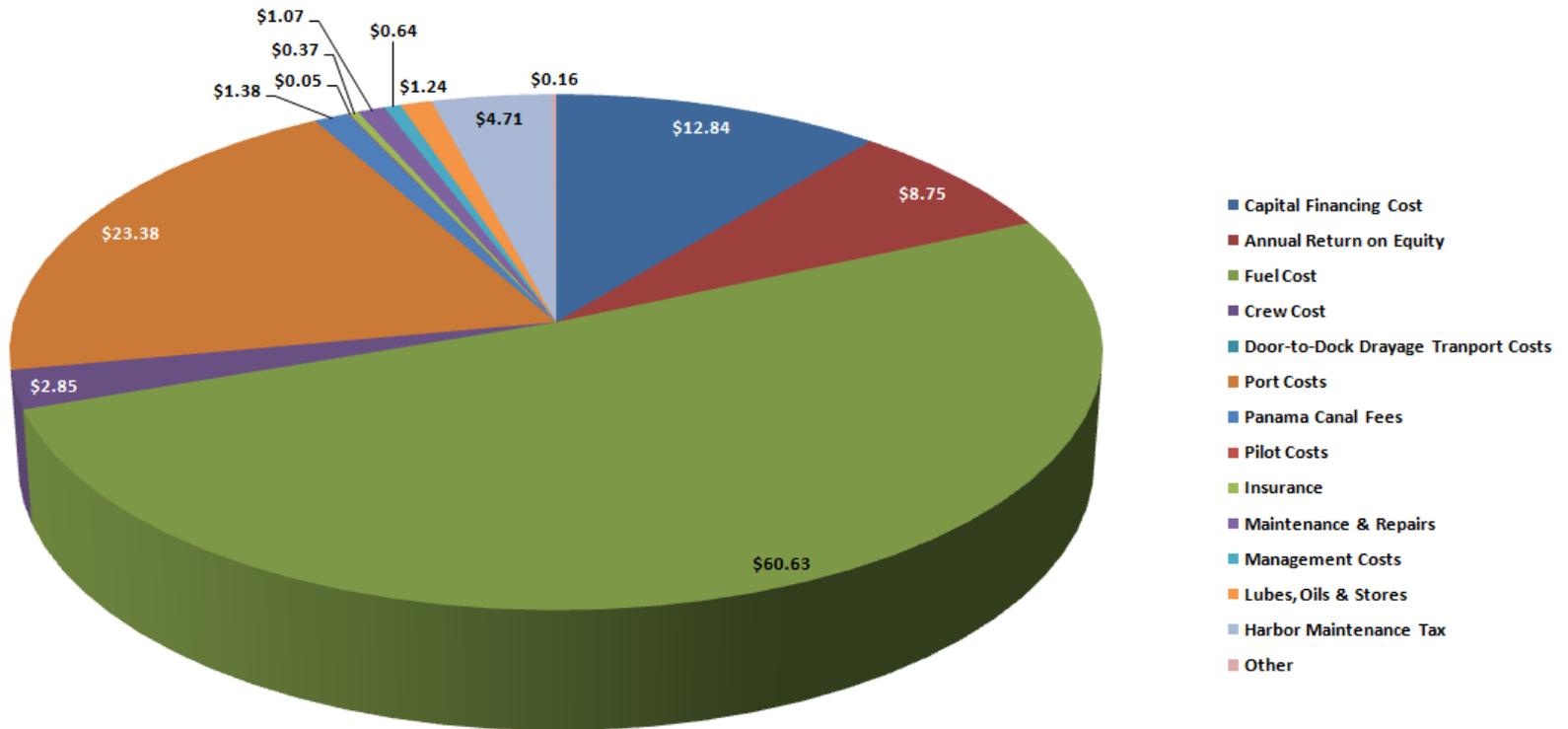
Annual Maintenance & Operations Cost: \$186,323,478.



Average Unit (Trailers + Containers) Transport Cost: \$1176.



Average Transport Cost/MTON Payload: \$118.07



User Caution

Users of a cost model are cautioned that it is intended to provide only an estimate of cost information. There are limits to the capabilities of these calculations beyond which results may not be accurate.

The data provided in the cost model is not a substitute for judgment, analysis and sound estimating practice. The cost model is an aid in developing an informed opinion of cost. If you are using the cost model as your sole cost authority for contract bids, you are reading more into the cost model than what has been intended.

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