CHP Planning Scenarios under the QF/CHP Settlement

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Presentation Outline

- Tracking CHP capacity and GHG emissions
- Key concepts to understand GHG analysis of CHP
- GHG accounting under new QF/CHP Settlement
- Scenarios for GHG reductions from existing CHP fleet

Tracking CHP Capacity

- Estimates on existing CHP capacity can vary widely
  - Difficult to estimate CHP energy consumed onsite
  - CHP exporting to grid
    - Public data available for Qualifying Facilities (QFs)
    - No public data on non-QFs
  - Lack of common data points among CHP databases create a challenge for comprehensive data reconciliation
  - Lack of common definition of “capacity”
- CEC has further narrowed the gap in data variance through project-by-project analysis
- Better data collection coming
  - ARB reporting regulations under cap and trade
  - CPUC reporting requirements for IOU procurement of CHP under new QF/CHP Settlement

CPUC Data Collection

- Data requests to IOUs in 2009 and 2010
- Returned a total of 6,696 MW of operational CHP in IOU territories
  - Almost 75% of CHP projects are QFs
  - Over 78% of CHP capacity in projects > 20 MW
  - 1,521 MW customer-side generation (self-generation only)
  - 5,174 MW mix of customer-side and export generation

Operational Projects (MW)			
	Not QF	QF	Total
SCE	313	2,281	2,594
SDG&E	41	341	382
PG&E	1,321	2,398	3,720
Total	**1,676**	**5,021**	**6,696**

Operational Projects (MW)				
	< 5 MW	5 - 20 MW	> 20 MW	Total
SCE	157	178	2,260	2,594
SDG&E	63	56	263	382
PG&E	717	301	2,702	3,720
Total	**936**	**535**	**5,225**	**6,696**

Tracking GHG emissions reductions from CHP

- Wide range in operational profiles
  - 100 kW – 300 MW in size
  - Capacity factors from 10% - 95%
  - Variance in ratio between power and heat production
  - Variance in ratio between export and onsite consumption
- Total efficiency rating must look at electrical and thermal
  - As electrical efficiency drops, the potential for thermal efficiency increases and visa-versa
- More study needed on avoided grid emissions and displaced boiler efficiencies from CHP

GHG Analysis: Key Concepts

Total Efficiency = (3.413*EO + TO) / Fuel Input

Where:

EO = electrical output in MWh

TO = thermal output in Btu

Fuel Input = fuel in Btu

Power-to-Heat Ratio = (3.413*EO) / TO

Where:

EO = electrical output in MWh

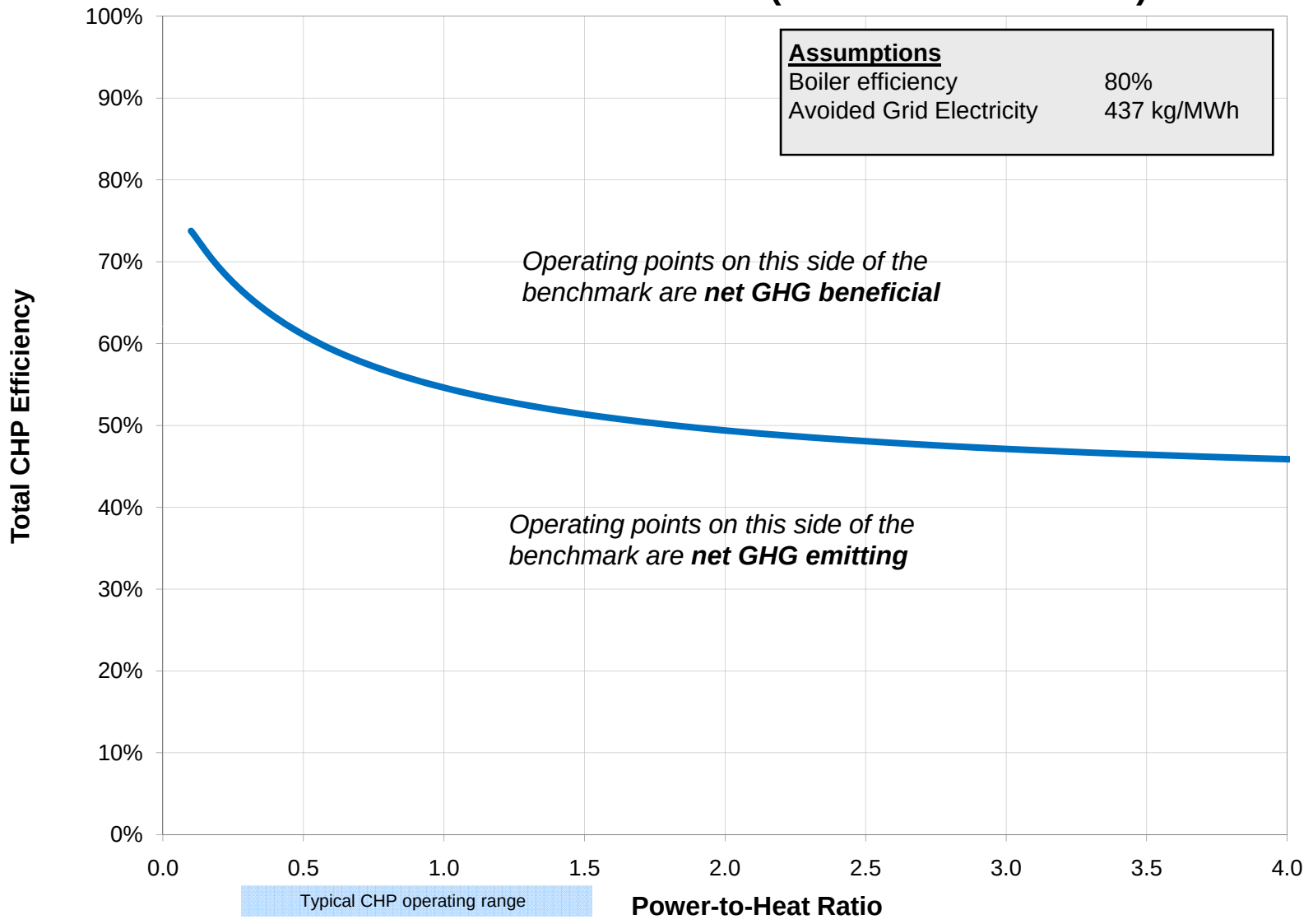
TO = thermal output in Btu

GHG Emissions *"Double Benchmark"*

When comparing CHP against separate heat and power, two avoided emission factors are needed:

1. Avoided boiler efficiency
2. Avoided grid efficiency

CHP GHG Break-even Curve ("Double Benchmark")



CHP GHG Analysis

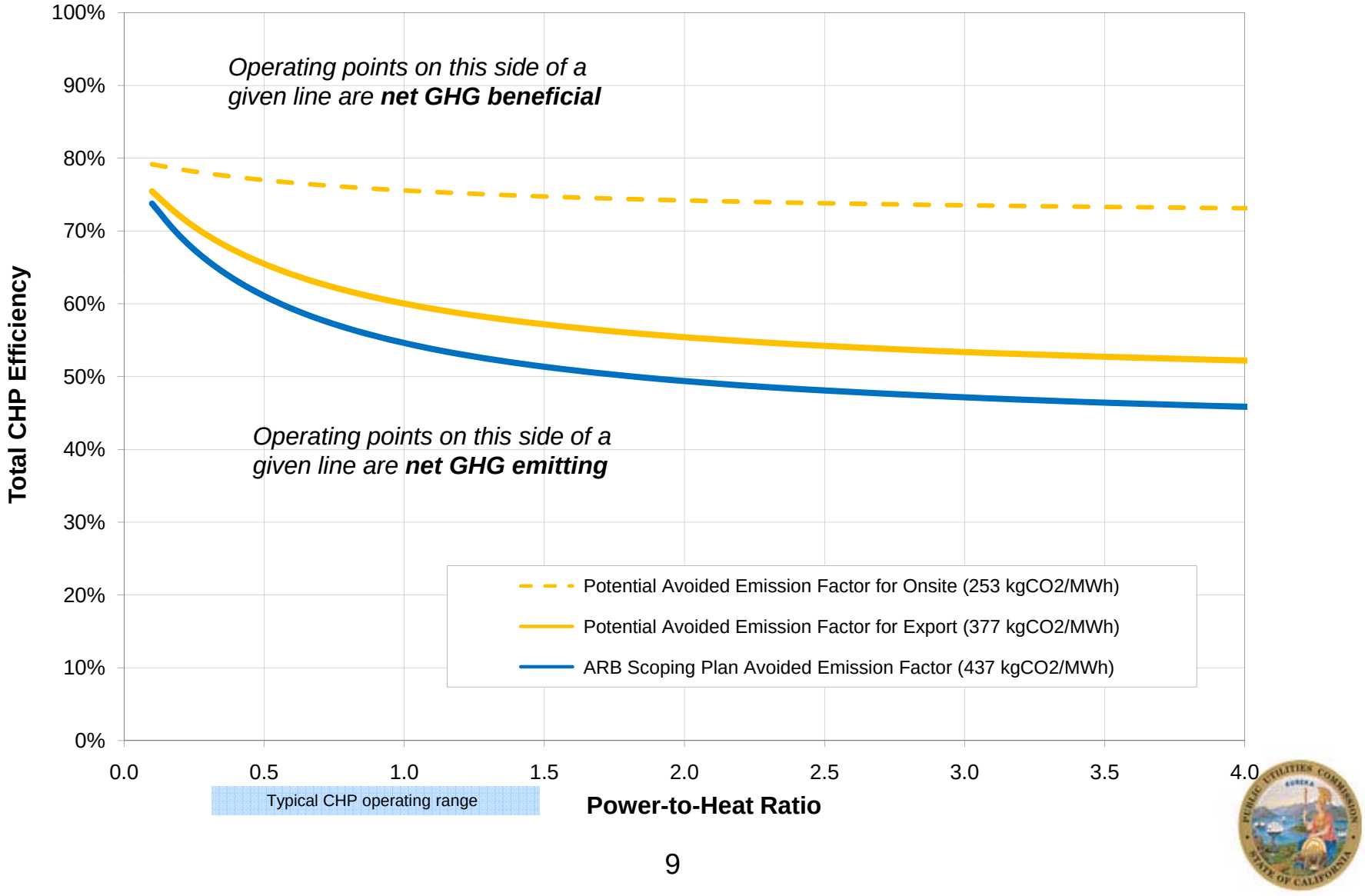
Assumptions

	ARB Scoping Plan	**Potential 2020**
Avoided Grid Emissions (export)	437*	377* kgCO2/MWh
Avoided Grid Emissions (on-site)	437	253 kgCO2/MWh
Renewable Portfolio Standard	0%	33%
T&D losses avoided (export)	0%	0%
T&D losses avoided (on-site)	7.8%	7.8%
Avoided Boiler Efficiency	80%	80%

Natural Gas Conversion Factor 0.05307 Tonne CO2e/MMBTU

** 437 kg/MWh = 8,234 btu/kwh (w.avg statewide emissions from gas-fired gen 2002-2004)*
** 377 kg/MWh = 7,104 btu/kwh (mix of new CCGT (95%) + new CT (5%))*

CHP GHG Break-even Curve



QF/CHP Settlement

- Effective as of Nov. 23, 2011
- Resolves existing disputes and future issues related to CHP QFs
- Key Provisions
  - Termination of "must take" obligation for QFs above 20 MW
  - Procurement primarily via a competitive solicitation process
  - New energy prices for QFs (SRAC)
  - New PPAs and Amendments
  - **<u>MW procurement and GHG reduction targets for IOUs</u>**
    - IOU MW target: **3,000 MW** of CHP by October 2015 (can be new or existing CHP)
    - IOU GHG reduction target: *incremental* **4.3 MMTCO2e** by 2020
      - Based on IOU's share of ARB Climate Change Scoping Plan CHP target
    - MW and GHG accounting towards targets specific to the Settlement – no two CHP facilities are alike and the accounting reflects these differences

GHG Accounting under QF/CHP Settlement

- Avoided emissions calculated using "*Double Benchmark*":
  - Avoided Electrical Efficiency 8,300 btu/kWh (440 kg/MWh)
  - Avoided Boiler Efficiency 80%
- Same avoided emission factors for export and onsite
- If "must-take" procurement and facility is net-GHG emitting, will not count for/against the GHG target
- For terminated and shut-down facilities, energy (and GHG emissions) is replaced at a defined market heat rate
- Utility-owned generation can only account for up to 10% of IOUs' GHG target

Emission Reductions from Existing CHP Under QF/CHP Settlement

Of the 6,696 MW of CHP data collected in 2009-2010, estimated performance data available for ~67% of CHP IOU fleet, or 4,512 MW.

Using QF/CHP Settlement assumptions, “snapshot” of net emission reductions:

Nameplate Capacity	Emissions Produced	Emissions Avoided	Net Emissions Reductions	Net Emissions Reductions
MW	Tonne CO2e	Tonne CO2e	Tonne CO2e	MMTCO2e
4,512	18,105,112	20,269,228	2,164,116	2.16

Assumptions

GHG Emissions Factor (exports)	440 Kg/MWh
GHG Emissions Factor (on-site)	440 Kg/MWh
Renewable Portfolio Standard	0%
T&D losses avoided (export) 0%	
T&D losses avoided (on-site)	0%
Avoided Boiler Efficiency	80%
Natural Gas Conversion Factor	0.05307 Tonne CO2e/MMBTU

Emission Reductions from Existing CHP Under Potential 2020 Assumptions

However, if we make different assumptions about what CHP is displacing, we see drastically different net emissions reductions from the existing CHP fleet.

Using potential 2020 emission factor, “snapshot” of net emission reductions:

Nameplate Capacity	Emissions Produced	Emissions Avoided	Net Emissions Reductions	Net Emissions Reductions
MW	Tonne CO2e	Tonne CO2e	Tonne CO2e	MMTCO2e
4,512	18,105,112	17,642,116	(462,995)	(0.46)

Assumptions

GHG Emissions Factor (exports)	377 Kg/MWh
GHG Emissions Factor (on-site)	253 Kg/MWh
Renewable Portfolio Standard	33%
T&D losses avoided (export)	0%
T&D losses avoided (on-site)	7.8%
Avoided Boiler Efficiency	80%
Natural Gas Conversion Factor	0.05307 Tonne CO2e/MMBTU

Assumes no change in electrical efficiency per facility

Emission Reduction Scenarios Under QF/CHP Settlement

How to get emissions reductions from ***existing*** CHP fleet?

Data based on CPUC data request to utilities in 2009 and 2010:

- Look at what is expiring before 2020
- Focus on >20 MW facilities
- *Scenarios are meant to be illustrative of possible outcomes – updated data needed to be accurate for planning purposes – scenarios should not be used outside of the context of this presentation*

CHP Expiring before 2020 (Nameplate MW)			
	<= 20 MW	**> 20 MW**	**Total**
Net reducing	96	2,392	2,488
Net emitting	48	759	807
Total	144	**3,151**	3,295

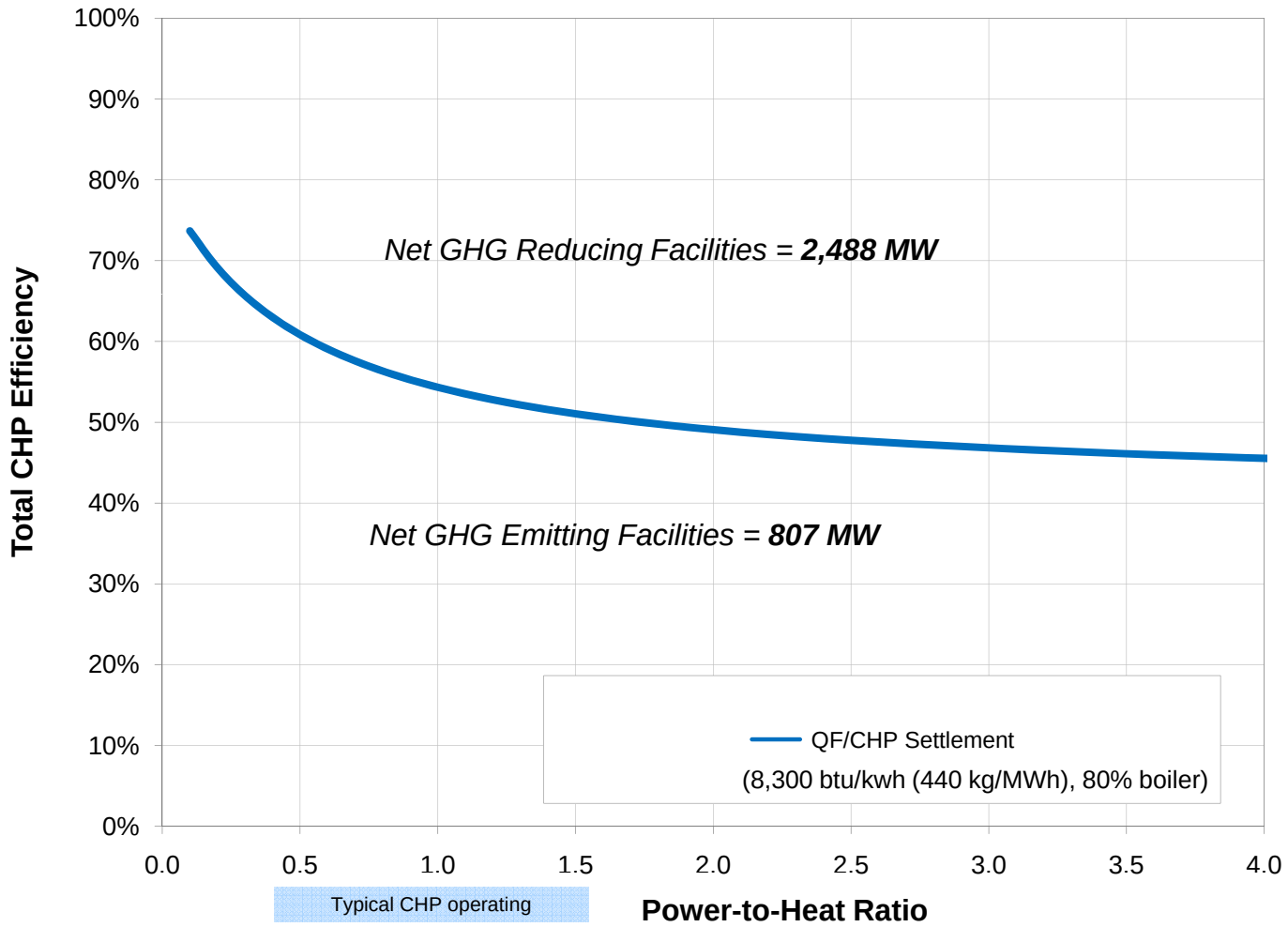
Assumptions

Avoided electrical efficiency	8,300 btu/kWh (440 kg/MWh)
Avoided boiler efficiency	80%

Scenarios:

1. Retire net-emitting facilities above 20 MW (759 MW)
2. Re-contract all net-reducing facilities (2,488 MW)
3. Repower least efficient facilities to at least 62% total efficiency (1,566 MW)

CHP GHG Break-even Curve



Scenario 1: Retire Net-emitting Facilities Greater Than 20 MW

GHG accounting per the QF/CHP Settlement for CHP shut-down:

- Does **not** use the double benchmark
- If no thermal need continues: ***Baseline emissions*** of inefficient facility minus emissions of ***replacement energy*** at a defined heat rate

$$\text{GHG Credit/Debit}_{\text{shutdown}} = E_{\text{baseline}} - E_{\text{replacement power}}$$

Possible Emission Credits for Shut-Down of Inefficient CHP			
	MW (Nameplate)	Tonne CO2e	MMTCO2e
Emissions from net-emitting facilities:	759	2,481,613	2.48
Emissions from replacement energy:	759	1,698,863	1.70
Net emissions credit (or debit):		782,750	0.78

Assumptions

Replacement energy heat rate	7,000 btu/kWh (heat rate will vary by facility)
Natural Gas Conversion Factor	0.05307 Tonne CO2e/MMBTU

Assumes no thermal need continuing

Scenario 2: Re-contract All Net-reducing Facilities

GHG accounting per the QF/CHP Settlement for new PPA with existing CHP:

- Use Settlement defined Double Benchmark (avoided electrical efficiency of 8,300 btu/kWh and 80% efficient boiler)
- Calculated by taking ***avoided emissions from SHP*** minus ***CHP emissions***

$$\text{GHG Credit/Debit} = (AE_{elec}+AE_{heat})-E_{CHP}$$

Nameplate Capacity	Emissions Produced	Emissions Avoided	Net Emissions Reductions	Net Emissions Reductions
MW	Tonne CO2e	Tonne CO2e	Tonne CO2e	MMTCO2e
2,488	11,536,128	13,249,038	1,712,909	1.71

Assumptions

GHG Emissions Factor (exports)	8,300 btu/kwh (440 Kg/MWh)
GHG Emissions Factor (on-site)	8,300 btu/kwh (440 Kg/MWh)
Renewable Portfolio Standard	0%
T&D losses avoided (export)	0%
T&D losses avoided (on-site)	0%
Avoided Boiler Efficiency	80%
Natural Gas Conversion Factor	0.05307 Tonne CO2e/MMBTU

Scenario 3: Repower least efficient facilities

Of the net-reducing 2,488 MW, estimated 1,566 MW operating below 62% TE

GHG accounting per the Settlement for Repowered facilities:

- Uses Settlement defined Double Benchmark (avoided electrical efficiency of 8,300 btu/kWh and 80% efficient boiler)
- Calculated by the avoided emissions of the ***repowered facility*** minus the avoided emissions of the ***facility prior to repower***

$$\text{GHG Credit/Debit}_{\text{repower}} = \text{AE}_{\text{repower}} - \text{AE}_{\text{prior}}$$

Nameplate Capacity	Emissions Avoided (Prior Operations)	Emissions Avoided (Repowered Operations)	Net Emissions Reductions	Net Emissions Reductions
MW	Tonne CO2e	Tonne CO2e	Tonne CO2e	MMTCO2e
1,566	23,979	1,620,762	1,596,783	1.60

Assumptions

Avoided electrical efficiency (on-site and export)	8,300 btu/kWh
Avoided boiler efficiency	80%

This scenario repowers electrical efficiency only and keeps thermal efficiency constant:

Average total efficiency of least efficient facilities	50% (33% electrical and 17% thermal)
Repowered total efficiency	62% (45% electrical and 17% thermal)

Summary of Scenarios

	Existing Capacity	Emission Reductions
Scenario 1:	759 MW (retire)	0.78 MMT
Scenario 2:	2,488 MW (re-contract)	1.71 MMT
Scenario 3:	1,566 MW (repower)	1.60 MMT

Scenarios are illustrative and not representative of all procurement options for existing CHP. More detailed analysis necessary to determine on a project-by-project basis most likely procurement pathway given various program eligibility requirements.

Conclusions

- Potential to achieve significant emission reductions from existing CHP fleet
  - GHG reductions from CHP depends on assumptions about avoided emissions
  - In turn, potential procurement of new generation to help meet GHG targets in part depends on how existing fleet is performing
    - The more GHG reductions we receive from the existing fleet, the more limited the space for new generation to contribute to GHG targets under the QF/CHP Settlement

- QF/CHP Settlement reporting model will be publicly available
  - Model template will be available for public to run both GHG emission reductions and MW procurement scenarios
  - First complete IOU reports due end-March 2012, publicly posted on CPUC website in April, and every six-months there after

Conclusions

- Competitive solicitation under QF/CHP Settlement is one of many CHP procurement programs
  - Less than 20 MW PURPA program (“must take” procurement)
  - CHP feed-in tariff program (AB 1613) (“must take” procurement)
  - “Optional As-Available” program (large facilities making small energy deliveries)
  - “Utility Pre-Scheduled Facilities” (dispatchable CHP)
  - Self Generation Incentive Program (SGIP)

- CHP can have many other benefits besides GHG reductions
  - Grid reliability
  - Relieve grid congestion
  - Onsite energy sources for host facilities

End of Presentation