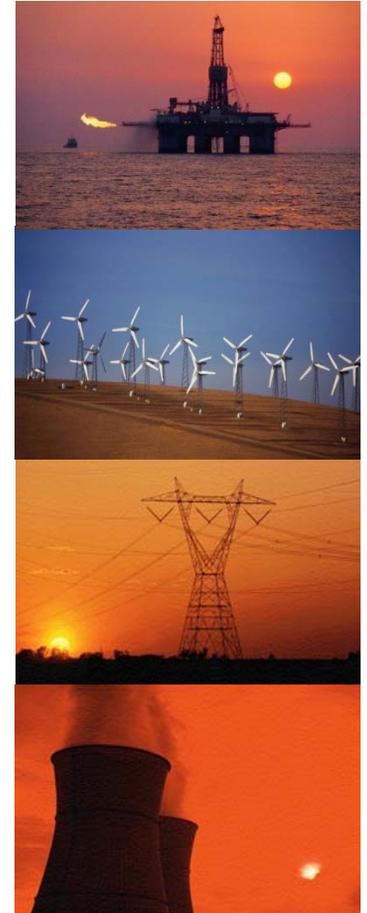


CHP Market Analysis

Presented by
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California Energy Commission
Combined Heat and Power Workshop
December 16, 2008



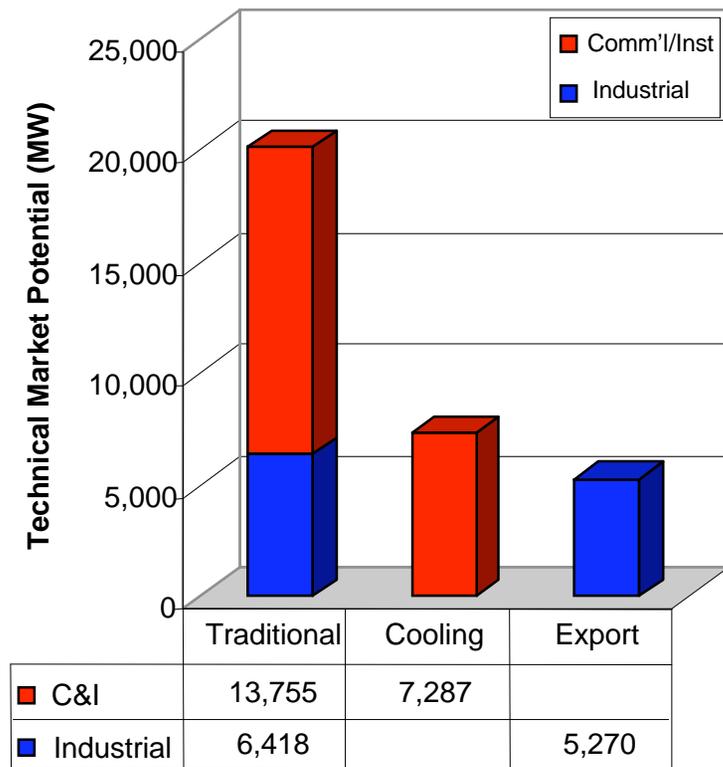
Presentation Topics

- Revisiting the 2005 CHP Market Assessment
 - Technical Market Potential
 - Commercial/Institutional and small industrial markets
 - Large industrial markets
 - Scenario results
- CHP Market Analysis: Electricity Export
- CHP Technology Mapping
- Issues Affecting CHP Market Penetration Analysis

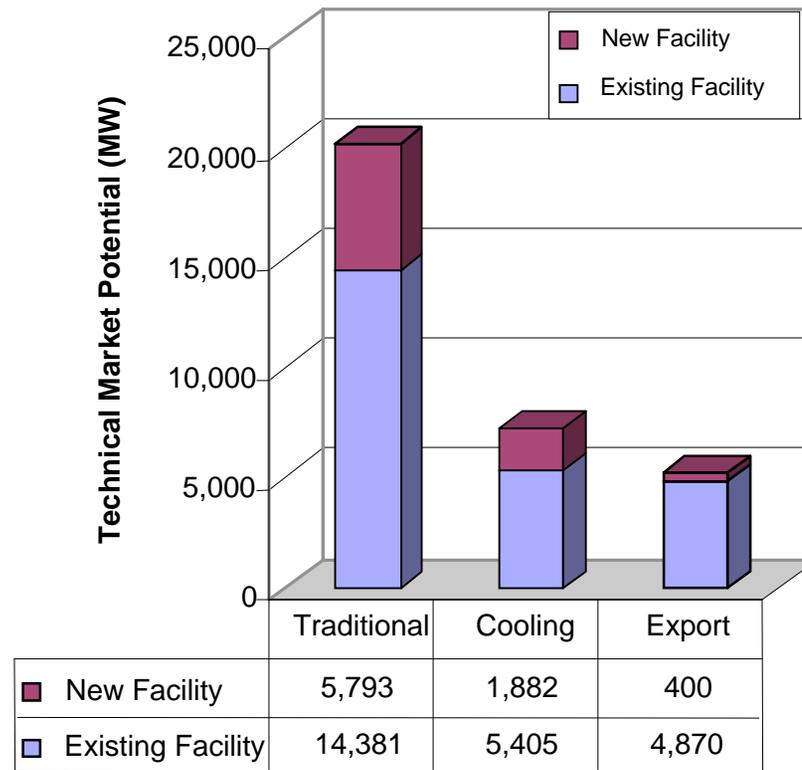
Project Objectives

- CHP Information for Graphical Information System (GIS) Mapping
 - Technical Market Potential by location (zip code or county)
 - Existing CHP by location
- Market Issues and Sustainability from a CO₂ Perspective
 - Technology Mapping – Economics vs. GHG Impact
 - CHP Export Market Potential
 - Evaluation of stationary power generation options – duct firing, organic Rankine cycles
 - Review of policy and technology trends impacting CHP
 - Market penetration analysis

2005 - Total Remaining CHP Technical Market Potential

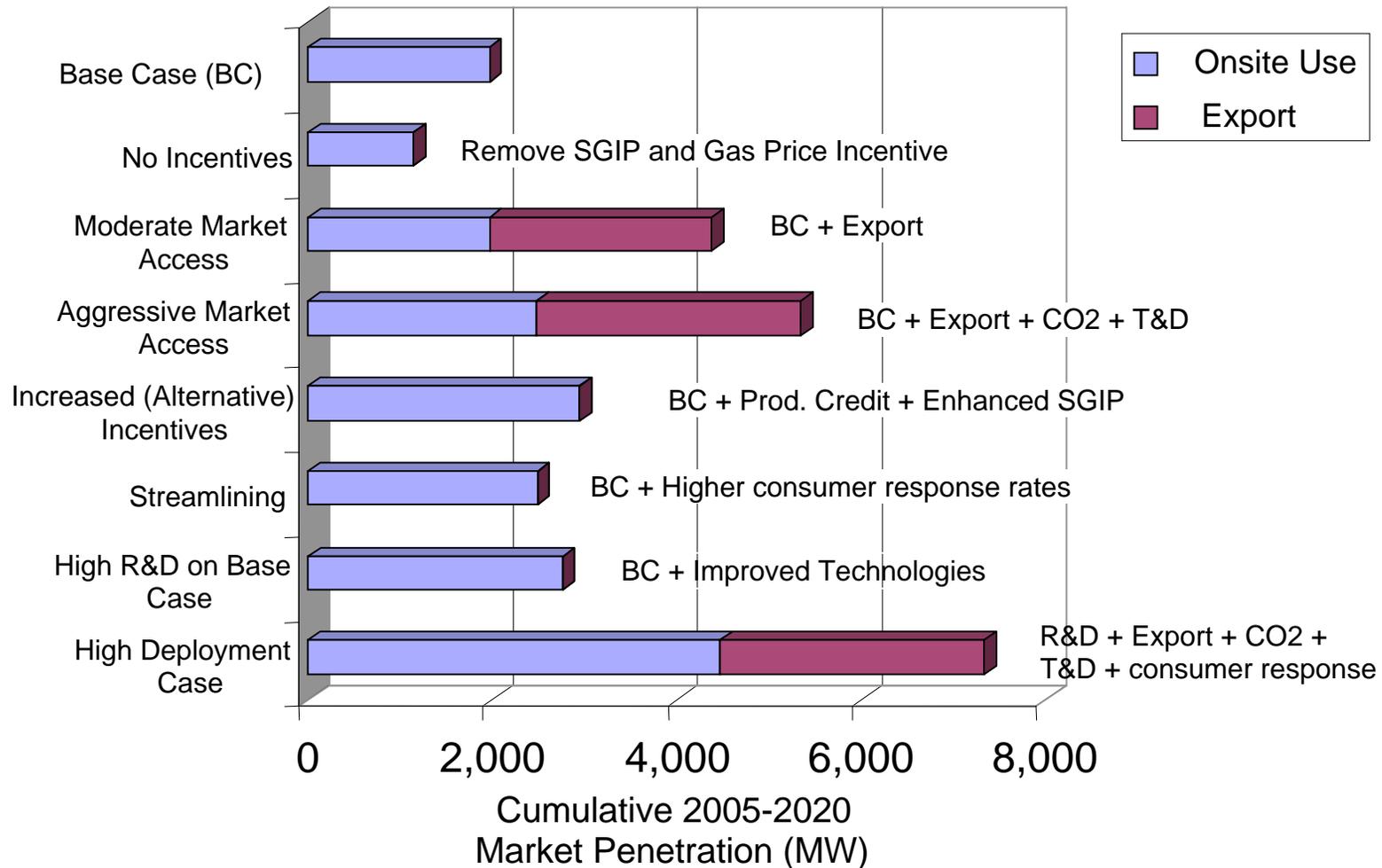


CHP Application Type



CHP Application Type

2005 - CHP Market Penetration Scenario Results



Re-evaluation of 2005 Analysis based on 2008 Issues

- What is the potential for CHP export to the grid?
- What is the contribution of CHP to meeting carbon reduction goals for AB-32?
 - GHG signatures for individual CHP technologies and applications – (Technology Mapping)
 - Avoided GHG emissions for the California power sector
 - Appropriate market incentives
 - CHP market penetration and overall contribution to carbon reduction

Re-evaluation of 2005 Analysis based on 2008 Issues

- What has changed since 2005?
 - Gas prices have increased by 25-30% in early years and by 5-10% by the end of the time horizon (2020 for 2005 study, 2028 for the new study)
 - Electric rates changed by -5 to +20%
 - CHP technology cost estimates increased 12-80%
 - SGIP ended for all non-renewable CHP except fuel cells
 - C&I market growth potentially lower due to recession

Technical Market Potential – Commercial, Institutional and Small Industrial Markets

- Commercial/institutional markets and small industrial estimated from iMarket database at a county level based on number of facilities in target market segments in several electrical consumption categories
 - 17,000 MW of remaining potential estimated in existing businesses – information on these existing facility sites were supplied to LLNL for the GIS mapping
 - 7,000 MW for new businesses based on California economic growth forecast in target markets – the market model assumes that this growth occurs in the same utility service territory but otherwise the location of new business is indeterminate
- These totals are further screened in the market model to reflect known constraints to CHP application – mismatch of electric and thermal loads, fuel availability, space constraints, management indifference.
- Ultimate penetration further constrained by customer acceptance factors (function of size)

Large Industrial Market – CHP Technical Market Potential - Export

- Evaluation of data for 947 industrial facilities in CA using the Major Industrial Plant Database (MIPD)
- Reported electric and steam demands are analyzed to determine
 - CHP capacity that would meet the on-site steam demand
 - Amount of CHP power that would meet on-site power demands
 - Amount of CHP power that is available for export to the grid
- These estimates are adjusted by known existing CHP
- This approach is used to identify all industrial CHP technical market potential 5 MW and larger
- The estimates for existing industrial facilities was supplied to the GIS-Mapping project by zip code

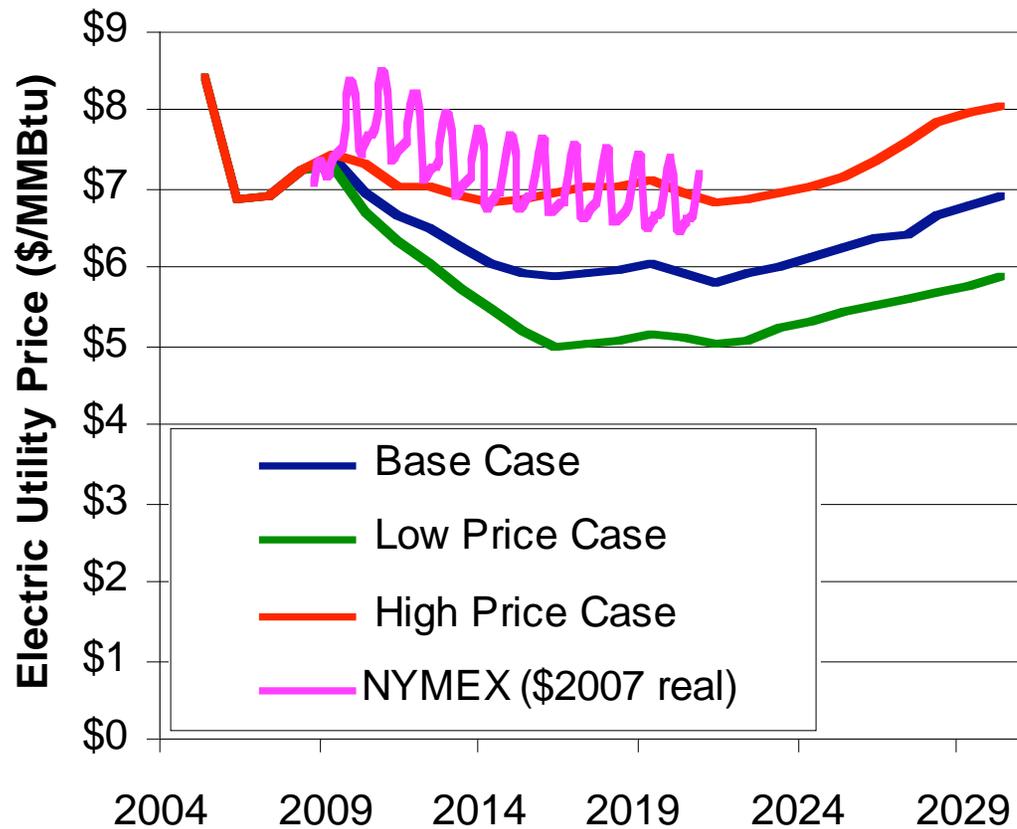
Large Industrial Market (2008 Analysis)

Large Industrial Market Technical Market Potential (MW)	5-20 MW		>20 MW		Total
	Existing Facility	New Market Growth	Existing Facility	New Market Growth	
CHP for On-site Power	191	72	518	122	903
CHP for Export Power	337	55	4,532	344	5,268
Total Technical Potential	528	127	5,050	466	6,171

- Export potential greatly exceeds the on-site use potential
- Export market potential is concentrated in 40 very large industrial facilities with CHP export capability of greater than 20 MW
- Export potential from industrial facilities 5-20 MW, that would meet AB-1613 guidelines is less than 400 MW

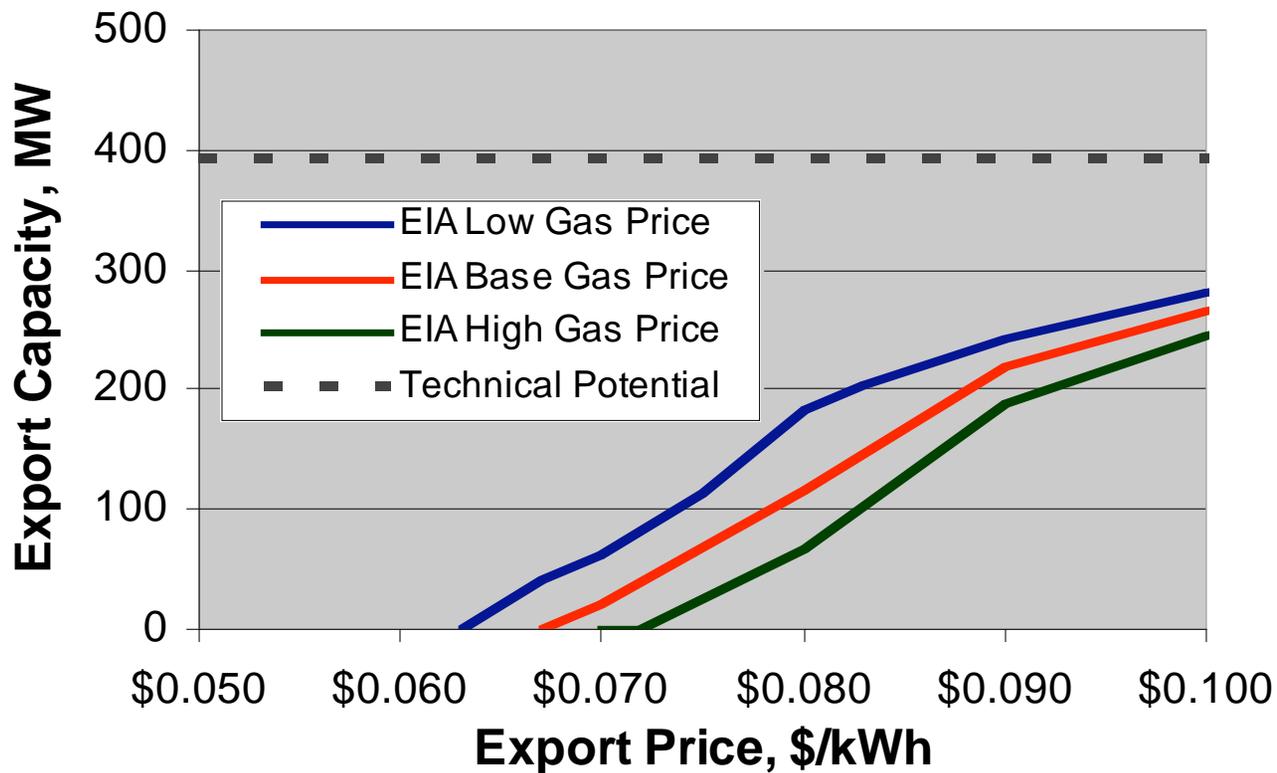
Natural Gas Price Forecast - 2008

Comparison of Adjusted NYMEX to EIA AEO2008 Forecast



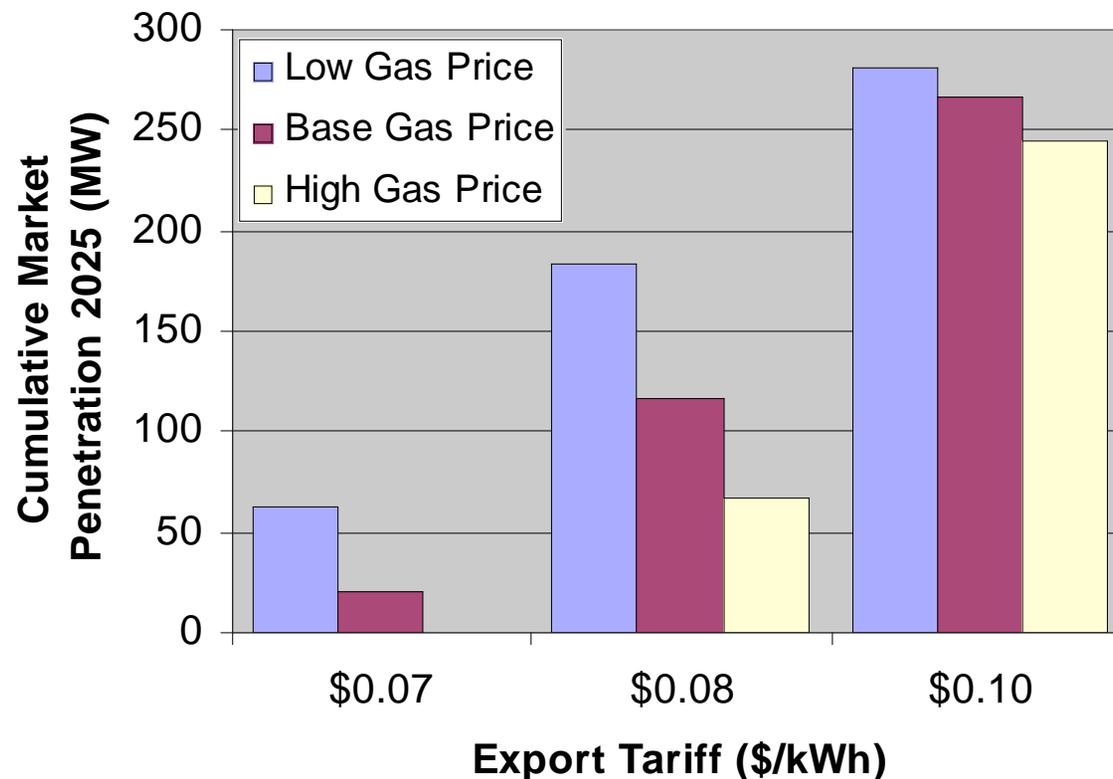
Parametric Export Market Penetration Analysis: 5-20 MW – Industrial Sector

2025 Cumulative Market Penetration



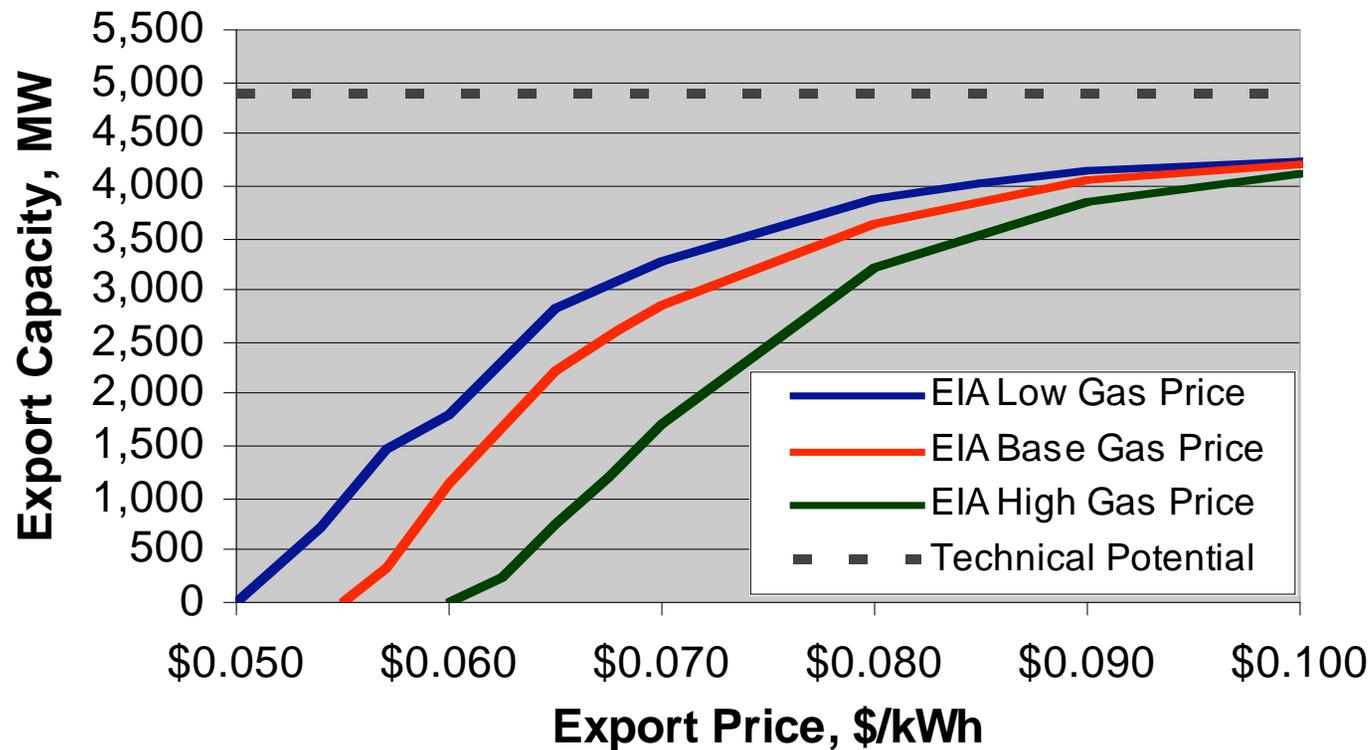
CHP Export Market Penetration at Selected Electric Tariffs: 5-20 MW - Industrial Sector

Effect of Gas Price and Export Tariff on Export Market Penetration



Parametric Export Market Penetration Analysis: > 20 MW - Industrial Sector

2025 Cumulative Market Penetration



Export Market Analysis Conclusions and Recommendations

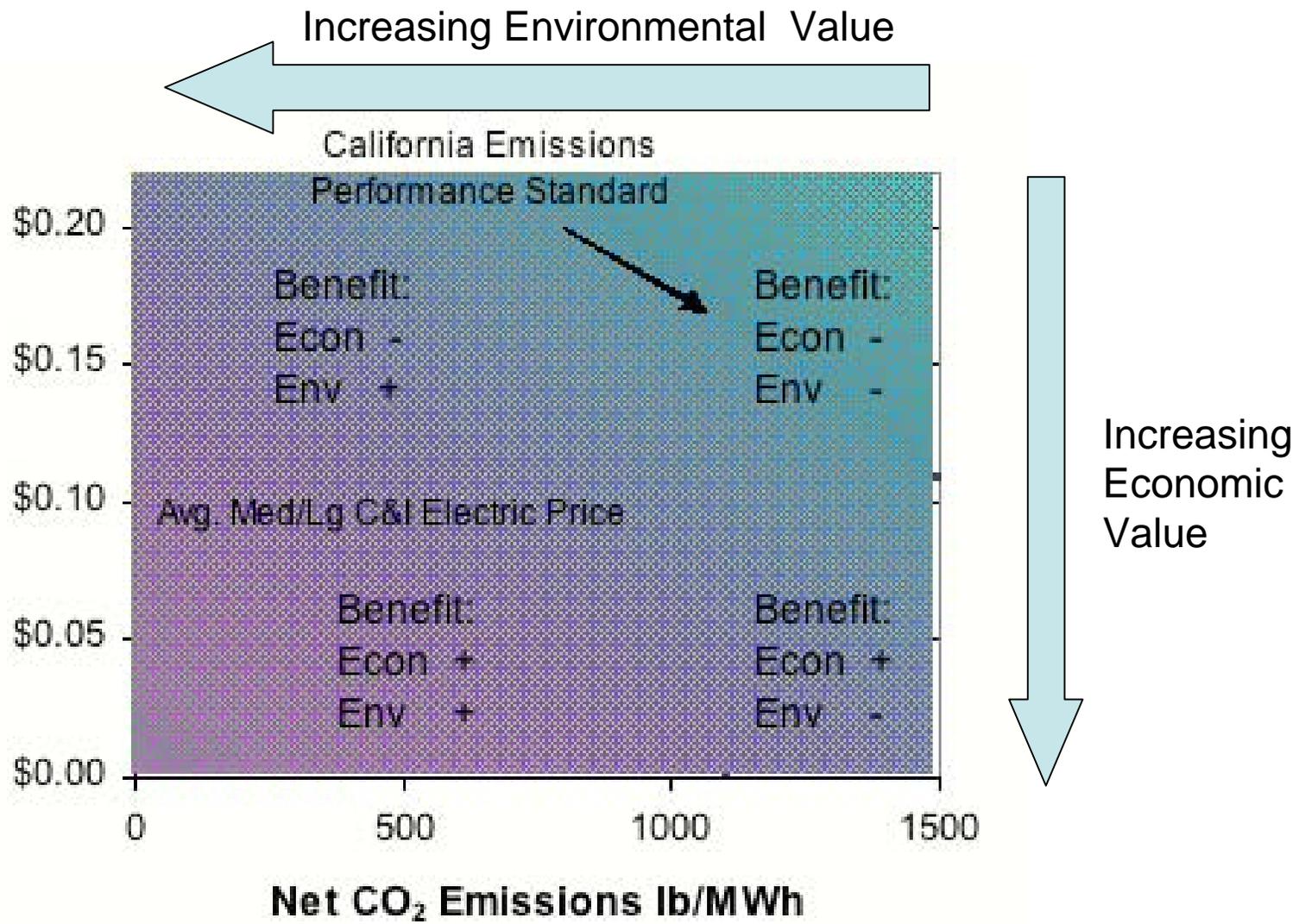
Conclusions

- Market potential concentrated in 40 very large industrial facilities (>20 MW)
- Market potential 5-20 MW size range is about 400 MW
- Market response in the 5-20 MW size would be about 120 MW at an \$0.08/kWh tariff (mid EIA natural gas price case)

Recommendations

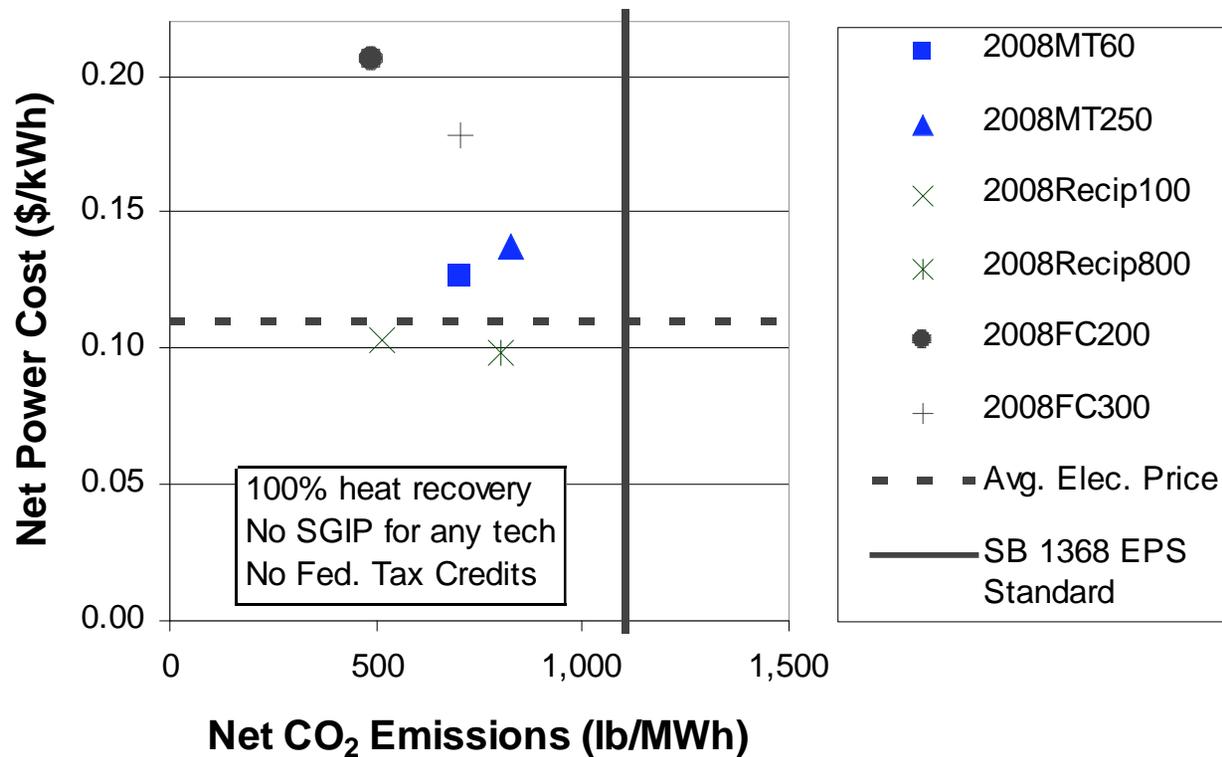
- Verify the facility data with help from direct contacts, utility information, and association support
- Analyze additional markets – ethanol production, enhanced oil recover, commercial and institutional markets

CHP Technology Mapping Framework



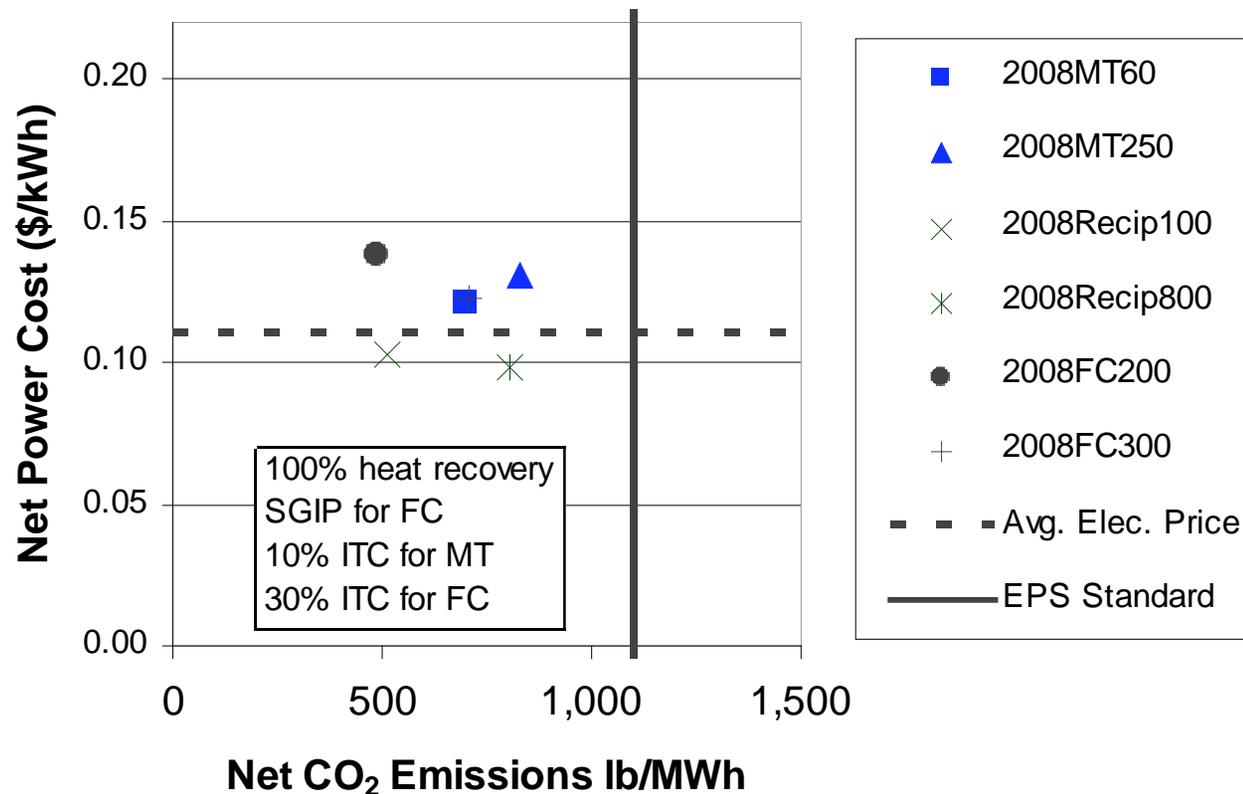
Mapping Analysis: No Incentives Case 2008 Technologies on Their Own Merits

CHP Technology Mapping < 1,000 kW No Incentives



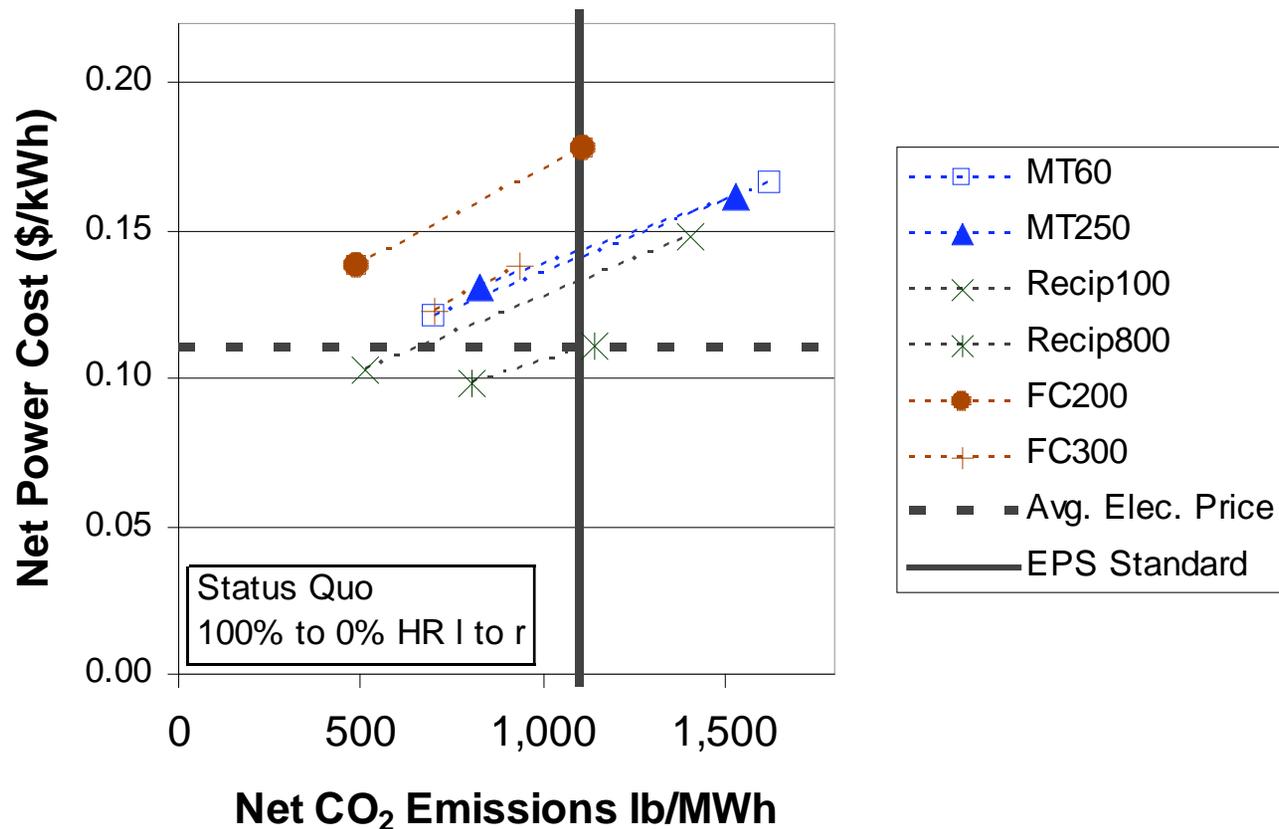
Mapping Analysis: Status Quo 2008 Technologies with Existing Incentives

CHP Technology Mapping < 1,000 kW Status Quo



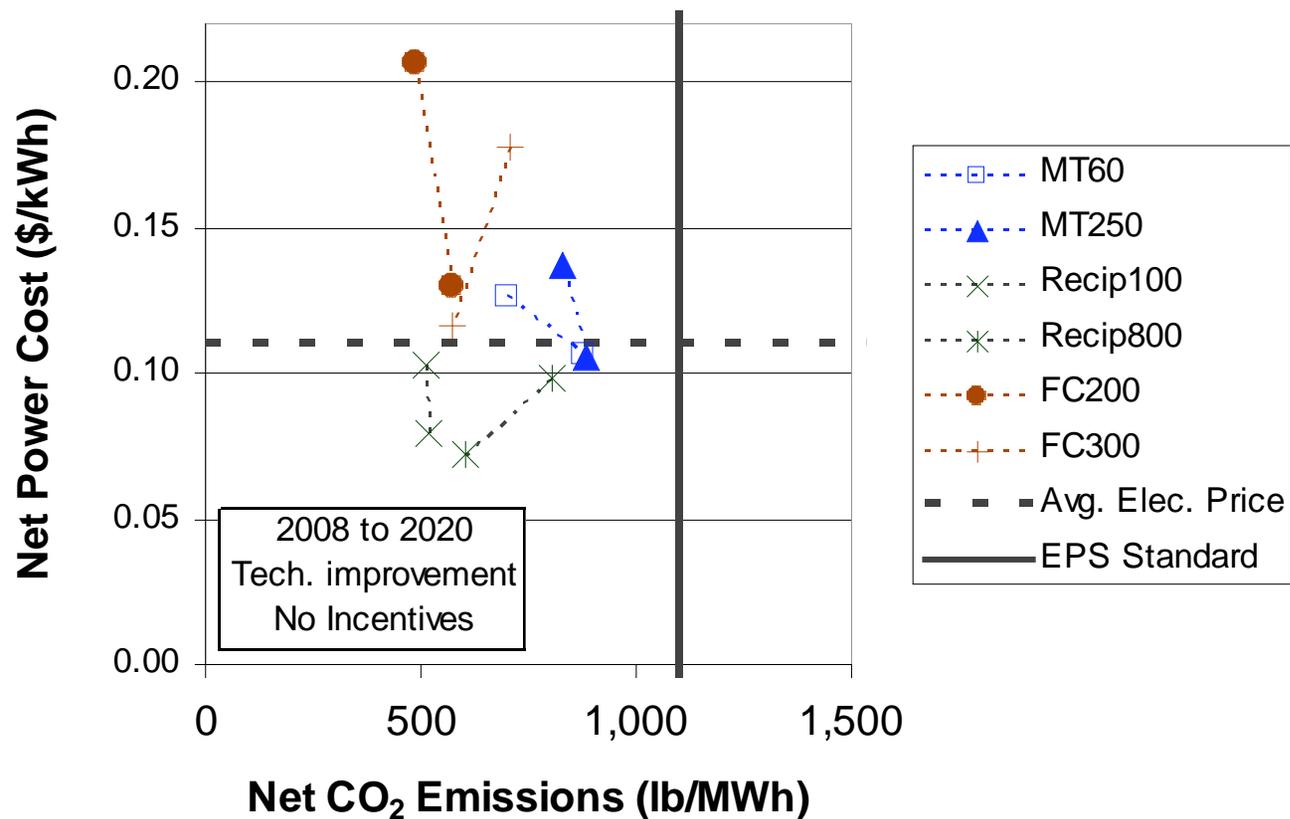
Effect of Thermal Utilization: 100% to 0%

CHP Technology Mapping < 1 MW, 100-0% Heat Recovery



Effect of Technology Improvement

CHP Technology Mapping < 1 MW, Technology Improvement



Recommended Future Work: Technology Mapping Completion

- Evaluate appropriate avoided power sector GHG emissions estimates – region EGRID values, selected comparison technology (GT-CC), Climate Trust bidding rules, interactive energy model output (EPRI NEMS, BEAR)
- Complete technology characterization – technologies larger than 1 MW, organic Rankine cycle systems
- Add additional applications – thermally activated cooling, duct firing
- R&D strategy and policy recommendations

Recommended Future Work: CHP Market Assessment Update

- Market Analysis Issues
 - Review of onsite technical market potential characterization
 - Verification of large industrial database analysis with customer, association, and utility contacts – steam loads, electric loads, existing CHP
 - Additional technology and market characterizations
- Policy Issues Scenario Development
 - Define natural gas price scenarios) for analyses
 - SGIP restoration
 - T&D benefit payment
 - Define export tariff(s)
 - CO₂ payments/incentives
 - Acceleration of technology improvement

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