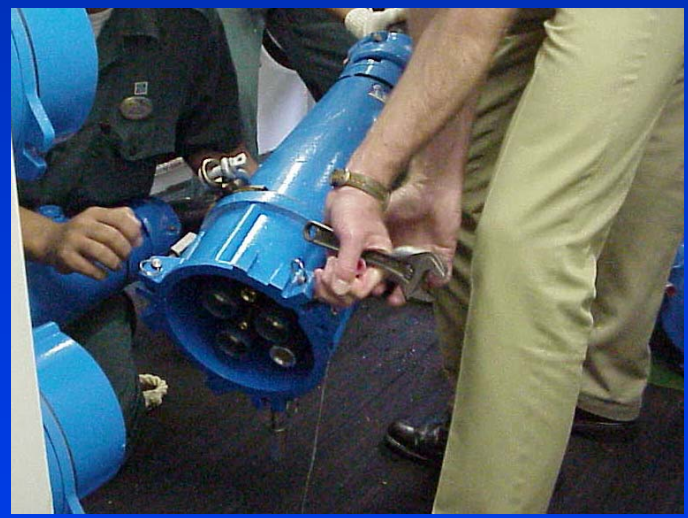
Cold-Ironing Feasibility Study

- Respond to City Council and Board Requests to Evaluate Feasibility of Providing Shore-based Electric Power to Ships while at Berth ("Cold-Ironing")
- POLB Study Includes Other Control Strategies
- Element of Port's Air Quality Improvement Program



THE PORT OF LONG BEACH

"Cold Ironing" Study Objectives

- Assess Opportunities and Constraints for "Shore-to-Ship" Electrification and Other Potential Control Options
- Identify Necessary Infrastructure on Vessels and Terminals
- Estimate Cost-Effectiveness of All Options
- Identify Potential Legal, Safety, Regulatory, and Labor Issues

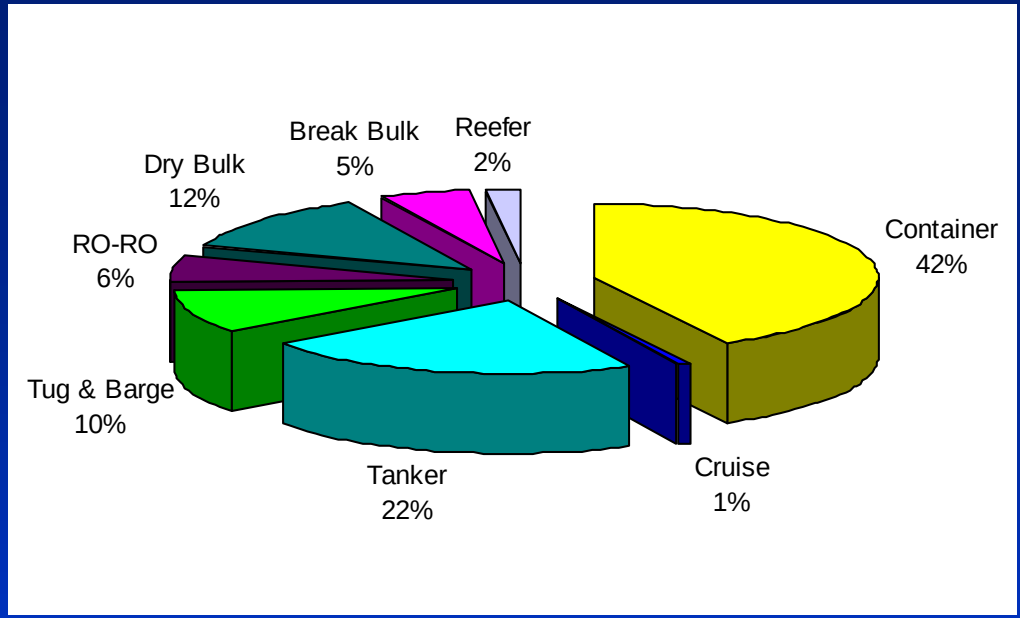
Key Study Elements

- 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

THE PORT OF LONG BEACH

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



THE PORT OF LONG BEACH

Twelve Study Vessels

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

THE PORT OF LONG BEACH

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

THE PORT OF LONG BEACH

Evaluation of Cost-Effectiveness

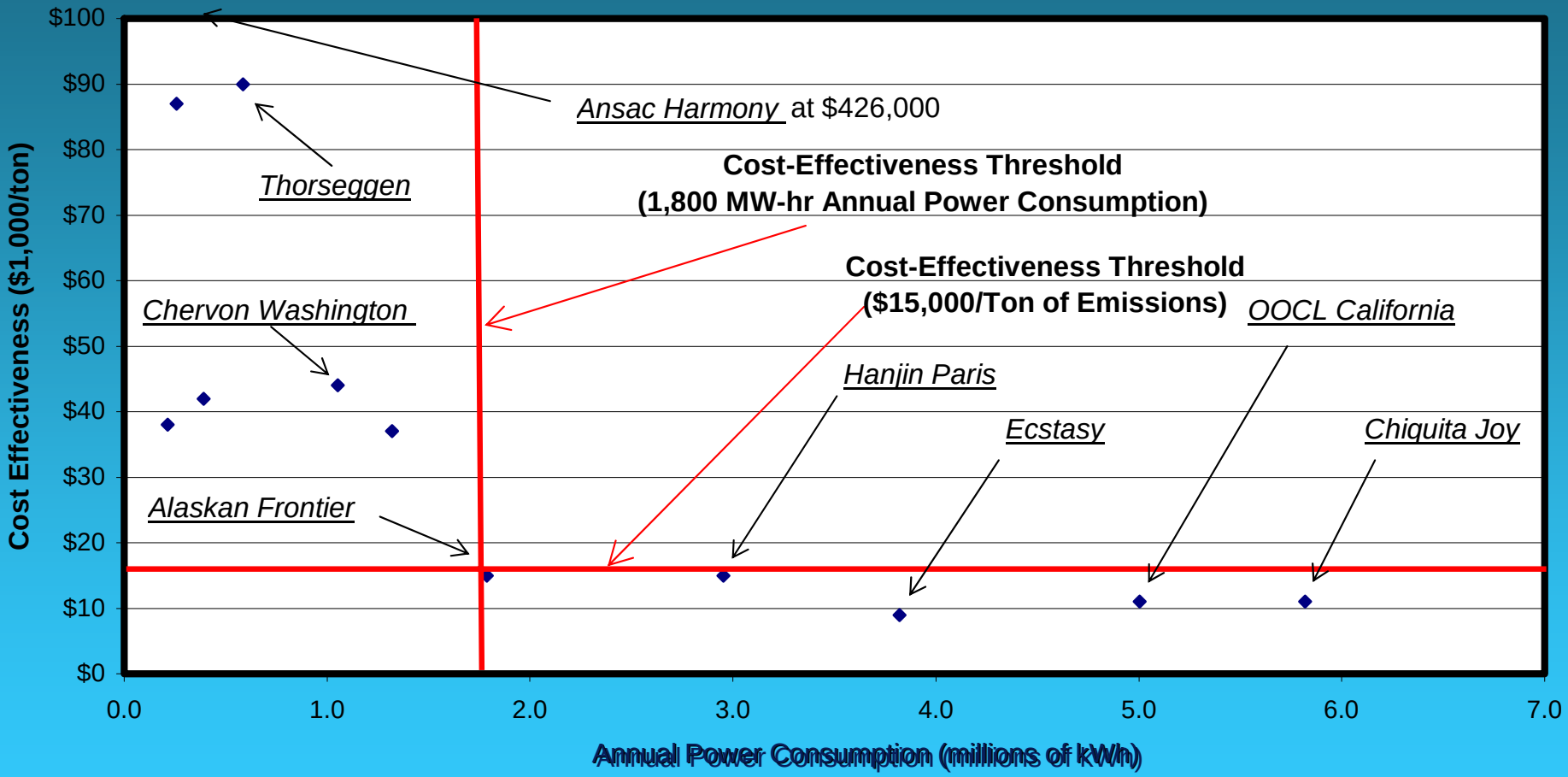
- Capital Costs for Retrofitting Cold Ironing to Berths and Ships (Port, Vessel Operator, and SCE costs)
- Capital Costs of Retrofitting Other Technologies (alternative fuels, exhaust treatment, engine modifications)
- Estimates of Operational Costs (e.g., electricity, fuels, maintenance, extra labor)
- Costs Expressed as Net Present Value

Cold-Ironing Concept

- 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

THE PORT OF LONG BEACH

Cost-Effectiveness of Retrofitting Shoreside Electrification



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

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

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

THE PORT OF LONG BEACH

Other Considerations

- ARB/AQMD considering requiring cold-ironing
- CARB cold-ironing feasibility study
- IMO rules will require lower sulfur fuel
- Legality of local regulation of international sources
- Operational flexibility constraints
- Safety and labor
- International standardization