The Importance of Being Earnest (or How to Inform the Policy Debate)

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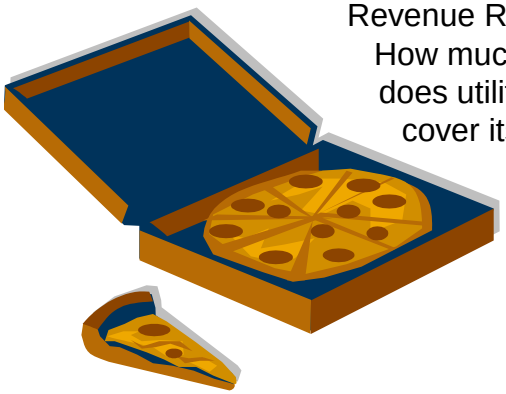
Empowered Energy™

Why Bother Being Part of the Policy Debate?

- If you're not there to represent your interests, who is? Likely, your competition!
  - More opportunities than resources to pursue them
- Policymaking is largely an educational process
  - Myriad of interests seeking influence
  - Workload dictates limited attention span
- Ratepayer interests must be protected
  - "Ratepayer Indifference"
  - Policymaker's equivalent of "Do No Harm"

Ratemaking Fundamentals: You Have to Be at the Table



Revenue Requirement: How much revenue does utility need to cover its costs?

Cost Allocation and Rate Design: Who pays how much?

Making Your "PITCH" Rules to Live By

- Be Prepared:
  - Many Competing Interests
  - Limited Attention Span
- Be Informative:
  - Data ≠ Information
  - Repetition ≠ Persuasion
- Be Transparent: Minimize Head Scratching
- Be Consistent: Stay on Message
- Be Honest: Avoid False Representations

Select Developments in California's Policy Debate

- P: MPR – Natural Gas Combined Cycle Costs
  - Know component costs driving policy decisions
- I: Cost of Generation – Integrating Renewables
  - Extend existing policy making capabilities
- T: CHP FIT – MPR Components + Market Price
  - Eye-catching visual as a leave-behind
- C: SB 32 Renewable FIT – TBD (Above-MPR)
  - Build on something familiar
- H: AB 32 – 2006 Global Warming Solutions Act
  - Not all results will support your position

1. Be Prepared

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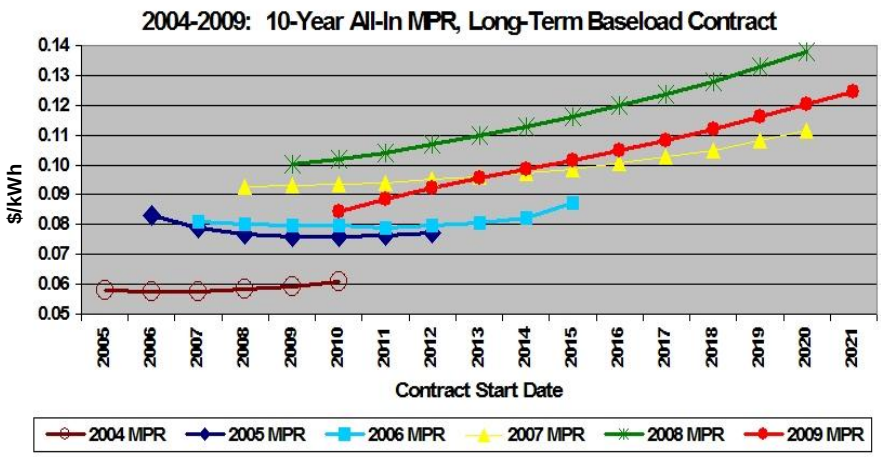
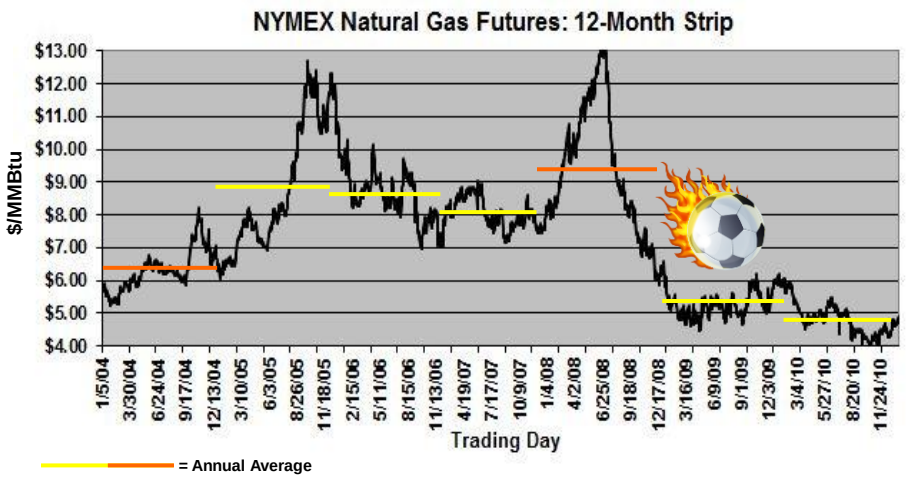
Market Price Referent ("MPR"): Tool of RPS Implementation

- 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)
- Auction held twice per year
  - Significant investment in bid preparation
  - No guarantee of success
    - Limits participation by smaller developers
- MPR sets threshold price for renewable energy contracts
  - All-in costs of representative natural gas combined cycle proxy plant
  - NPV of contract price vs. MPR over contract term
  - Long-term RPS contracts ≤ MPR deemed reasonable
    - Authorized in utility rates
  - RPS obligations limited by available funding for > MPR costs

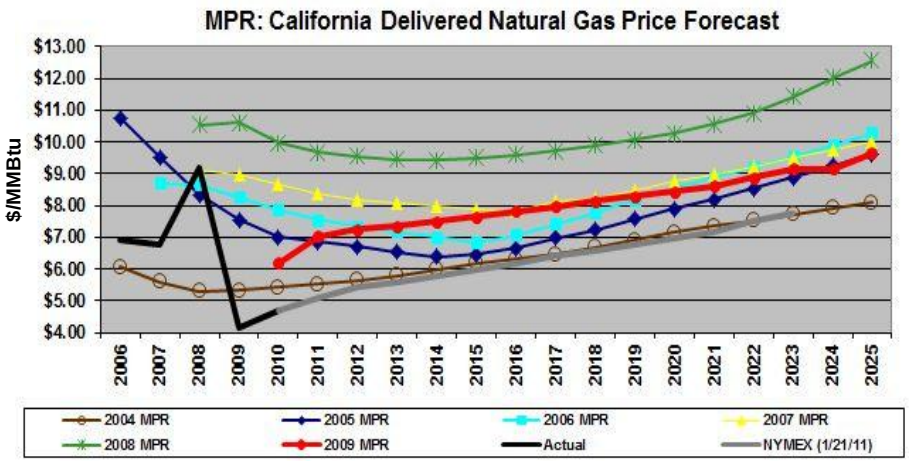
Adopted MPR, 10-Year Baseload Contract



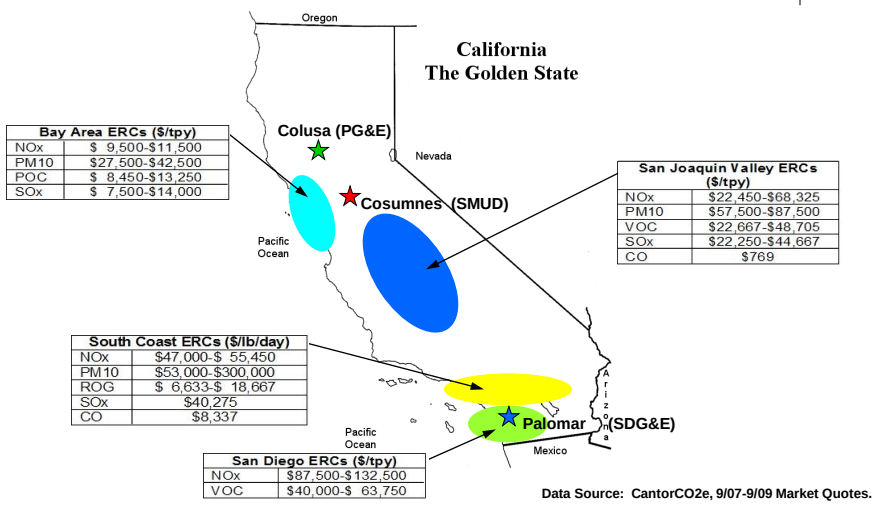
Natural Gas Market Prices Differ Day-to-Day



Embedded Natural Gas Price Depends on Forecast Timing

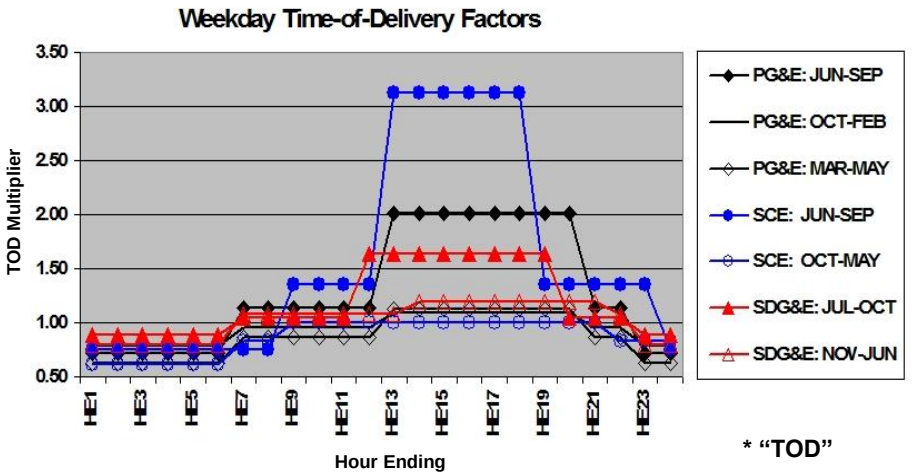


Proxy Plant is "Representative" Actual Costs Differ by Region



Data Source: CantorCO2e, 9/07-9/09 Market Quotes.

Different Products Valued Using Time-of-Delivery* Factors



* "TOD"

2. Be Informative

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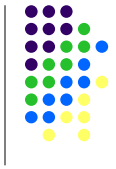

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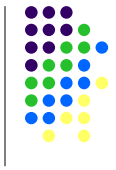
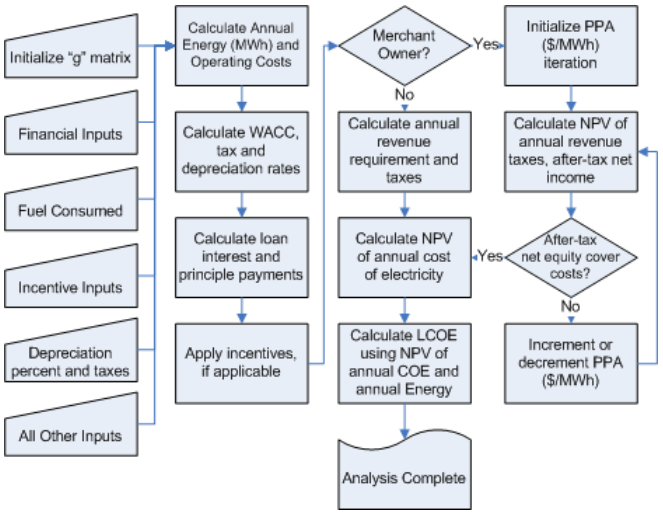
Cost of Generation: Adding Dynamics to a Static Model



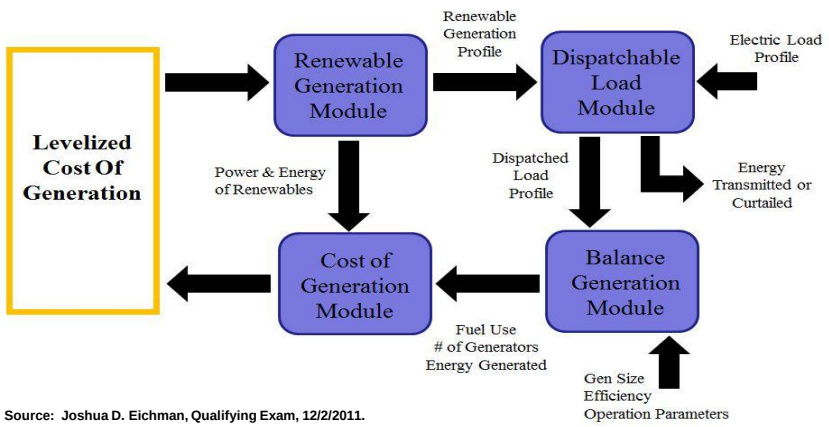
- California Energy Commission ("CEC") Cost of Generation Model
  - Calculates Levelized Cost Of Electricity ("LCOE") for many different generating technologies
- Renewable Energy Secure Communities ("RESCO") project
  - Converts CEC's Excel-based model to MATLAB code
  - Significant analytical enhancements
    - Engineering
    - Economics
  - Designed to assess impacts of integrating renewables

RESCO: Cost Module (One Among Many)



RESCO: Integrated Model (Illustrative)

Modeling Methodology



Source: Joshua D. Eichman, Qualifying Exam, 12/2/2011.

3. Be Transparent

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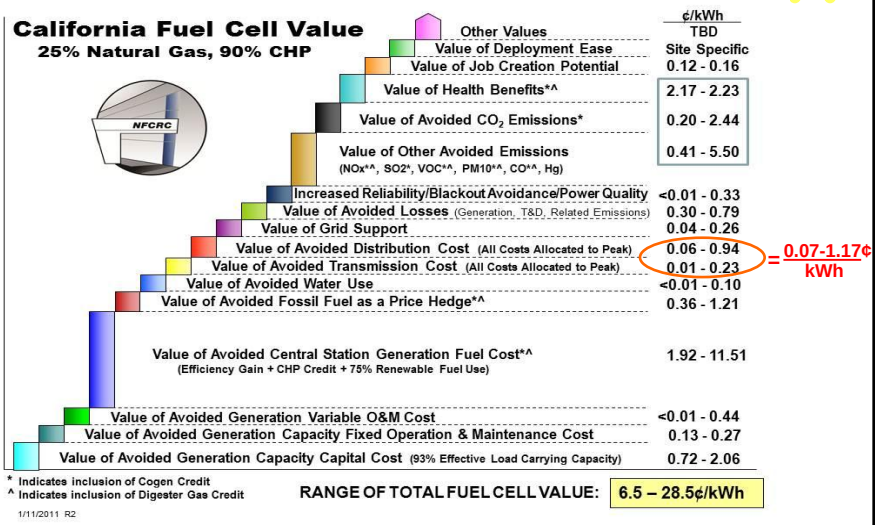
Value Proposition of Fuel Cells Using Digester Gas and CHP



AB 1613: Combined Heat and Power ("CHP") Feed-In Tariff

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

CHP FIT: Illustrative Calculation for JAN 2011 Contract Date

2009 MPR Fixed Component: **$0.02230/kWh**

+

JAN 2011 NYMEX Settlement: $4.216/MMBtu

Basis to CA Border: ($0.22/MMBtu)

Local Distribution: $0.35/MMBtu

NG Component ($/MMBtu): $4.216/MMBtu - $0.22/MMBtu + $0.35/MMBty = **$4.786/MMBtu**

NG Component ($/kWh): $4.786/MMBtu x 6,924 Btu/kWh x 0.000001 MMBtu/Btu = **$0.03314/kWh**

+

2009 MPR Variable Component: **$0.00451/kWh**

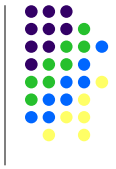
Operation Year	Inputs from 2008 MPR	$/kwh
2009	Fixed component	0.02186
	Variable O&M Adder	0.00443
2010	Fixed component	0.02230
	Variable O&M Adder	0.00451
2011	Fixed component	0.02274
	Variable O&M Adder	0.00459
2012	Fixed component	0.02319
	Variable O&M Adder	0.00466
2013	Fixed component	0.02365
	Variable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

CHP FIT = $0.02230/kWh + $0.03314/kWh + $0.00451/kWh = $0.060/kWh*

*** Prior to TOD Factor and Locational Adder**

4. Be Consistent

Select Developments in California's Policy Debate



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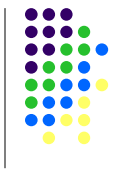
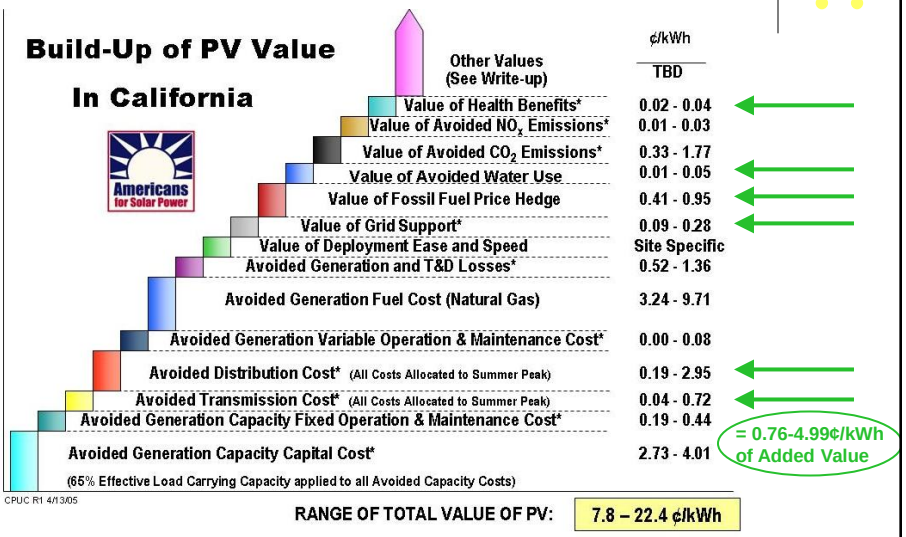
SB 32 Renewable FIT Design: New MPR Applications



- SB 32: Renewable FIT
  - For eligible renewable generation ≤ 3 MW
    - Eases difficulties of bidding into RPS solicitations
  - 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
      - Additional value may be established if peak demand is offset
    - Avoided transmission & distribution improvements
  - Adjusted for TOD
  - Specific pricing formula not yet determined

Solar PV: Value Above MPR for Renewables Feed-In Tariff



5. Be Honest

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AB 32: Putting a Price on Carbon

- Assembly Bill 32 ("AB 32") - California Global Warming Solutions Act of 2006
  - Legislative mandate to reduce greenhouse gas ("GHG") emissions to 1990 levels by 2020
  - Survived 2010 ballot initiative for (in effect) indefinite postponement
  - California Air Resources Board ("CARB") to implement cap-and-trade program on 1/1/2012
- How to measure net GHG reductions?
- How to value cost of net GHG reductions?

A New Interpretation of Cost-Effectiveness

- Lesson learned: *Clarify definitions at the outset!*
- ARB cost-effectiveness focuses specifically on ***program cost*** per unit of avoided emissions
  - Traditional cost-effectiveness = Cost of emissions reduction measure / quantity of avoided emissions
  - Head-to-head technology comparison expanded application of cost-effectiveness concept
  - Allows for relative ***savings*** for avoided emissions

Adding CHP/CCHP Increases Fuel Cell Avoided Emissions and Value

Step 1: Value Incremental CO_2 Emissions at $35/ton of CO_2 ; Apply to Technology Cost Difference

1A. Fuel Cells without CHP/CCHP

Incremental CO2 Market Cost/(Value) ($/MWh)	vs. Simple Turbine ($/MWh)	vs. NGCC ($/MWh)	vs. Microturbine ($/MWh)	vs. Diesel Engine ($/MWh)
PAFC	(0.35)	2.63	10.26	(9.28)
MCFC	(3.33)	(0.35)	7.29	(12.25)
MCFC/T	(9.89)	(6.92)	0.72	(18.82)
PEMFC	(1.55)	1.43	9.06	(10.47)

1B. Fuel Cells with CHP/CCHP

Incremental CO2 Market Cost/(Value) ($/MWh)	vs. Simple Turbine	vs. NGCC	vs. Microturbine	vs. Diesel Engine
PAFC	(8.41)	(5.44)	2.20	(17.34)
MCFC	(8.53)	(5.55)	2.08	(17.45)
MCFC/T	(9.89)	(6.92)	0.72	(18.82)
PEMFC	(1.55)	1.43	9.06	(10.47)

Fuel Cells + CHP/CCHP Competes Head-to-Head with NGCC

Step 2: Calculate Cost-Effectiveness of Fuel Cell Emissions Reductions

2A. Fuel Cells without CHP/CCHP

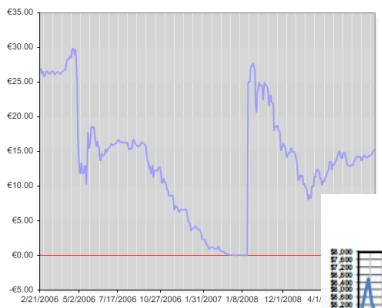
CO/NOx/VOC Cost-Effectiveness (NPV$/ton)	vs. Simple Turbine	vs. NGCC	vs. Microturbine	vs. Diesel Engine
PAFC	(216,327)	380,823	No Emissions Reduction	(25,630)
MCFC	(217,375)	288,793	No Emissions Reduction	(26,104)
MCFC/T	(184,049)	40,518	No Emissions Reduction	(28,292)
PEMFC	(29,933)	97,594	No Emissions Reduction	(19,296)

2B. Fuel Cells with CHP/CCHP

CO/NOx/VOC Cost-Effectiveness (NPV$/ton)	vs. Simple Turbine	vs. NGCC	vs. Microturbine	vs. Diesel Engine
PAFC	(129,769)	(11,030)	No Emissions Reduction	(29,386)
MCFC	(146,249)	10,056	No Emissions Reduction	(28,560)
MCFC/T	(204,509)	6,101	No Emissions Reduction	(29,569)
PEMFC	(72,011)	44,413	No Emissions Reduction	(24,115)

Cap-and-Trade: Regulator Sets Quantity, Market Sets Price

European CO_2 Prices ($/tonne)

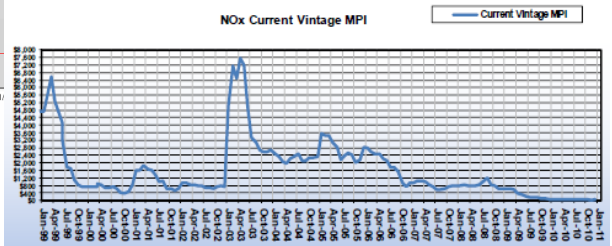


Source: **CantorCO2e website.**

EU ETS – 27 European States

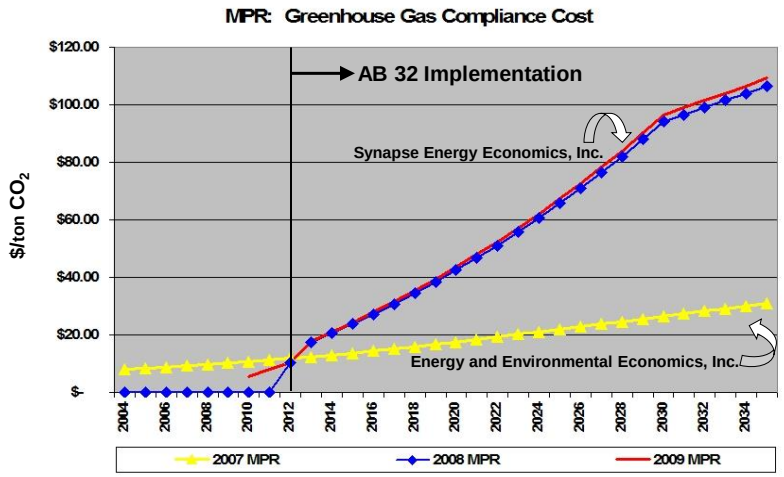
- **Phase I – 2005-2007**
- **Phase II – 2008-2012**
- **Phase III – 2013-2020**

Northeastern U.S. NO_x Prices ($/ton)



Source: **CantorCO2e, "Monthly Market Price Indices," December 2010, p. 3.**

Assumed $35/ton CO2 Price? As Good a Guess as Any!



Participate & Make An Effective P – I – T – C – H

- You can't win if you don't play
- Likelihood of success increases if you are:
  - Prepared
  - Informative
  - Transparent
  - Consistent
  - Honest
- There's strength in numbers
  - Collaborate with like-minded parties

Conclusion: Steps to Inform Policy Debate & Implementation

Identify Technology-Specific Attributes

↓

Quantify Technology-Specific Value Proposition

↓

Rank Power Generation Technologies by Value Proposition and Suitability for Achieving Policy Goals

↓

Contribute to the Efficient Achievement of Policy Goals at Minimum Cost

↓

Enable Evolution of Next Generation Products:
(i) Flexible Fuel Hybrid Distributed Generation
(ii) Natural Gas- & Coal-Fired Hybrid Central Plant Generation.