Cold-Ironing At Long Beach

Step 1: Feasibility Study

- **Evaluate Feasibility of Providing Shore-based Electric Power to Ships while at Berth ("Cold-Ironing")**
- **POLB Study Includes Other Control Strategies**

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Key Study Elements

- Evaluate Vessel Fleet Calling Long Beach
- Select Representative Ships for Detailed Study
- Calculate Hotelling Mode Power Demand and Resultant Emissions
- Develop Concepts for Retrofitting Cold Ironing System and Other Control Options
- Estimate Cost-Effectiveness of All Options
- Identify Political and Institutional Issues

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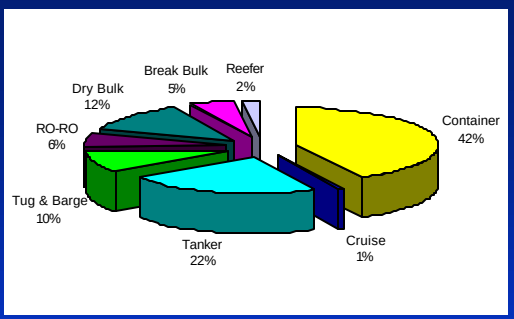
Vessel Fleet

- In the year ending 5/2003 1,150 vessels made 2,900 calls at POLB
- Half of the vessels called only once; only 121 called more than six times
- Containerships, tankers, and reefers constituted two-thirds of the calls



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Twelve Study Vessels

- 4 Container Ships
- 3 Tankers
- 1 Reefer
- 1 Dry Bulk
- 1 Ro-Ro (Auto Carrier)
- 1 Break Bulk
- 1 Cruise Ship

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Study Vessel Characteristics

- Number of calls: 1 to 52 per year
- Time at berth: 12 to 121 hours
- Electrical Load: <500 to >7000 kW
- Total annual hotelling emissions: 1 to 188 tons

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Cold-Ironing Concept and Costs

- Retrofitting Wharves and Vessels
- Supply 6.6 kV Power to Wharf
- Transformers for Specific Vessel Needs
- Both Barge-Mounted and Direct-Connection Configurations – Example Only
- Upgrade SCE's Infrastructure

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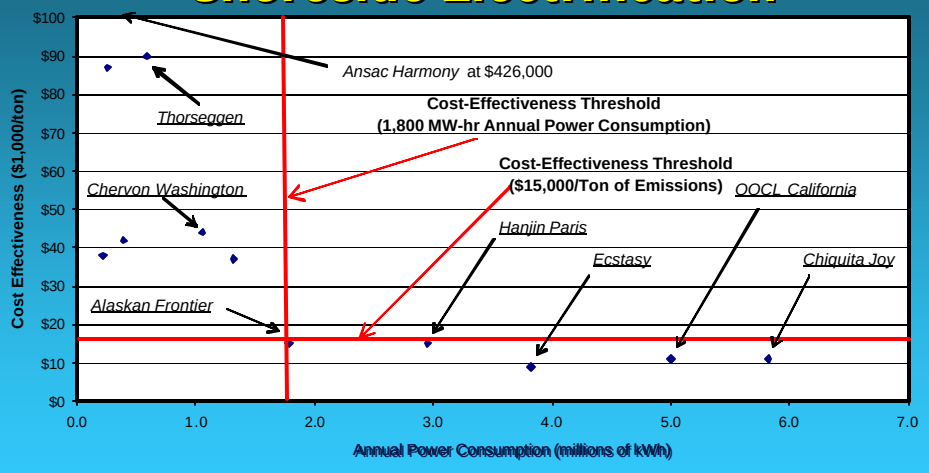
Cost-Effectiveness of Retrofitting Shoreside Electrification



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Other Control Options

- **Clean Fuels**
  Marine Gas Oil, Low Sulfur Diesel, Biodiesel, Fischer-Tropsch Diesel
- **Lower Emitting Engines**
  Fuel Emulsification, Timing Retard, EGR, Humid Air Motor
- **Add-on Exhaust Treatment**
  SCR, PM filters, Oxidation catalysts
- **Engine Replacement**
  LNG/CNG, EPA Tier 2 diesel

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Infeasible Control Options

- Fischer-Tropsch Diesel
- Bio-Diesel
- CARB #2 Diesel
- Diesel Oxidation Catalyst
- Diesel PM Filter
- Cryogenic Refrigerated Containers
- Injection Timing Delay
- Exhaust Gas Recirculation
- Direct Water Injection
- Selective Catalytic Reduction
- Repowering with EPA Tier 2 Engine

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Potentially Feasible Control Options

- **Marine Gas Oil**
  - Engine compatibility and logistics
- **Emulsified Diesel Fuel**
  - Engine compatibility, power loss, logistics
- **Natural Gas / Dual Fuel Engines**
  - Safety, fuel storage, distribution, and availability

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Cold-Ironing at Long Beach

Step 2: Follow-Up Study

!! DRAFT ONLY !!

- Analyzed Entire Population 5/03 – 5/04
- Identified Frequent Flyers (>6 calls)
- Identified Cost-Effective Candidates Among the Frequent Flyers (> 1.8 million KW per year)
- Estimated Hotelling Emissions From Candidates

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Vessel Characteristics

Vessel Type	No. of Freq. Callers	Calls Per Year	Percent Of Total Vessels	Percent Of Total Calls
Container	110	994	11%	31%
Reefer	2	53	0.2%	2%
Cruise	4	164	0.4%	5%
Tanker	24	241	2%	8%
Auto Carrier	7	60	1%	2%
Dry Bulk	2	25	0.2%	1%
Break Bulk	2	30	0.2%	1%
Total	151	1,567	15%	49%

5/2003 – 5/2004

Total Vessels: 1,033

Total Calls: 3,207

Frequent Flyers: 151

Frequent Calls: 1,567

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The Bottom Line

CANDIDATE VESSELS

Candidates	**26**
Types	**22 Container, 2 Reefer, 2 Cruise**
TEU	**200 – 7,000**
Calls/Yr	**7 - 105**
Hrs @ Berth	**400 - 1800**
Power Consumption	**2,000,000 to 8,200,000 KWH**

- Frequent Flyers: 5,400 tpy
- Candidates: 3,600 tpy

(30% of all hotelling emissions)

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Next??

- BP and POLB Have Embarked on a Cold-Ironing Project – 2006
- New Terminals (e.g., Pier S) and Wharves Will Be Cold-Ironed
- Existing Terminals?
- Legal Constraints?

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