

# Ships, Trains, and the Future of Goods Transport

5<sup>th</sup> Annual Haagen-Smit Symposium

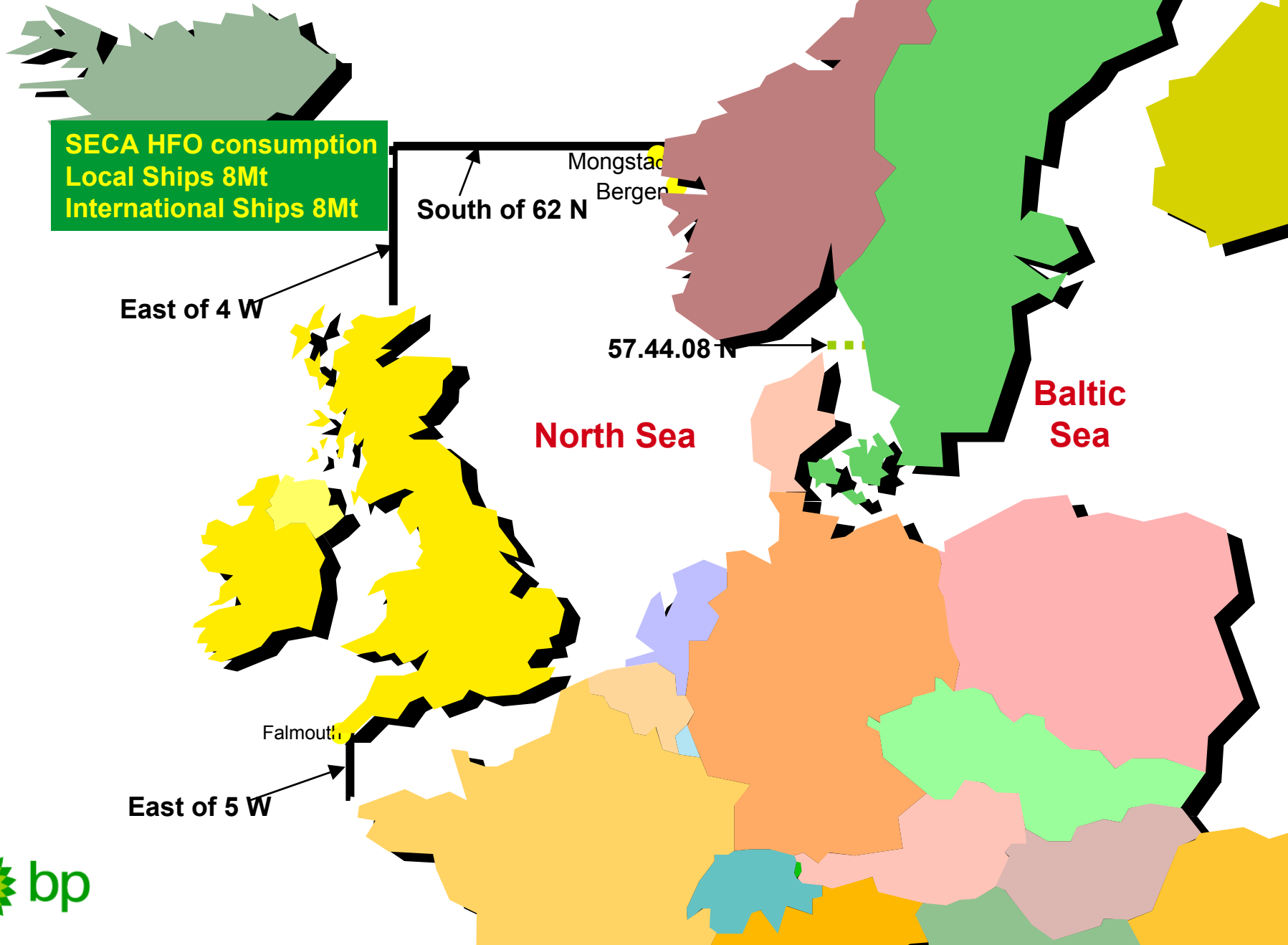
## ***Merchant Ship Combustion Plant Cleaner Fuel or Lower Emissions?***

Tuesday 18<sup>th</sup> – 21<sup>st</sup> APRIL 2005  
Seascape Resort, Monterey Bay, Aptos, California

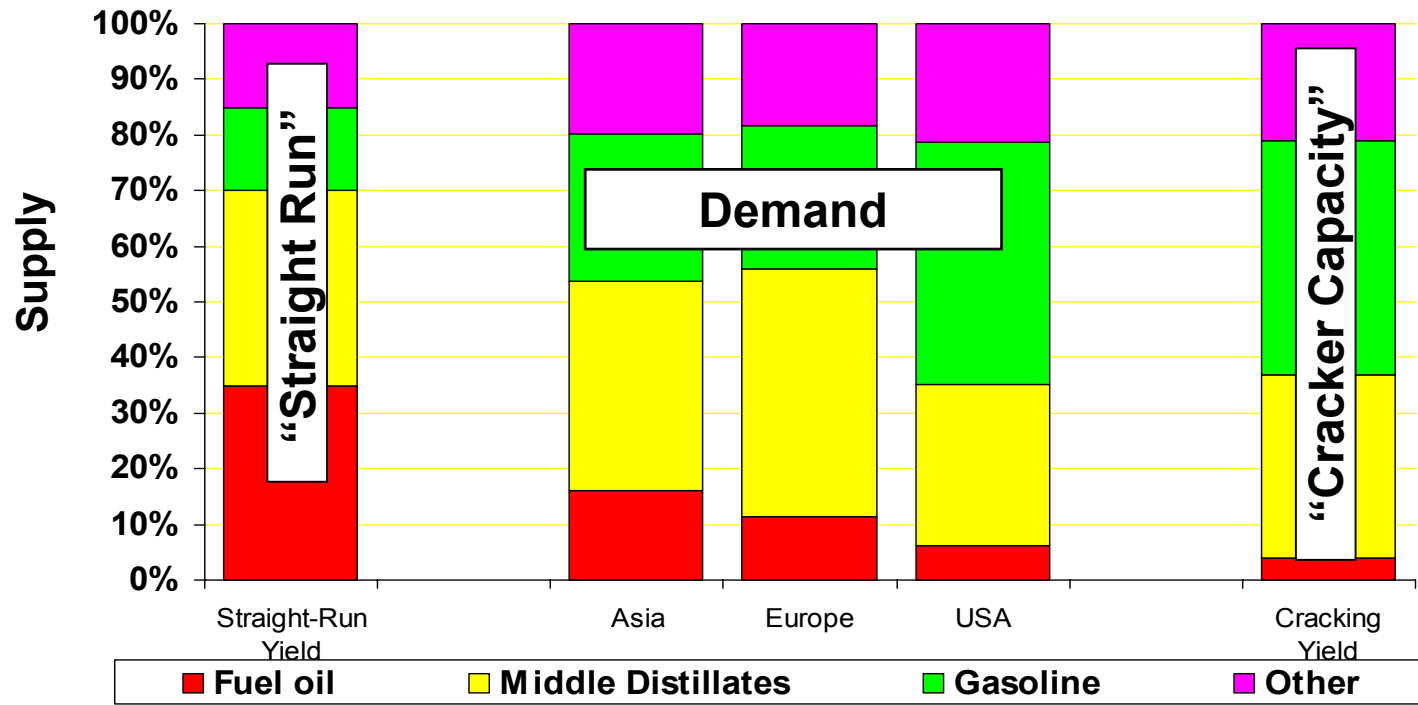
Donald M. Gregory  
Director, Environment & Sustainability, BP Marine



# Baltic & North Sea SECA



# Refinery Production vs Demand



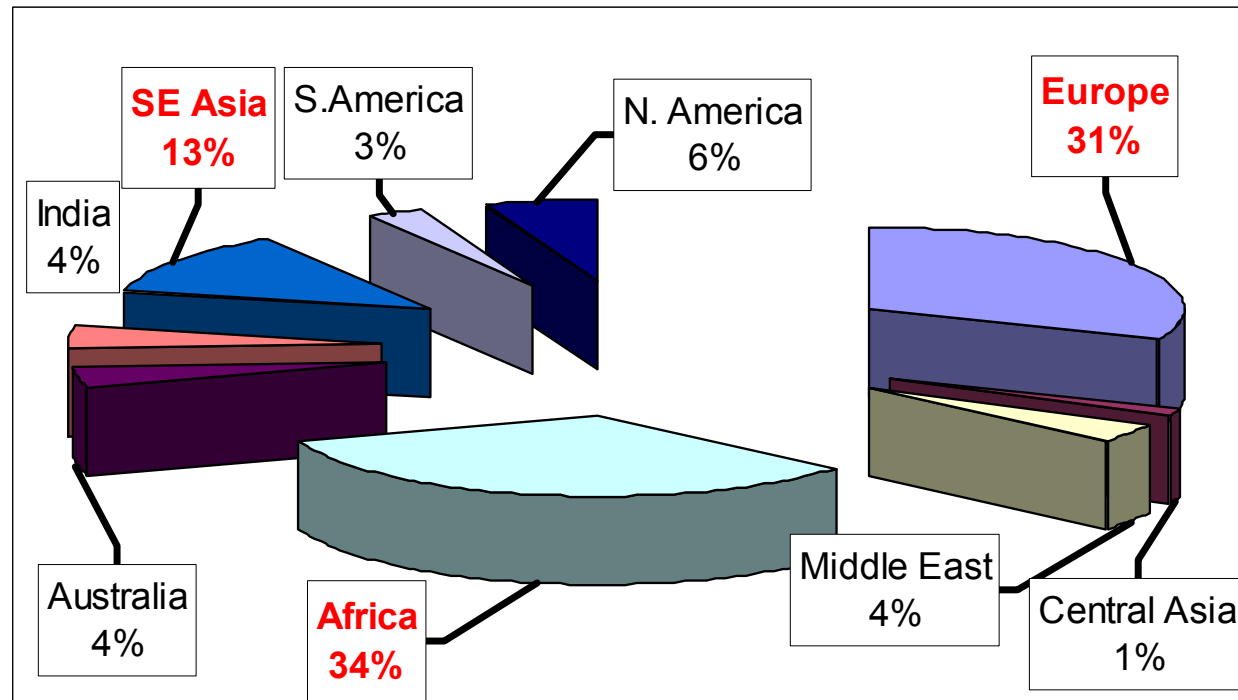
- Global demand for crude circa 84m barrels/day
- Global demand for marine residual fuel circa 4% of crude or 6m barrels/day
- Many US refineries coke residue, except during turnaround/upset/regulatory limit

**PROCESSING CRUDE = RESIDUE PRODUCTION**

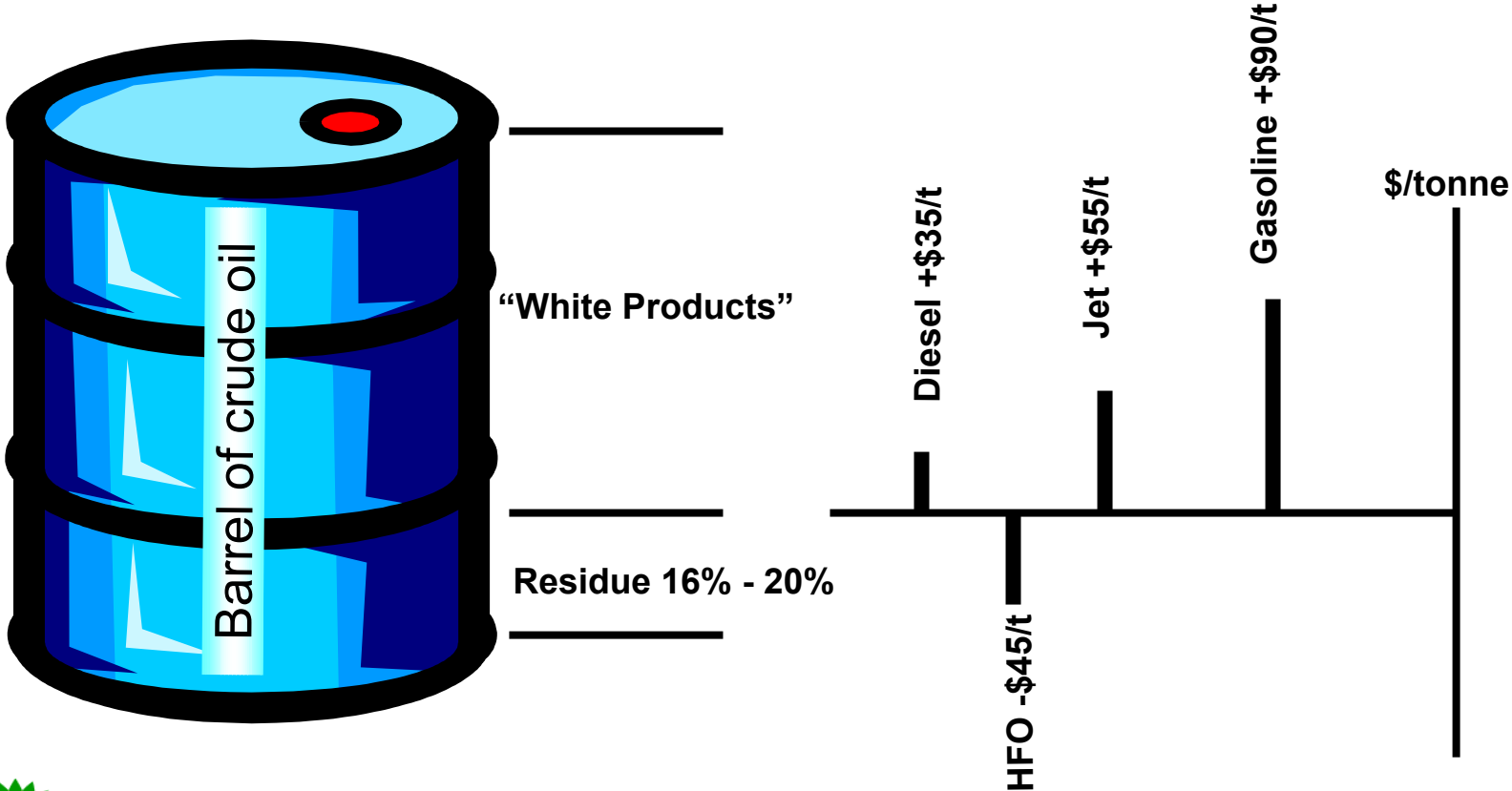


# Sources of production of light crudes

- Demand for LSFO likely to exceed 20 Mt/annum (European demand)
- Limited sources of “naturally” occurring LSFO
- Blending has and will continue to cause concern
- Early adopter experiences
  - Poor ignition quality
  - Fuel sludging

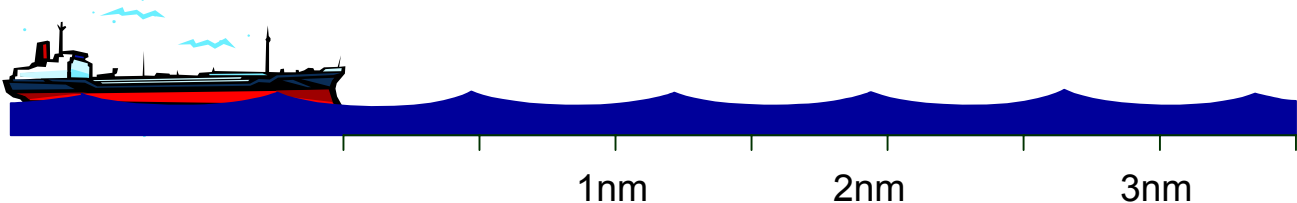


# Energy Sources - Relative fuel costs

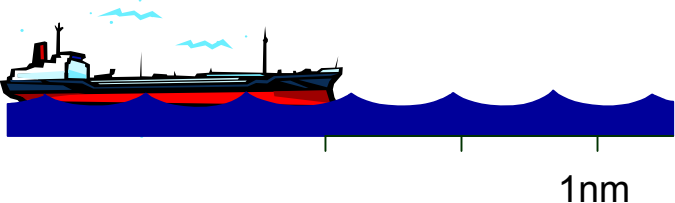


# Comparative Energy Costs

Fuel – Heavy Fuel Oil



Fuel – Marine Diesel Oil



***Distance travelled for \$100 of fuel by an 18 knot ship operating at 20MW***



# Shipowners options for compliance

- Alternative energy in port
  - High cost, safety risks
  - Possibly low emissions reduction benefit
- Use only diesel oil
  - High cost, tank size
  - Convenient, lower maintenance, no fuel changeover
- Use 1.5% sulphur fuel
  - Higher cost, availability, tank segregation, fuel changeover
  - Flexible option, little investment
- Blend fuel prior to use
  - Investment, maintenance, verification, reliability
  - Flexible option, low cost
- Install abatement technology
  - Investment
  - Lowest cost fuel, emissions credits, use in port
- Join an emissions trading group (not yet an option)
  - Provides an assured means of achieving compliance, choice and lowest cost options for the ship operator

difficult

Ease of compliance

easier



# Emissions Abatement Technology

Technology	NOx	PM	SOx	BP Activity
Selective Caltalytic Reduction	98%	–	–	None
Non Thermal Plasma	~98%	~98% HC	–	Possible synergy with SWS
Exhaust Gas Recirculation	~30 - 50%	~80%	~50%	Supported SWS company
Charge Air Humidification	~30%	–	–	None
Emulsion Fuels	~30%	~50%	–	Activity on invert emulsions
Sea Water Scrubbing	~10 – 20%	~80%	95%	Supporting introduction to market in 2005



# First commercial scrubber installation



mv Pride of Kent project

# Scrubber Performance Objectives

- SO<sub>x</sub> reduction > 95%
- NO<sub>x</sub> reduction ~10%
- Particulate reduction ~ 80%
- No measurable impact to sea water condition
- Easy handling & disposal of sludge

# Development Work Programmes

- Scrubbing Efficiency
  - SO<sub>x</sub> ~measured at 80% but expected to reach 95% - 98%
  - NO<sub>x</sub> ~measured at 10%
  - PM – to be determined (expected 80% by mass)
- Environmental Impact Assessment (water stream)
  - Trace HC & other elements
  - Toxicology studies
  - NO<sub>x</sub> – nutrient impact
  - Neutralisation number
  - PM characterisation
- Scrubbing Guidelines
- On-line Exhaust Gas Monitoring
- On-line System Performance Monitoring
- Sludge Disposal Assessment



# Menu of options

## OPTIONS

- Alternative energy sources
- Multiple fuels
- Fuel Blending on board
- Abatement technology
- Emissions trading

## BENEFITS

- Provides shipowner with flexibility to choose preferred option
- Lower cost impact, probably only 30% of sulphur cap cost
- Ease of compliance = Higher levels of compliance

## FUTURE

- Development of zero emissions SWS
- New low GHG fuels
- Synergies with other industries

