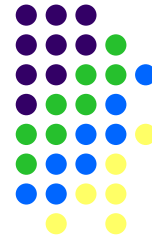


California's Market Price Referent: Setting the Bar for Renewables

Distinguished Energy Lecturer
University of California - Irvine
May 19, 2010

Lori Smith Schell, Ph.D.



Market Price Referent ("MPR"): Tool of RPS Implementation

- Renewables Portfolio Standard ("RPS")
 - Mandated 20% by 2010 (Senate Bill ("SB")107, 9/26/2006)
 - Targeted 33% by 2020 (Executive Order S-14-08, 11/17/2008)
- California Public Utilities Commission ("CPUC") Decisions
 - CPUC D.03-06-071
 - Order Initiating Implementation of the Senate Bill 1078 Renewables Portfolio Standard Program (6/19/2003)
 - Mandated 1% increase per year to reach 20% of retail sales by 2017
 - CPUC D.04-06-015
 - Opinion Adopting Market Price Referent Methodology (6/9/2004)
 - CPUC D.08-10-026
 - Decision on Market Price Referent for the California Renewables Portfolio Standard (10/16/2008)



MPR Proxy Plant: “Average” Means to an End



- **The End:**
 - Establish market price referent (“MPR”) at or below which the cost of long-term contracts with eligible renewable energy resources is deemed reasonable and authorized in utility rates
- **The Means:**
 - Define a new natural gas-fired combined cycle (“NGCC”) generating plant as the MPR “proxy plant”
 - Calculate fixed-price cost of baseload electricity for contract term
- **The Application:** Identify above-market costs of acquiring renewable resources and allocate funds to compensate
 - Compares NPV of contract price and MPR over contract term
 - Limits RPS obligations of retail sellers to quantity that can be procured with available funding
 - Supplemental Energy Payments (“SEPs”) initially awarded by the California Energy Commission (“CEC”) via Public Goods Charge
 - Above-Market Funds (“AMFs”) now awarded by the CPUC

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MPR Cash Flow Model: Major Inputs



- Solves for revenue required to cover all costs + provide required rate of return on equity
- Major Cost Categories
 - Plant (Capital) Costs (\$)
 - Emissions Reduction Credits (“ERCs”)
 - Fixed Costs (\$/kW-yr)
 - Variable Costs (\$/kWh)
 - CEC report for biannual Integrated Energy Policy Report provides Operations & Maintenance (“O&M”) costs
 - “Comparative Costs of California Central Station Electricity Generation”
 - Natural Gas Fuel Costs (\$/MMBtu)
- MPR values updated annually

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MPR Plant (Capital) Costs: Based on Actual Generators



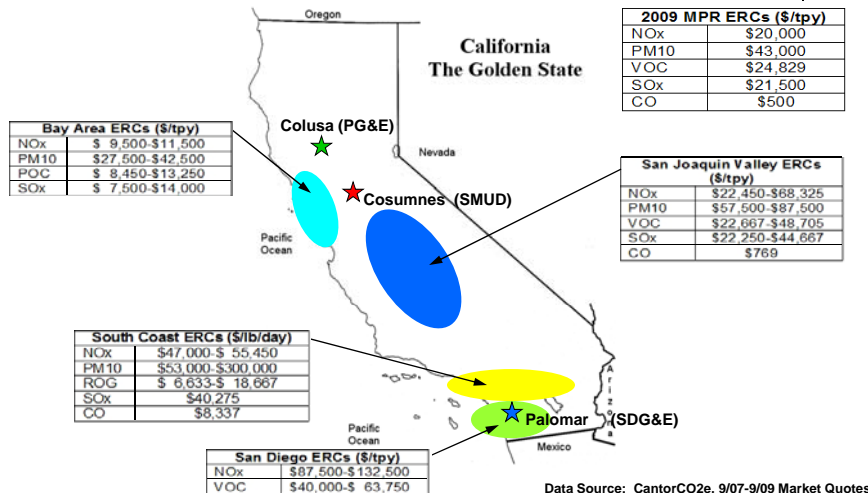
- 3 California NGCC generating plants used as capital cost “go-by” for MPR proxy plant
 - Palomar (SDG&E); as of 2005 MPR
 - 546 MW, San Diego County, Online 4/1/06
 - Cosumnes (SMUD); as of 2005 MPR
 - 500 MW (Phase 1), Sacramento County, Online 2/24/06
 - Colusa (PG&E); as of 2008 MPR
 - 660 MW, Colusa County, Estimated Online 10/1/10
- Dry cooling assumed (~\$20 MM cost)
 - Reduces incremental benefits of any renewables or distributed generation that require any water use

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Environmental Compliance Costs Depend on Geography

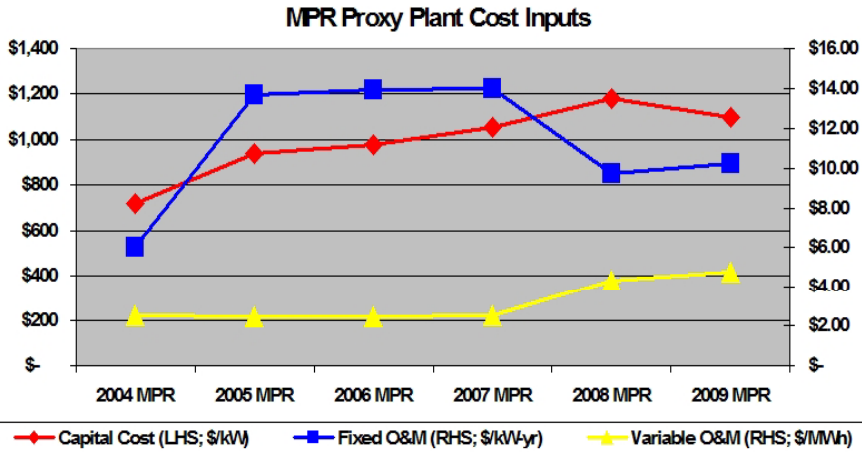


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MPR Proxy Plant: Cost Trends Over Time



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MPR Proxy Plant: Operational Inputs



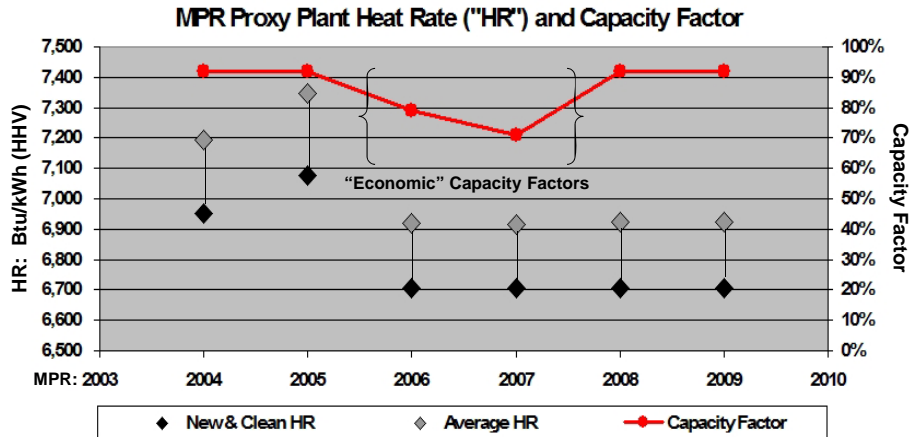
- Capacity and Capacity Factor
- Heat Rate (“HR”)
 - New and Clean (Btu/kWh, HHV)
 - Annual Degradation Factor (Range: 1.69-3.50%)
 - Average (Btu/kWh, HHV)
- Losses
 - Transformer Losses (0.50%)
 - Losses to Load Center (1.50%)
 - Transmission & Distribution system losses
 - Not Location-Specific
 - Optimal location of renewables or distributed generation may **avoid** even greater losses

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Capacity Factor and Heat Rate: Clean & New vs. Average



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MPR Proxy Plant: Natural Gas Fuel Costs



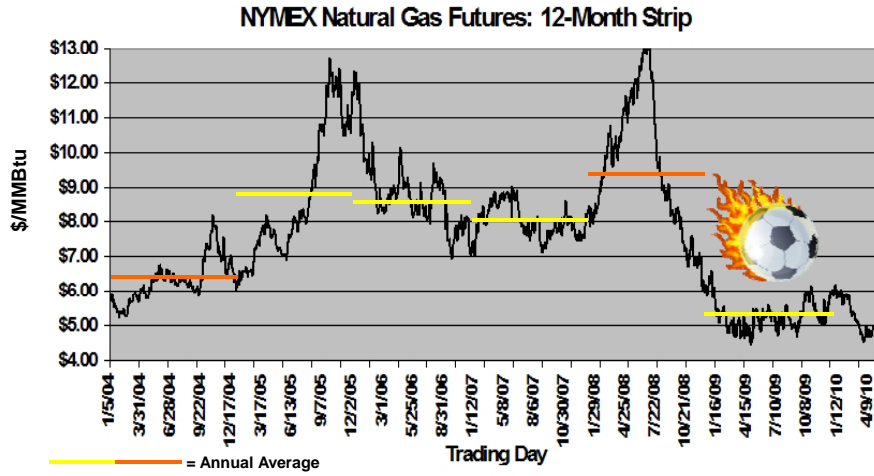
- 20-Year Forecast = Futures + Fundamentals
 - New York Mercantile Exchange ("NYMEX") natural gas futures contract prices to end of trading horizon
 - Current trading horizon = 12 years
 - Since 1990, NYMEX trading horizon has varied from 18 months to 12 years
- Purchased & proprietary longer-term fundamental forecast used beyond NYMEX trading horizon
 - Trend NYMEX pricing to connect to 3 (unidentified) out of 4 longer-term fundamental forecasts
 - Cambridge Energy Research Associates
 - Global Insight
 - PIRA Energy Group
 - Wood Mackenzie Levelized Cost Basis
- MPR Levelized Fuel Cost (2004-2009): \$6.02-\$10.42/MMBtu

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Natural Gas Market Volatility Confounds Forecast Accuracy

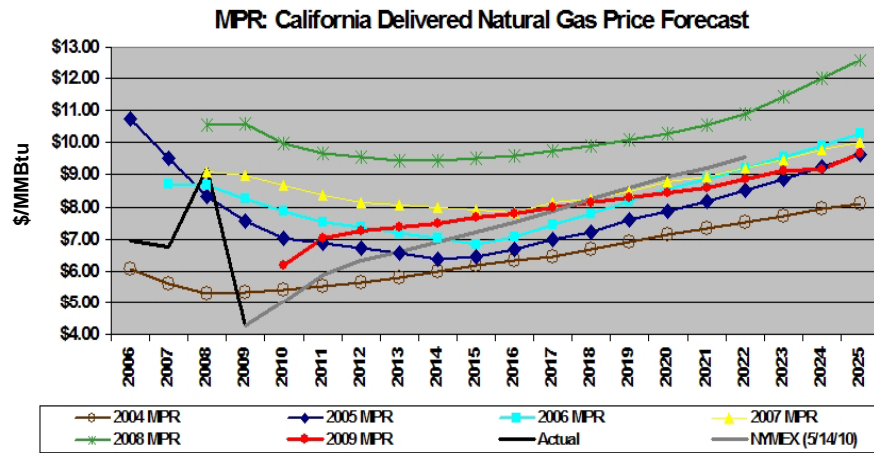


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Embedded Natural Gas Price Depends on Forecast Timing

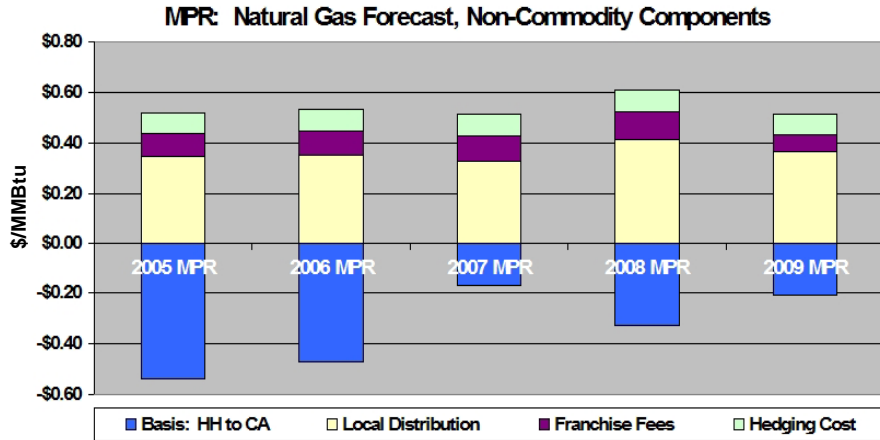


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Non-Commodity Components Also Affect Natural Gas Forecast

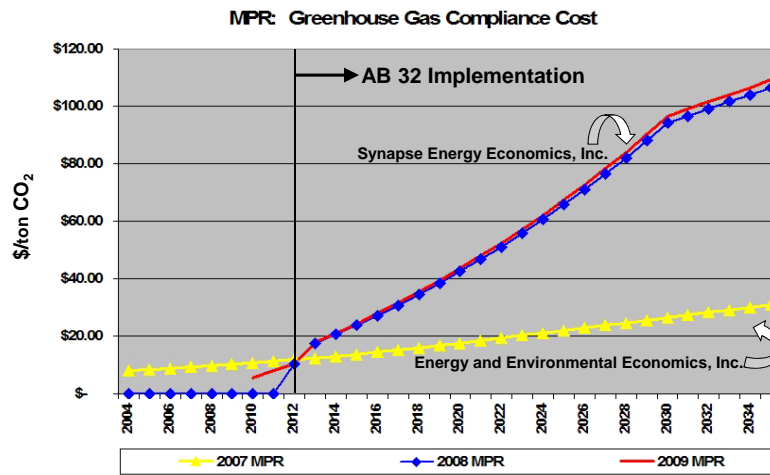


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Greenhouse Gas Compliance: Starts with AB 32* Implementation



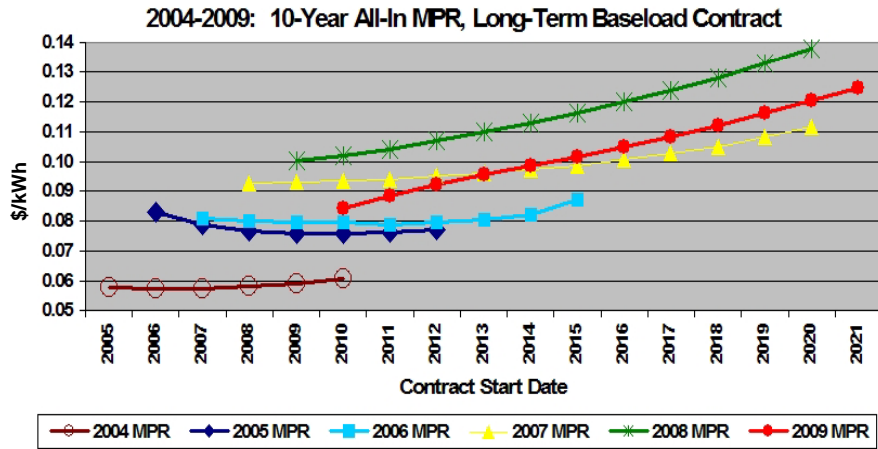
* AB32 = California Global Warming Solutions Act of 2006; to be implemented by the California Air Resources Board ("CARB").

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Adopted MPR Values, 10-Year Baseload Contract

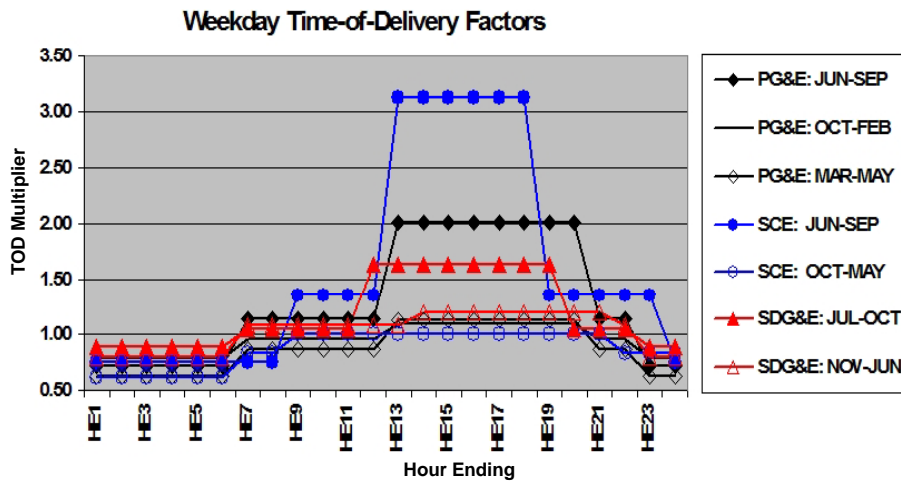


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Time-of-Delivery Adjustment Differentiates Product Value



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Renewable Water & Wastewater Feed-In Tariff (“FIT”)



- AB 1969: Small renewable generator FIT
 - To support renewable deployment on publicly owned water & wastewater treatment facilities
 - Voluntary expansion to other facilities by PG&E and SCE
 - 1.5 MW maximum capacity
 - Base Price = All-In MPR
 - 10-, 15-, or 20-year fixed price
 - Non-negotiable
 - MPR year determined by contract execution date; actual value set by project on-line date
 - Adjusted for Time-of-Delivery (“TOD”)
 - All green attributes transferred to the buyer (i.e., utility)

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FIT Design Changes Provide New MPR Applications



- SB 32: Renewable generator FIT
 - For eligible renewable generation ≤ 3 MW
 - Eases difficulties of bidding into RPS solicitations
 - Base Price = All-In MPR + *Value for Other Attributes*
 - Environmental benefits
 - Includes current and anticipated environmental compliance costs
 - Peak demand & congestion reduction benefits
 - Expedited interconnection if peak demand is offset
 - CPUC may establish additional value if peak demand is offset
 - Avoided transmission & distribution improvements
 - Adjusted for TOD
 - Specific pricing formula not yet determined
 - Separate CPUC proceeding for renewable FIT up to 20 MW

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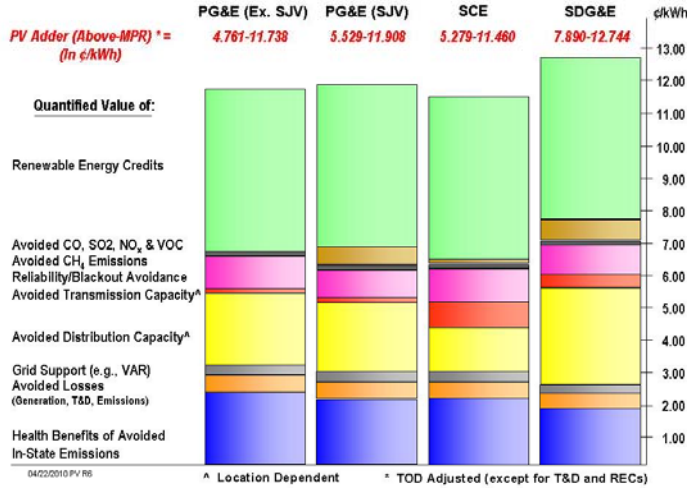
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Rooftop PV: Above-MPR Value Components for SB 32 FIT



Small-Scale Solar PV in California: PV Adder (= Above-MPR Value)



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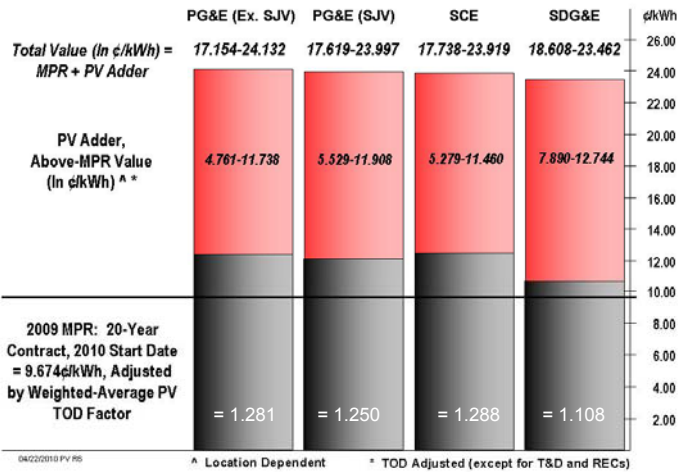
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Rooftop PV: Total Proposed Value Range for SB 32 FIT



Small-Scale Solar PV in California: Total Value (2009 MPR + PV Adder)



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AB 1613: Combined Heat and Power (“CHP”) FIT



- CHP Sized for Thermal Load, Exporting ≤ 20 MW
 - (1) Fixed Component of 2008 MPR (based on 10-year contract) **minus** GHG Compliance Costs
 - GHG Compliance Costs to be Paid by Purchaser
 - (2) Monthly Natural Gas Price Index (@ 6,924 Btu/kWh, 2008 MPR HR) **plus** Cost of Local Distribution
 - Allows for efficient natural gas price hedging
 - Keeps most volatile component of MPR “fresh”
 - (3) 2008 MPR Variable O&M Cost Component
 - Sum of (1)-(3) Multiplied by Applicable TOD Factor
 - 10% Location Bonus Possible
 - CHP in areas with Local Resource Adequacy needs (defined, transmission-constrained local areas)

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CHP FIT: Illustrative Calculation for May 2010 Contract Date



2010 MPR Fixed Component: **\$0.02230/kWh**

+

MAY 2010 NYMEX Settlement: \$4.27/MMBtu

Basis to CA Border: (\$0.22/MMBtu)

Local Distribution: \$0.35/MMBtu

NG Component (\$/MMBtu): \$4.27/MMBtu -

\$0.22/MMBtu + \$0.35/MMBtu = **\$4.40/MMBtu**

NG Component (\$/kWh): \$4.40/MMBtu x 6,924

Btu/kWh x 0.000001 MMBtu/Btu = **\$0.03047/kWh**

+

2010 MPR Variable Component: **\$0.00451/kWh**

Operation Year	Inputs from 2008 MPR	\$/kwh
2009	Fixed component	0.02186
	Variable O&M Adder	0.00443
2010	Fixed component	0.02230
	Variable O&M Adder	0.00451
2011	Fixed component	0.02274
	Variable O&M Adder	0.00459
2012	Fixed component	0.02319
	Variable O&M Adder	0.00466
2013	Fixed component	0.02365
	Variable O&M Adder	0.00474
		0.02367
		0.00483

CHP FIT = \$0.02230/kWh + \$0.03047/kWh + \$0.00451/kWh = \$0.0573/kWh*

* Prior to TOD Factor and Locational Adder

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Conclusions: MPR Provides Critical California Policy Link



- Use of MPR expanding into new applications
 - Water & Wastewater FIT
 - All-In MPR, TOD-Adjusted
 - SB 32 Renewables FIT
 - All-In MPR + Above-MPR Value, TOD-Adjusted
 - CHP FIT
 - Select components of deconstructed MPR
 - Monthly market index & site-specific delivery costs replace embedded MPR natural gas forecast
 - Enables natural gas price hedging and financing
- Leverages existing in-depth MPR review process
 - Increasing transparency over time
- Links related efforts of CPUC, CEC and CARB
 - Benefits California's ongoing RPS & climate change efforts

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Additional MPR Detail (Background Slides)



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I – MPR Proxy Plant: Financial Inputs



- Debt
 - 50-70% of Plant (Capital) Costs
 - 6.5-8.03% Interest Rate
 - 20-Year Term
- Return on Equity (%)
 - 20-Year Target
- Depreciation
- Tax Rates
 - Federal: 35%
 - State: 8.84%
 - Total Effective: 40.75%

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II – MPR Proxy Plant: Plant (Capital) Costs (\$)



- Turbines
- Balance of Plant
- Transmission/Gas/Water Interconnections
- Land
- Permitting/Siting
- Interest During Construction/Financing Cost
- Emissions Reduction Credits (“ERCs”)
- Initial Working Capital
- Initial Spare Parts
- Local Benefit & Mitigation Costs
- Insurance During Construction

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III – MPR Proxy Plant: Fixed Costs (\$/kW-yr)



- Administrative & General
- Labor
- Other O&M
- Station Power
- Transmission O&M
- Capital Additions (Not Major Maintenance)
- Ongoing Spare Parts
- Negative Initial Working Capital

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IV – MPR Proxy Plant: Variable Costs (\$/kWh)



- Major Maintenance
- Water/Consumables/Chemicals
- Source of Fixed and Variable O&M Costs:
 - CEC's Report: "Comparative Costs of California Central Station Electricity Generation"
 - Updated every other year
 - Includes fossil fuel, nuclear and renewable generation
 - Provides input to biannual Integrated Energy Policy Report ("IEPR")

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