GreenerScheduling4004

a module in Route4004

www.shipstrategy.com

A tool to assist owners and operators in

Reducing the emission of Green house gases through more effective scheduling of the fleet

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NORWEGIAN MARITIME SOLUTIONS

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Emissions from ships is an increasingly important factor to take into account for all ship owning and operating companies

- Shipping activities contribute significantly to the air pollution all over the world.
- Gases that effect climate change include carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). Ship engines also produce other air pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx), non-methane volatile organic compounds (NMVOCs), particulate matter, and sulphur dioxide (SO2).
- The amount of emissions produced is primarily a function of
  - the amount of fuel consumed,
  - the characteristics of the fuel,
  - the engine technology employed, and
  - any post-combustion emission controls in place.

Assessment of Emissions Reduction Potential

DESIGN (New ships)	Saving of CO_2/tonne-mile	Combined	Combined
Concept, speed & capability	**2% to 50%**	**10% to 50%**	**25% to 75%**
Hull and superstructure	**2% to 20%**		
Power and propulsion systems	**5% to 15%**		
Low-carbon fuels	**5% to 15%**		
Renewable energy	**1% to 10%**		
Exhaust gas CO_2 reduction	**0%**		
OPERATION (All ships)			
Fleet management, logistics & incentives	**5% to 50%**	**10% to 50%**	
Voyage optimization	**1% to 10%**		
Energy management	**1% to 10%**		

GreenerScheduling4004 will be an important tool to achieve these savings

GreenerScheduling4004

- **GreenerScheduling4004 is a software program that will estimate emissions a fleet of vessels generate when it is scheduled on a commercial basis.**
  - **Trades and cargoes are specified by load port, discharge port, cargo intake, freight rate etc**
  - **Ships are specified by speed, fuel consumption, dwt, NOX, CO2, SO2 and other parameters.**
  - **Route4004 will first calculate all voyages with days at sea, days in port, cargo loaded, freight revenue and TC result pr day for each voyage.**
  - **GreenerScheduling4004 will then calculate the total amount of fuel consumed and the total kwh output of engines**
  - **Estimate the emissions based on data for the fuel type and the engine specifications.**
  - **If costs for emissions are specified, GreenerScheduling4004 will take this into consideration when finding an optimal schedule for the fleet.**
- **In a study by Marintek from 2000, it is estimated that more effective scheduling can reduce emissions substantially by upto 40 % and also contribute to a much higher income on tc basis.**

The scheduling task will get more complicated

Traditional factors to include:

Port costs

Fuel cost

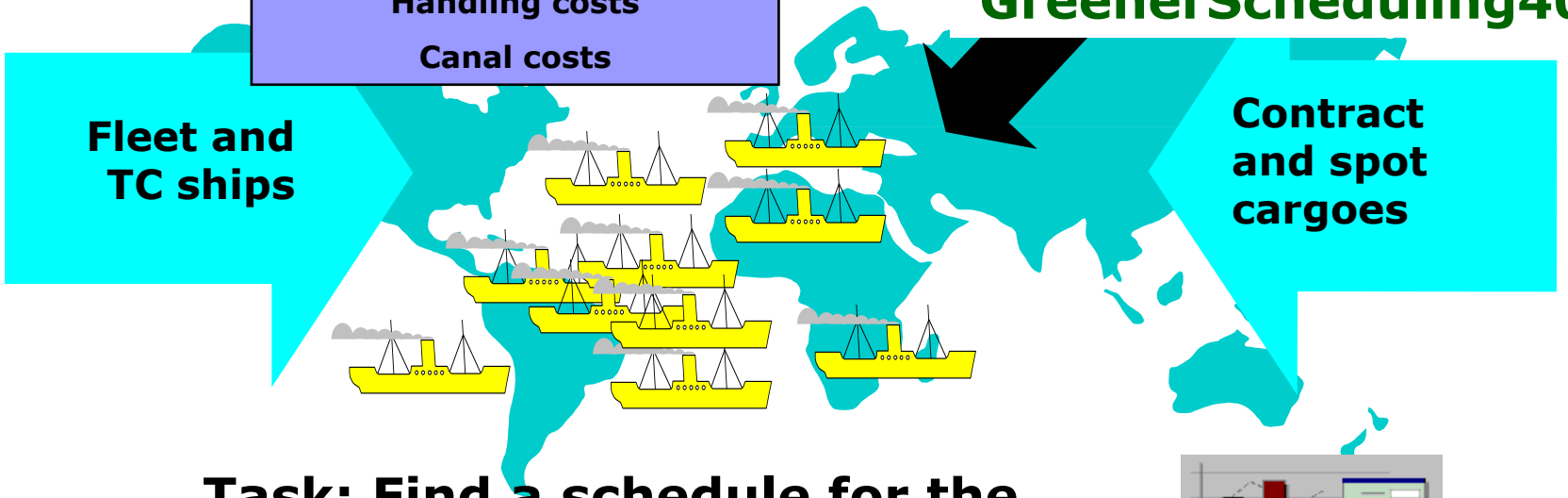
Handling costs

Canal costs

NEW FACTORS to include:

Cost of emissions

GreenerScheduling4004

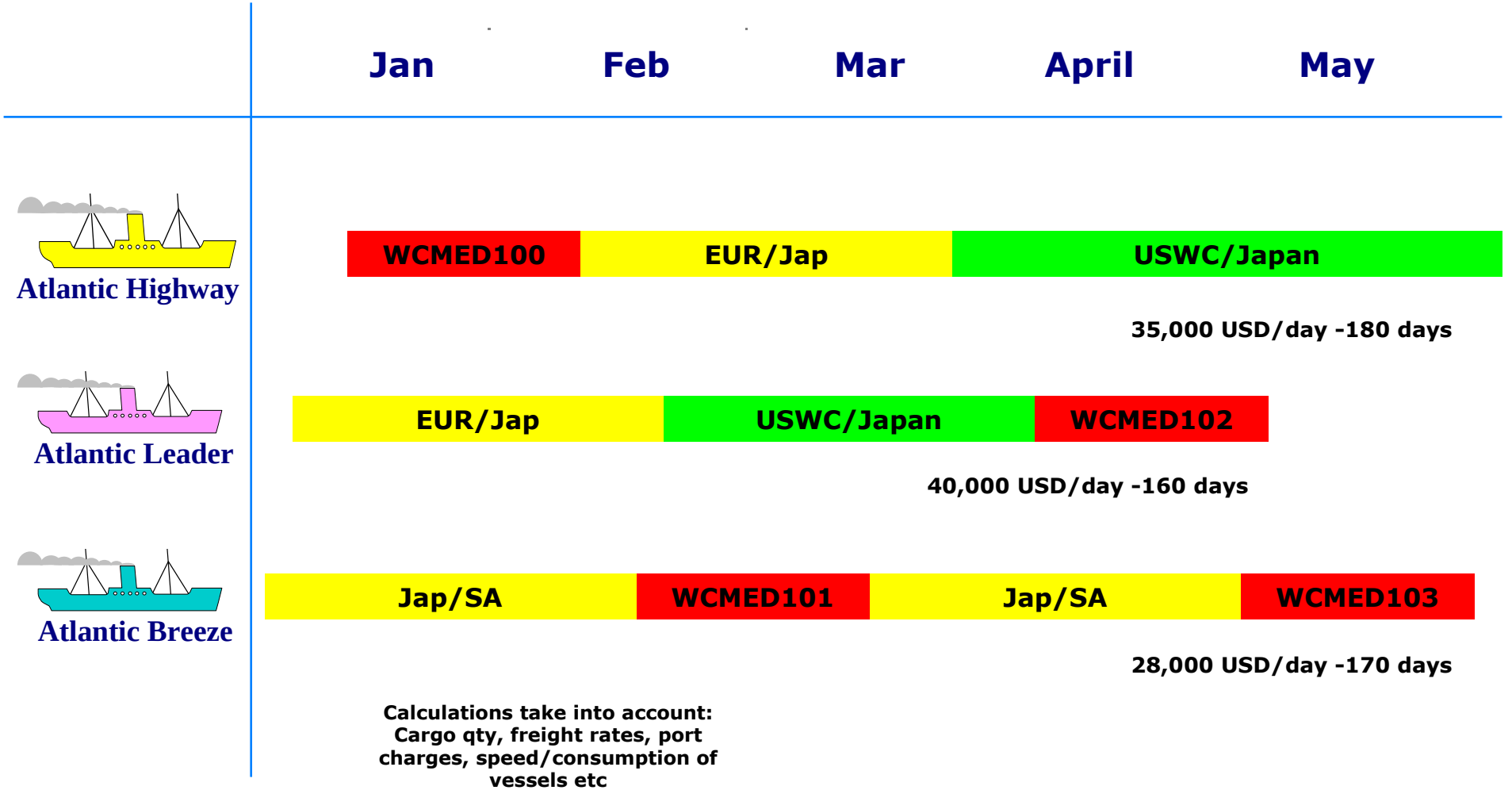


Task: Find a schedule for the fleet that maximizes the total TC result taking into account the cost of emissions

GreenerScheduling4004– Steps in typical usage

- Step 1 – Make a commercial fleet schedule (1 to 12 months period)
  - Calculating voyage estimates for all cargoes and ships in the fleet
- Step 2 – Calculate the quantity of emissions from such schedule
  - Provide management with an estimate of what pollutants the fleet is generating
- Step 3 – Calculate the cost of emissions
  - These can be costs as they are today or future expected costs that will be imposed on the shipping industry
- Step 4 – Let GreenerScheduling4004 find an ”optimal” schedule that maximizes the fleet’s TC result and minimizes emissions
  - GreenerScheduling4004 will enable the operator to find a schedule that will minimize air emissions and in this way comply with regulations.

Step 1: Calculate voyage estimates for all cargoes and ships in the fleet

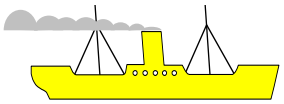


Step 3: GreenerScheduling4004 calculates the cost (*) of emissions from this schedule

Total voyage emission cost: USD 286,000

180 days

Jan | Feb | Mar | April | May | June



Atlantic Highway

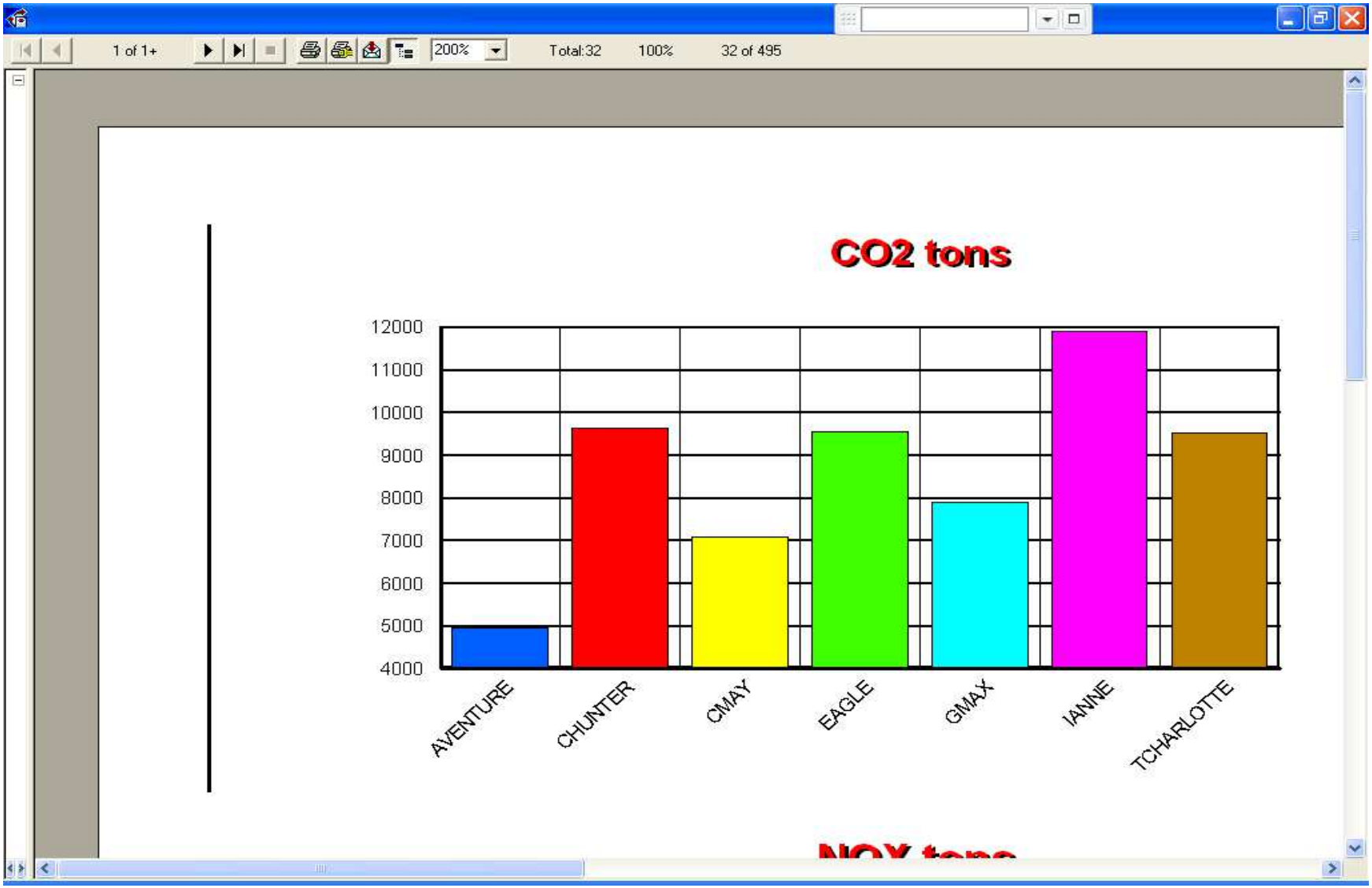
55,000 dwt bulker

14.5 kn on 40 mt pr day

10,000 kw * 80 %

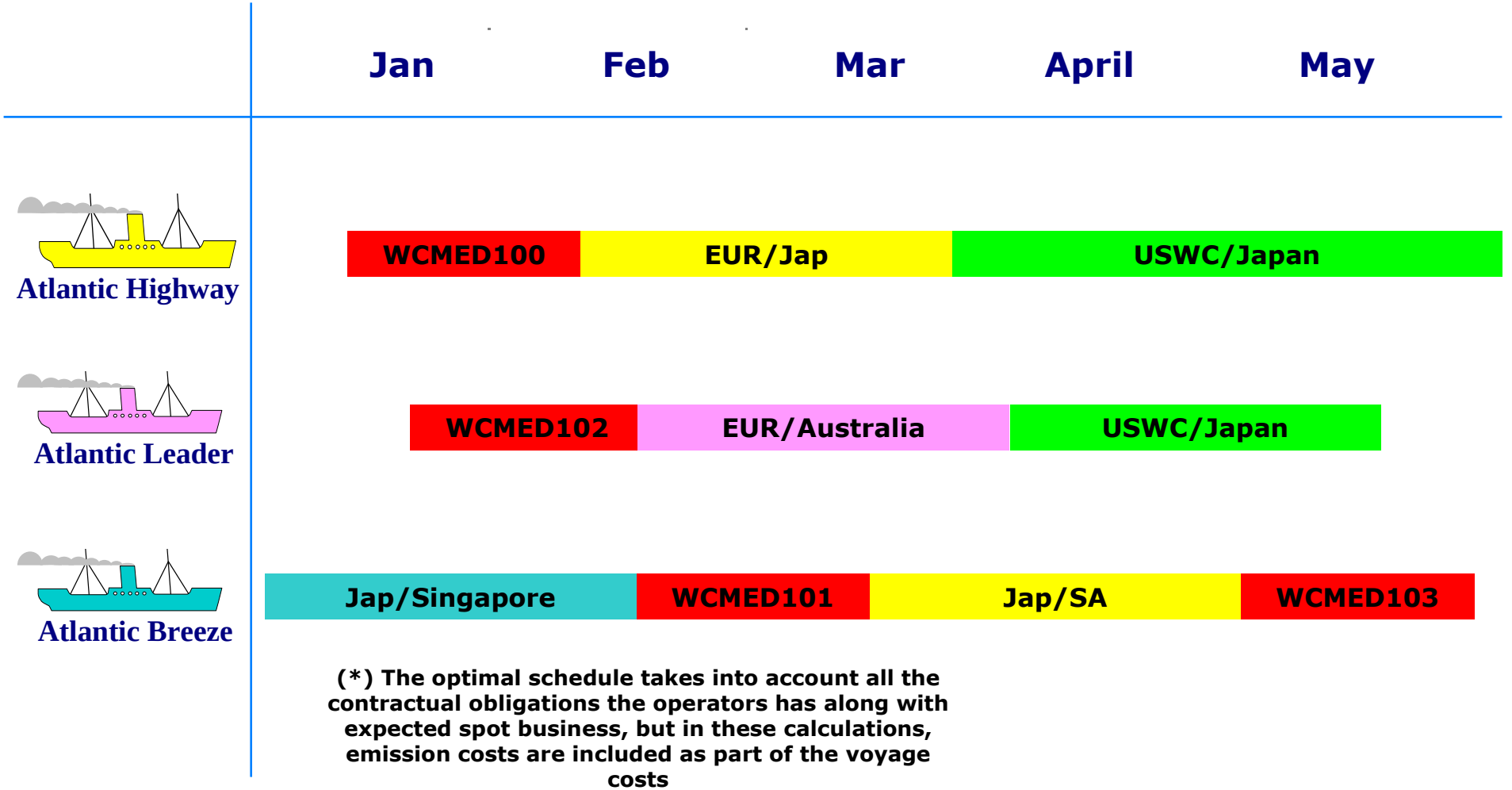
	WCMED100 | EUR/Jap | USWC/Japan
	Total fuel consumption: 6,000 mt
	Total engine output: 30 mill kwh
CO2	18,000 tons * 10 USD/ton = USD 180,000
SO2	200 tons * 80 USD/ton = USD 16,000
NOX	450 tons* 200 USD/ton = USD 90,000
CH4	7 tons
CO	50 tons
PM	30 tons
NMVOC	40 tons

(*) Cost of emissions is based on cost pr pollutant as stated by global or local authroities



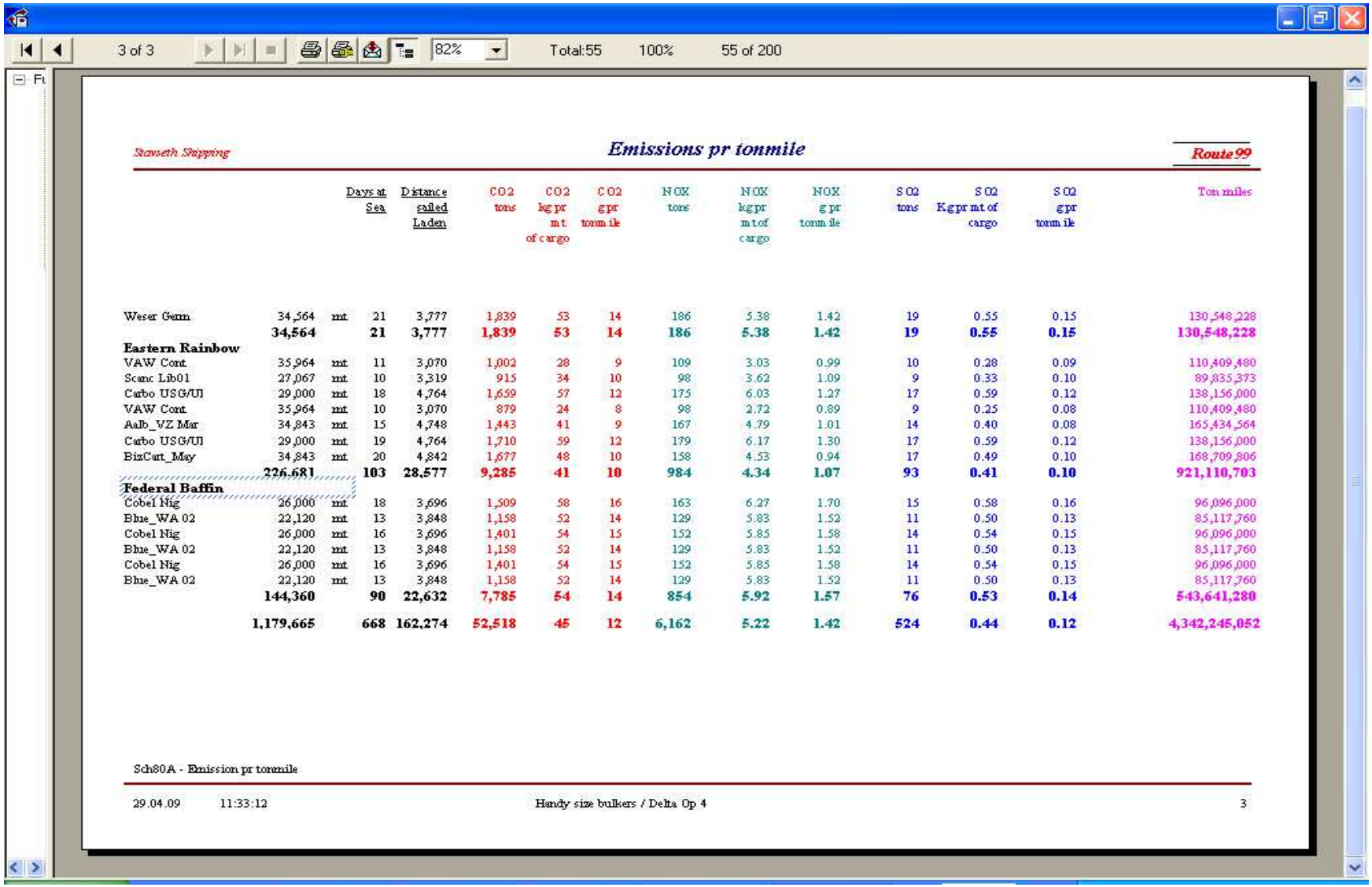
Illustrative:
GreenerScheduling4004

Step 4: Route4004 can calculate an optimal (*) schedule for the fleet that takes into account emissions costs



(*) The optimal schedule takes into account all the contractual obligations the operators has along with expected spot business, but in these calculations, emission costs are included as part of the voyage costs

Emissions pr ton mile



Stavseth Shipping

Emissions pr tonmile

Route 99

			Days at Sea	Distance sailed Laden	CO2 tons	CO2 kg pr mt of cargo	CO2 g pr tonn ile	NOX tons	NOX kg pr mt of cargo	NOX g pr tonn ile	SO2 tons	SO2 Kg pr mt of cargo	SO2 g pr tonn ile	Ton miles
Weser Germ	34,564	mt	21	3,777	1,839	53	14	186	5.38	1.42	19	0.55	0.15	130,548,228
	34,564		**21**	**3,777**	**1,839**	**53**	**14**	**186**	**5.38**	**1.42**	**19**	**0.55**	**0.15**	**130,548,228**
Eastern Rainbow														
VAW Cont	35,964	mt	11	3,070	1,002	28	9	109	3.03	0.99	10	0.28	0.09	110,409,480
Scanc Lib01	27,067	mt	10	3,319	915	34	10	98	3.62	1.09	9	0.33	0.10	89,835,373
Carbo USG/UI	29,000	mt	18	4,764	1,659	57	12	175	6.03	1.27	17	0.59	0.12	138,156,000
VAW Cont	35,964	mt	10	3,070	879	24	8	98	2.72	0.89	9	0.25	0.08	110,409,480
Aalb_VZ Mar	34,843	mt	15	4,748	1,443	41	9	167	4.79	1.01	14	0.40	0.08	165,434,564
Carbo USG/UI	29,000	mt	19	4,764	1,710	59	12	179	6.17	1.30	17	0.59	0.12	138,156,000
BixCart_May	34,843	mt	20	4,842	1,677	48	10	158	4.53	0.94	17	0.49	0.10	168,709,806
	226,681		**103**	**28,577**	**9,285**	**41**	**10**	**984**	**4.34**	**1.07**	**93**	**0.41**	**0.10**	**921,110,703**
Federal Baffin														
Cobel Nig	26,000	mt	18	3,696	1,509	58	16	163	6.27	1.70	15	0.58	0.16	96,096,000
Blue_WA 02	22,120	mt	13	3,848	1,158	52	14	129	5.83	1.52	11	0.50	0.13	85,117,760
Cobel Nig	26,000	mt	16	3,696	1,401	54	15	152	5.85	1.58	14	0.54	0.15	96,096,000
Blue_WA 02	22,120	mt	13	3,848	1,158	52	14	129	5.83	1.52	11	0.50	0.13	85,117,760
Cobel Nig	26,000	mt	16	3,696	1,401	54	15	152	5.85	1.58	14	0.54	0.15	96,096,000
Blue_WA 02	22,120	mt	13	3,848	1,158	52	14	129	5.83	1.52	11	0.50	0.13	85,117,760
	144,360		**90**	**22,632**	**7,785**	**54**	**14**	**854**	**5.92**	**1.57**	**76**	**0.53**	**0.14**	**543,641,280**
	1,179,665		**668**	**162,274**	**52,518**	**45**	**12**	**6,162**	**5.22**	**1.42**	**524**	**0.44**	**0.12**	**4,342,245,052**

Sch80A - Emission pr tonmile

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