Peak Energy Rent ('PER') Mechanism: *A Review*

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Background

- In its December 21, 2010 Filing, ISO-NE and NEPOOL proposed a change to the method used to calculate the PER strike price.
- The parties said that "the PER mechanism is complex and other concerns about its design and functioning have been raised which warrant further consideration" and committed to:
  - Begin stakeholder process to review:
    - all inputs and other aspects of the currently effective PER,
    - alternative PER mechanisms and their applicability to the FCM.
  - Submit a filing to the Commission by July 1, 2012 that either
    - sets forth any resulting changes to the PER mechanism or
    - reports on the results of stakeholder process, if there are no changes.
- FERC acknowledged the filing parties' commitment in its Order concerning the December filing.

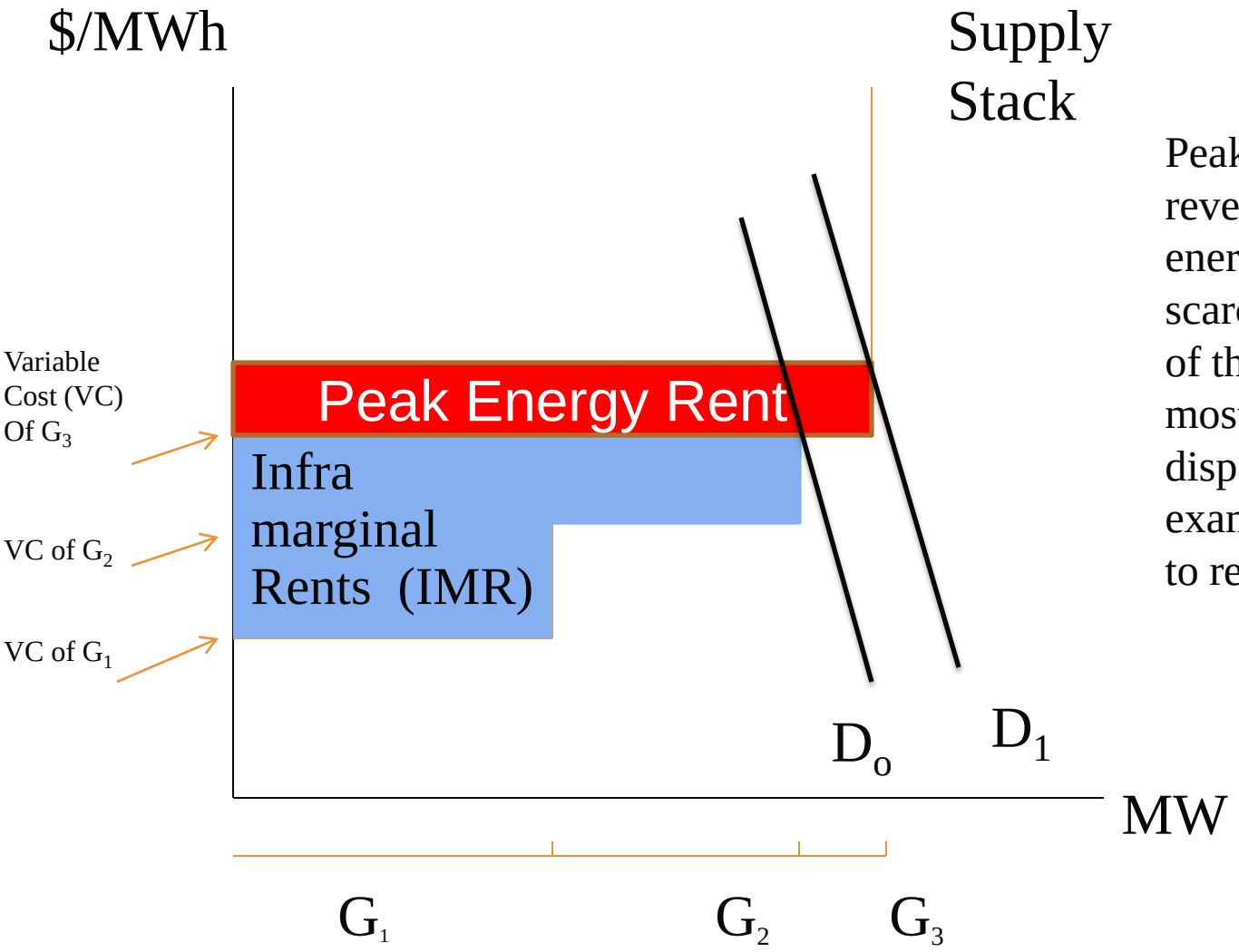
Proposed Schedule

- January: Overview of the PER Adjustment Mechanism
- February: Stakeholder comments/proposals
- March: Responses to stakeholder proposals
- April: ISO presents any recommended rule changes
- May: MC votes on any recommended changes
- June: PC votes on MC recommendations
- July: File with FERC recommended tariff changes, if any or letter describing stakeholder process

Overview of Presentation

- What is a peak energy rent?
- Why pay resources for capacity?
- Design objectives of the FCM
- Fundamental Elements of the FCM
- PER Adjustment and Market Power
- Existing PER Adjustment Mechanism: Details
- Existing PER Adjustment: Observations
- Summary Observations

What is a Peak Energy Rent?



Peak energy rent is the revenue earned in an ideal energy-only market during scarcity conditions in excess of the variable cost of the most expensive unit dispatched (G_3 in this example); it allows that unit to recover its fixed costs

G_1 BASE LOAD
G_2 MID MERIT
G_3 MARGINAL

Why Pay Resources for Capacity?

- Peak energy rents are a volatile source of revenue and insufficient for marginal generators to recover fixed costs given that:
  - Offer cap in place to reduce exercise of market power during scarcity conditions limits peak energy rents
  - Resource adequacy standard requires an excess margin of resources offering into energy markets
- Capacity payments
  - Replace the insufficient revenue, i.e. “missing money”
  - Help stabilize the stream of revenues that generators need to recover fixed costs
  - Help ensure the availability of sufficient capacity to meet the existing resource adequacy standard

Forward Capacity Market ('FCM')

Design Objectives

- Reliability
  - Make sure sufficient capacity is available to meet the generation adequacy standard
- Financial
  - Allow new resources to compete with existing resources to serve load
  - Replace the missing scarcity rents with a smooth revenue stream available to recover fixed costs
  - Reduce incentive for generators to exercise market power in the energy market
  - Protect consumers from high energy prices

Fundamental Elements of the FCM

- FCM establishes a price that the ISO will pay to acquire a reliability option that is both physical and financial.
  - Physical: gives ISO the right to call on a generator to supply their capacity supply obligation (CSO) at the market clearing LMP (when market clearing LMP > or equal to generator's offer price)
  - Financial: gives ISO the right to collect the (positive) difference between the market clearing LMP and a pre-defined strike price.
    - Also called the Peak Energy Rent (PER) Adjustment
- PER Adjustment is an integral part of the reliability option that the ISO purchases from generators

Peak Energy Rent (PER) Adjustment
Basic Principles

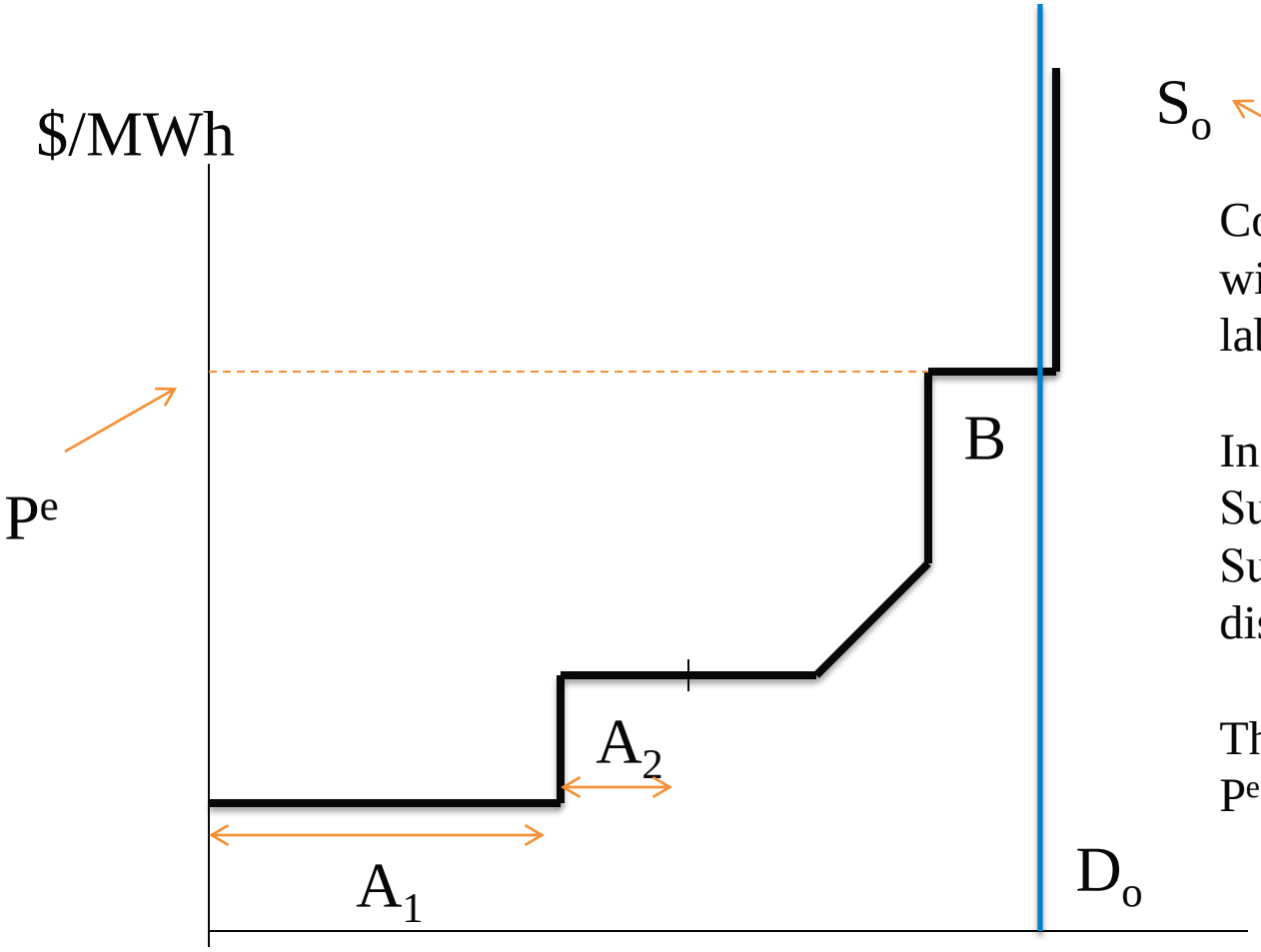
- When the hourly energy price exceeds the strike price, the capacity payment is reduced by the PER Adjustment:
  - PER Adjustment = (LMP – Strike Price) * CSO
  - Example: if LMP is $600 per MWh and Strike Price is $525 , then a supplier with a capacity supply obligation (CSO)of 100 MW would have its capacity payment reduced by ($600-$525)*100 or $7500 in that hour. If the LMP falls to $500 in the next hour, PER adjustment would be zero for that hour.
- The Strike Price (S) is set daily at a level based on the variable cost of a deemed “proxy unit” that would be dispatched as the system enters a scarcity condition.

PER Adjustment and Market Power

PER Adjustment: *Primary Rationale*

- Main rationale for PER Adjustment is to curb suppliers' incentive to exercise market power in the energy market.
  - Market Power (MP) is the ability to profitably alter prices away from competitive levels.
  - Market power in the energy market is exercised by withholding generation and/or offering generation at a high price (>VC).
  - Exercise of market power can cause an unnecessary dispatch of more expensive resources (inefficiency) and a price increase that transfers wealth from consumers to suppliers.
  - Example: Assume Supplier A owns two relatively inexpensive generating units and Supplier B owns an expensive unit.

Competitive Market Outcome

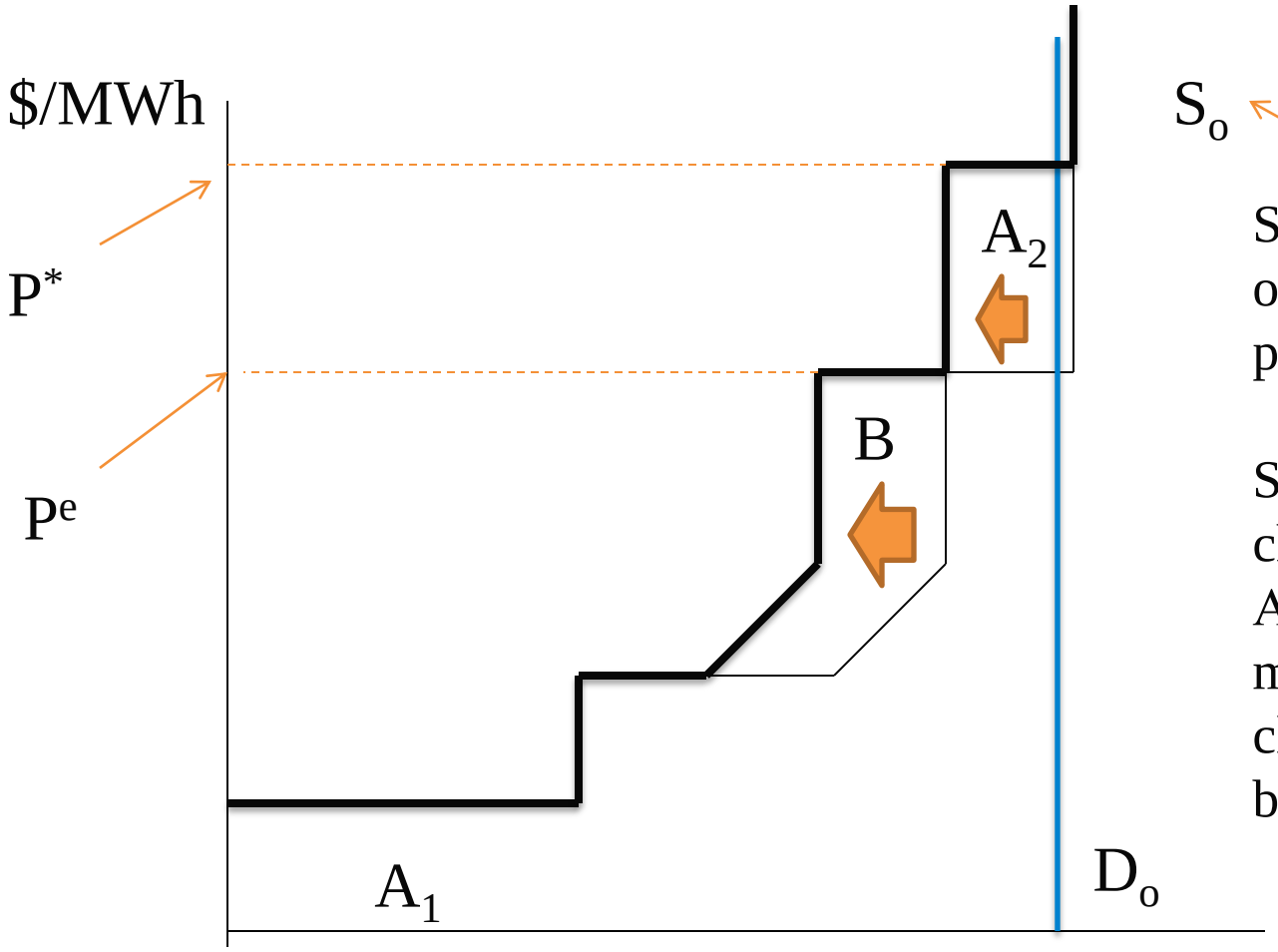


Competitive Supply Curve S_o with two of many suppliers labeled separately as A and B

In this competitive market, Supplier A's units and Supplier B's unit would be dispatched.

The market clearing price is P^e

Market Outcome w/ exercise of Market Power



Suppose that Supplier A offers its Unit 2 at high price (>MC)

Supply Stack would change so that Supplier A's 2nd unit now sets the market clearing market clearing price at P* and boosts profit

PER Adjustment: *Primary Rationale (continued)*

- PER Adjustment reduces the potential gain from this type of strategic bidding behavior
  - With the PER Adjustment, any generator with a CSO must remit (LMP-S)* CSO when LMP>S
  - This reduces the incremental profit that a supplier expects to earn from withholding output or bidding high (above S) in attempt to drive LMP above competitive levels.

PER Adjustment: *Primary Rationale (continued)*

A Numerical Example

Supplier	MC ($/MWh)	CSO (MW)	Profit w/ Comp	Profit w/ MP	Variable Profit Net of PER Adjustment		
			P^e =$120	P*= $300		P*=$300	
					S= $120	S=$180	S=$300
A Unit 1	$ 50	300	$ 21,000	$ 75,000	$ 21,000	$ 39,000	$ 75,000
A Unit 2	$ 60	100	$ 6,000	$ 24,000	$ 6,000	$ 12,000	$ 24,000
A			**$ 27,000**	$ 99,000	**$ 27,000**	$ 51,000	$ 99,000
B	$ 120	100	$ -	$ 18,000	$ -	$ 6,000	$ 18,000

PER Adjustment Eliminates Incentive to Exercise Market Power

PER Adjustment: *Primary Rationale (continued)*

- Better than a bid cap at deterring market power because it applies to the entire CSO even when the generator is not running.
  - Supplier has much less of an incentive to extend a unit maintenance outage or fake a forced outage to raise or maintain LMP > S
    - Difficult to determine that a maintenance outage has been extended beyond a reasonable period
  - Physical withholding is equivalent to a supplier offering to supply power at an infinite price (> bid cap)

PER Adjustment *Primary Rationale (continued)*

- Creates a strong incentive for generators to produce more during system operating deficiencies
  - Without the PER adjustment, suppliers may find it in their economic interest to not bring additional capacity on line immediately when a large unit trips offline and the LMP spikes. (depends on the infra marginal units that it owns)
  - With the PER Adjustment, once the LMP >S, every additional dollar the energy price rises will lower a generator's profit unless it responds by making additional supplies available.
- Attenuates suppliers' incentive to overstate available capacity since the deduction is tied to the entire CSO

Existing PER Adjustment:

Details & Observations

Existing PER Adjustment Mechanism:
Details

- Hourly PER = (RTLMP-S)* Scale Factor*Availability Factor
  - RTLMP: for each Load Zone associated with particular capacity zone
  - S: variable cost of marginal generating proxy unit (22,000 BTU/kWh) * daily cost of gas or oil whichever is *higher*
  - Scale factor: creates lower weighting for hours when load is low relative to forecasted peak
    - Calculated as the actual hourly integrated load divided by the summer 50/50 predicted peak forecast
  - Availability Factor: marginal proxy unit = 0.95
- Monthly PER = Sum of Hourly PER values for the month.
- Average monthly PER = 12 month moving average of Monthly PER values prior to the obligation month.

Existing PER Adjustment Mechanism
Details (continued)

- PER Adjustment = Average Monthly PER * PER CSO
  - PER CSO = minimum [CSO, (CSO – Self Supply Obligation)]
  - Monthly PER Adjustment is capped at the FCA Payment adjusted to account for obligations acquired or shed for the same commitment period after the FCA
  - PER CAP = FCA Payment + [(ARA CSO+MRA CSO+IBTCSO) *FCA Clearing Price*)]
    - FCA payment is payment received for activity in the Forward Capacity Auction
    - [ARA CSO +MRA CSO +IBT CSO] are obligations acquired or shed
    - FCA clearing price * is adjusted for price collar (This price is used as a proxy price to prevent opportunities to manipulate the PER CAP such as could be done with a bilateral at zero contract price)
    - ARA is annual reconfiguration auction, MRA is the monthly reconfiguration auction and IBT is internal bilateral transactions

Existing PER Adjustment Mechanism:
Observation # 1

- Reduces the incentive for suppliers to exercise market power in the ***real time*** energy market.
  - Important because the risk of suppliers exercising market power is greatest in the real time energy market
  - Virtual trading and priced demand bids significantly reduce the ability of suppliers to exercise market power in the day ahead energy market.

Existing PER Adjustment Mechanism:
Observation #2

- Does not distort DA/RT energy market bidding strategies
  - PER Adjustment is based on the supplier's CSO and not on the megawatts that a supplier clears in real time.
  - A competitive supplier cannot change the PER Adjustment by bidding more or less in the DA or RT energy market
  - Key Point: Existing PER Adjustment has no impact on the profitability of clearing DA versus RT.

Existing PER Adjustment Mechanism:
Observation #2

- Example : Assume
  - Supplier has one unit with MC = $50/MWh and CSO= 300 MW
  - PER Strike price is $120/MWh
  - DALMP =$100
  - RTLMP =$150
    - Case 1 : Clears DA w/ PER Adjustment
    - Case 2 : Clears RT w/ PER Adjustment
    - Case 3 : Clears DA w/ No PER Adjustment
    - Case 4 : Clears RT w/ No PER Adjustment
  - Table on slide 24 shows calculation of total variable profit for each case
  - Table on slide 25 shows that the relative profit of clearing DA or RT is not impacted by the existing PER Adjustment

Existing PER Adjustment Mechanism:
Observation #2 (continued)

	MW	Revenues	VC	PER ADJ	Total
Case 1: Clears DA w/ PER Adjustment					
DA	300	$ 30,000		$ (9,000)	$ 21,000
RT	300		$ (15,000)		$ (15,000)
RT-DA	0	$ -			
Variable Profit					**$ 6,000**
Case 2: Clears RT w/ PER Adjustment					
DA	0	$ -			$ -
RT	300		$ (15,000)	$ (9,000)	$ (24,000)
RT-DA	300	$ 45,000			$ 45,000
Variable Profit					**$ 21,000**
Case 3: Clears DA w/ no PER Adjustment					
DA	300	$ 30,000			$ 30,000
RT	300		$ (15,000)		$ (15,000)
RT-DA	0	$ -			
Variable Profit				$ -	**$ 15,000**
Case 4: Clears RT w/ no PER Adjustment					
DA	0	$ -			$ -
RT	300		$ (15,000)		$ (15,000)
RT-DA	300	$ 45,000			$ 45,000
Variable Profit				$ -	**$ 30,000**

Existing PER Adjustment Mechanism:
Observation #2 (continued)

Summary of Total Variable Profit		
	PER Adj.	No PER Adj
Clears DA	$ 6,000	$ 15,000
Clears RT	$ 21,000	$ 30,000
Difference	**$ 15,000**	**$ 15,000**

Existing PER Adjustment Does Not Change the Profitability of Clearing in DA versus Clearing in Real Time

Existing PER Adjustment:
Observation #3

- Adds an extra step and risk to FCM bidding
  - Suppliers recover their going forward fixed costs (FC) through : Infra marginal Energy Rents (IMR) + Peak Energy Rents (PER) + Capacity Payments (CP)
  - Without a PER Adjustment,
    - Suppliers Minimum FCM Offer = FC – E(IMR) –E(PER) +RP
      - E() indicates expectation
      - RP: risk premium associated with forecasting E(IMR) and E(PER)
      - Minimum FCM Offer is " the missing money" needed to recover going forward fixed costs
      - Peaking units don't expect to receive any IMR so their
        - Minimum FCM Offer = FC – E(PER) + RP

Existing PER Adjustment:
Observation #3

- Example:
  - Assume that the fixed cost (FC) of peaking unit is $8 /kW-m and the expected PER is $2/ kW-m
    - With no PER Adjustment, the unit's FCM offer = $8 - $2 + $1 (RP) =$7
- FCM bidding would be simpler if the PER Adjustment deducted the actual peak energy rents earned during the commitment period.
  - Suppliers would not have to forecast peak energy rents and could simply bid their fixed costs
    - FCM Offer for peaking unit in example above would be FC=$8

Existing PER Adjustment:
Observation #3 (continued)

- But the existing PER Adjustment does not net off the peak energy rents that generators ***actually*** earn during the commitment period.
- Instead, the existing PER Adjustment nets off ***a portion*** of the peak energy rents that generators would ***hypothetically*** earn if their entire PER CSO cleared in the real time energy market
- So, suppliers also need to add raise their FCM offers (i.e. delist bid) to account for the expected value of the existing PER Adjustment
  - Minimum FCM Offer = FC – E(PER) + E(PER ADJ) + RP
- Even suppliers who expect to clear their entire CSO in the real time market must markup their FCM bids to account for the expected PER Adjustment because the PER Adjustment will differ from expected real time peak energy rents by the scale factor which varies hourly

Minimum FCM Offer Strategies for Peaker

	Single Settlement		Multi -Settlement	
		Clears DA Only	Clears DA and RT	Clears RT Only
No PER Adjustment	FC- E(PER)	FC –E(DA PER)	FC-E(DA PER) –E(RT PER)	FC-E(RT PER)
Existing PER Adjustment	FC -E(PER)+ E(PER ADJ)	FC- E(DA PER) + E(PER ADJ)	FC- E(DA PER)-E(RT PER)+ E(PER ADJ)	FC –E(RT PER) + E(PER ADJ)

Notes:
E(PER) = expected peak energy rents to be earned in single settlement market
E(DAPER)=expected DA peak energy rents to be earned
E(RTPER)= expected RT peak energy rents to be earned
E(RT PER ADJ) = expected PER Adjustment based on existing rules
FC = Going Forward Fixed Generation Costs including ROE

Table omits the market risk premium that would need to be included anytime a bid involves an expectation of future revenue

Existing PER Adjustment:
Observation #3 (continued)

- Key Points:
  - The existing PER Adjustment has the same effect on the minimum FCM bid regardless of whether a supplier expects to clear in the DA or RT energy market
  - If the PER Adjustment were eliminated, FCM bids would be reduced by the expected PER Adjustment

Existing PER Adjustment:
Observation # 3 (continued)

- Estimating the value of expected PER Adjustment
  - Suppliers can use the same forecast of hourly real time peak energy rents (RTLMP-S) required to forecast the peak energy revenue required to construct their FCM bid. (Slide 29)
  - No need to consider DA/RT bidding strategy since the PER Adjustment depends only on the supplier's CSO–not on the megawatts they expect to actually clear in real time market.
  - Practical complication is the scale factor which varies hourly.

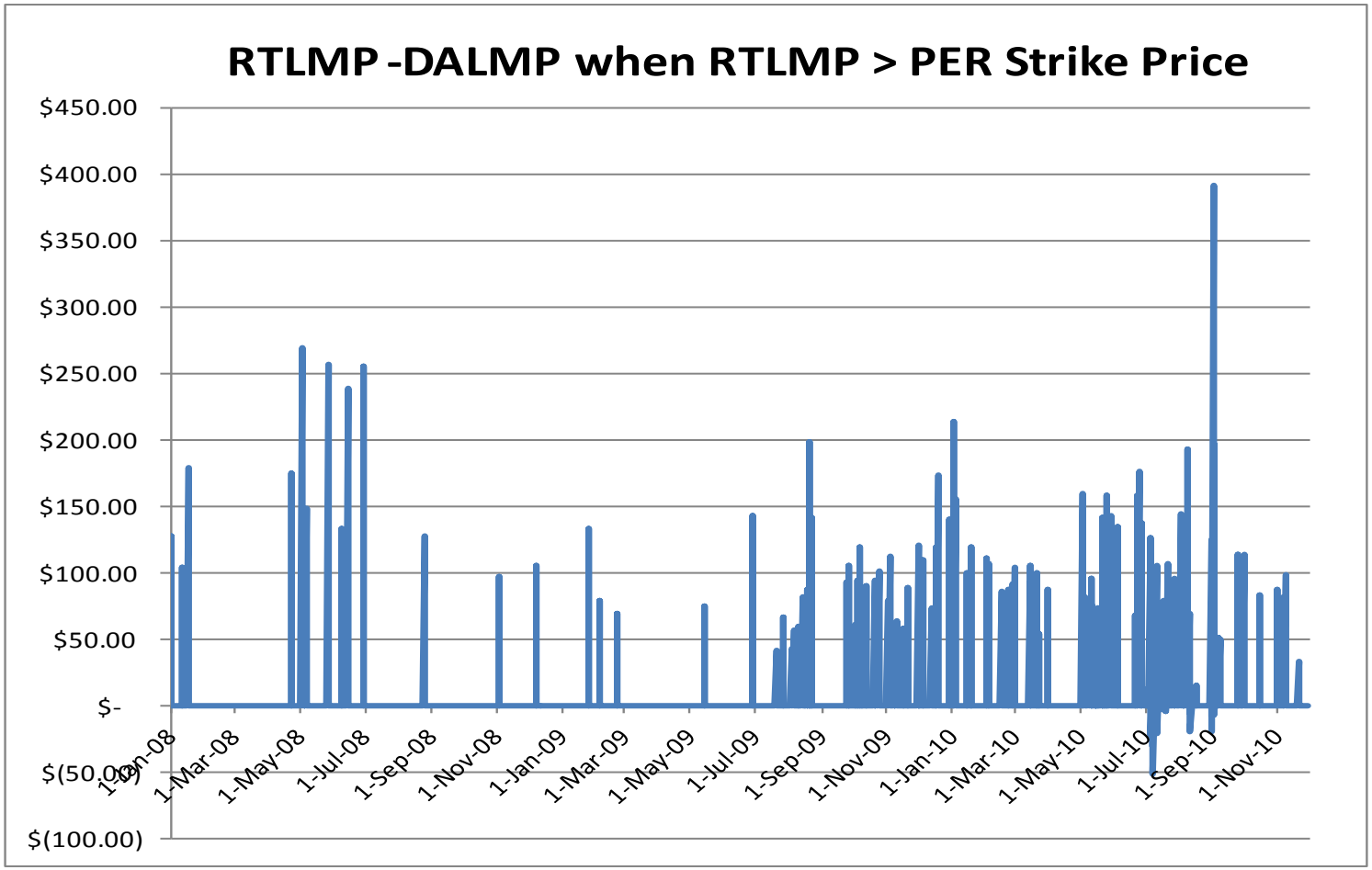
Existing PER Adjustment:
Observations # 3 (continued)

- When the FCM rules change to conform with the proposed energy market rules that comply with FERC Order 745. demand response providers who participate in the FCM market be subject to the PER adjustment and will, therefore, need to factor the value of the PER Adjustment into their FCM bids just like generators

Existing PER Adjustment:
Observation #4

- Partially protects consumers from high energy prices
  - Consumers are not credited for DA peak energy rents (DALMP-S) even though 93% of energy settles at the day DA price
  - But PER Adjustment based on RTLMP applies to entire CSO not just real time deviations
  - This would be a wash if DALMP~RTLMP when RTLMP >S
  - But RTLMP is generally > DALMP when RTLMP >S
    - 319 hours Jan 2008-to-Nov 2010 when RTLMP > S
    - RTLMP > DALMP in 293 of those hours w/ avg. diff.=+$81
    - RTLMP < DALMP in 26 of those hours w/ avg. diff.= -$16

Real Time and Day Ahead Price Differentials



Existing PER Adjustment:

Observation #4 (continued)

- Consumers were credited for ~$224 million through existing PER Adjustment between June 2010 and October 2011

- Compares to $54 million in revenue paid to generators in the form of DA and RT peak energy rents over the same period
  - DA peak energy rent revenue is DA energy market revenue paid to generators when (DALMP-S) >0
  - RT peak energy rent revenue is RT energy market revenue paid to generators when (RTLMP-S) >0

- PER Adjustment credit more than offset DA and RT peak energy revenues for 94% of capacity resources.
  - On Average (Total Peak Energy Rents -PER Adjustment)/ CSO = - $0.27/kW-mo

Existing PER Adjustment:

Observation #4 (continued)

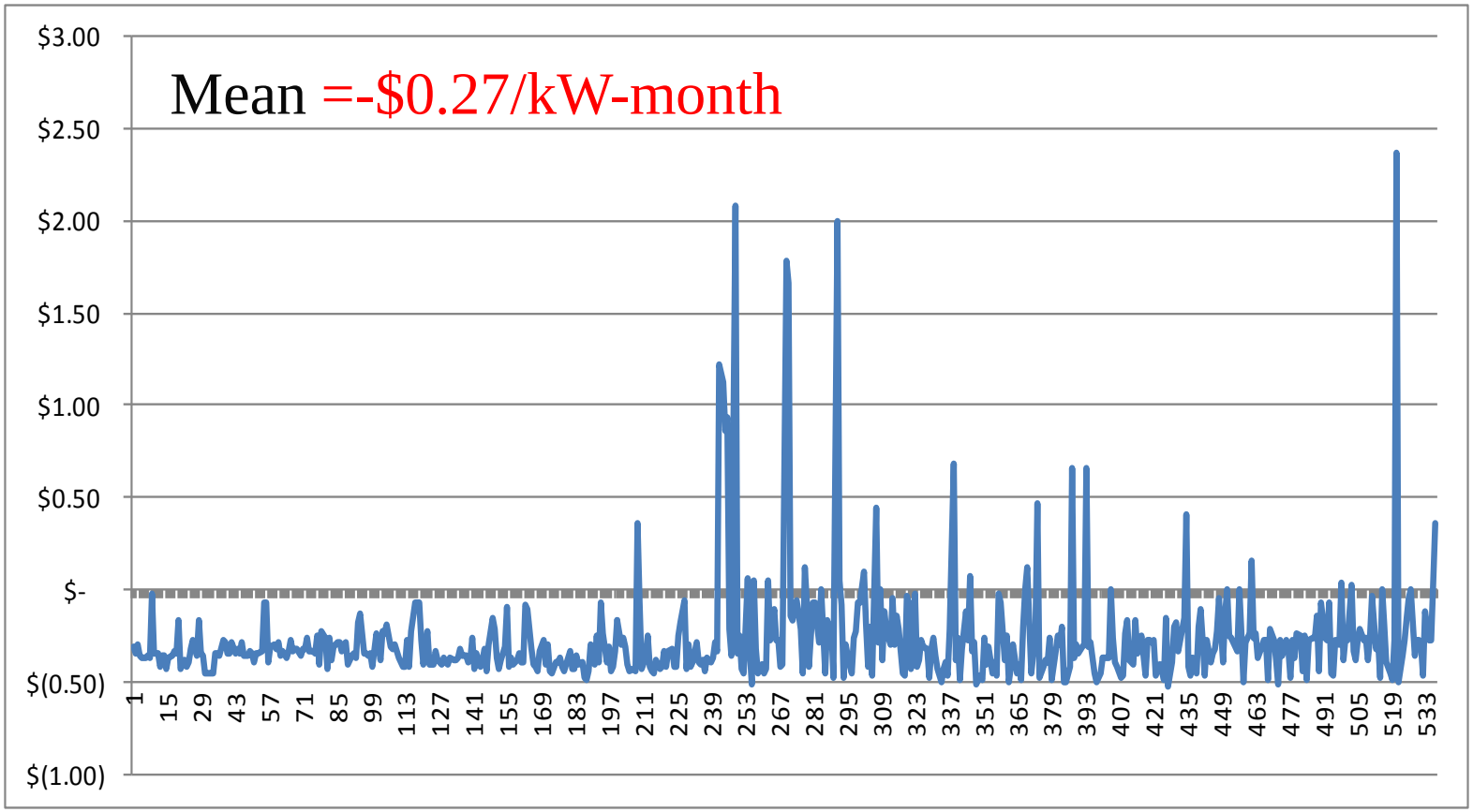
- Does not mean that consumers were overcompensated.
  - FCM bids should have been higher than otherwise to allow for the expected PER Adjustment (see slide 29)
  - Capacity prices have been administratively supported above expected market clearing levels for several years
  - Consumers paid ~$2.5 billion for capacity during this period

Peak Energy Rents Paid by Load vs. PER Adjustment

Month	DA PER Revenues	RT PER Revenues	Total PER Revenues	PER Adjustment Revenues based on Monthly PER	Actual PER Adjustment Revenues
6/1/2010	$ 32,012	$ 1,561,561	$ 1,593,573	$ (22,058,281)	$ (8,326,062)
7/1/2010	$ 26,198,529	$ 3,459,162	$ 29,657,691	$ (49,738,115)	$ (9,988,156)
8/1/2010	$ 9,627,327	$ 4,573,161	$ 14,200,488	$ (59,827,812)	$ (14,080,541)
9/1/2010	$ 6,224,116	$ 2,335,074	$ 8,559,190	$ (30,608,037)	$ (16,534,711)
10/1/2010	$ 275	$ 42,440	$ 42,715	$ (555,109)	$ (18,990,556)
11/1/2010	$ 188	$ 160,509	$ 160,698	$ (2,479,634)	$ (18,174,258)
12/1/2010	$ -	$ -	$ -	$ -	$ (17,983,458)
1/1/2011	$ -	$ -	$ -	$ -	$ (17,598,259)
2/1/2011	$ -	$ -	$ -	$ -	$ (17,145,556)
3/1/2011	$ -	$ -	$ -	$ -	$ (16,672,092)
4/1/2011	$ -	$ -	$ -	$ -	$ (16,279,557)
5/1/2011	$ -	$ -	$ -	$ -	$ (16,305,785)
6/1/2011	$ -	$ -	$ -	$ -	$ (13,593,824)
7/1/2011	$ -	$ 155	$ 155	$ -	$ (11,769,796)
8/1/2011	$ -	$ (19,650)	$ (19,650)	$ -	$ (7,685,142)
9/1/2011	$ -	$ (64,554)	$ (64,554)	$ -	$ (2,776,200)
10/1/2011	$ -	$ -	$ -	$ -	$ (266,049)
	$ 42,082,446	$ 12,047,859	**$ 54,130,306**	$ (165,266,988)	**$ (224,170,001)**
Since 12/1/10	0	$ (84,049)	$ (84,049)	$ -	$ (138,075,718)

Total PER Revenues net of PER Adjustment /Avg. CSO

(ranked from high to low average CSO)



High Average CSO

Low Average CSO

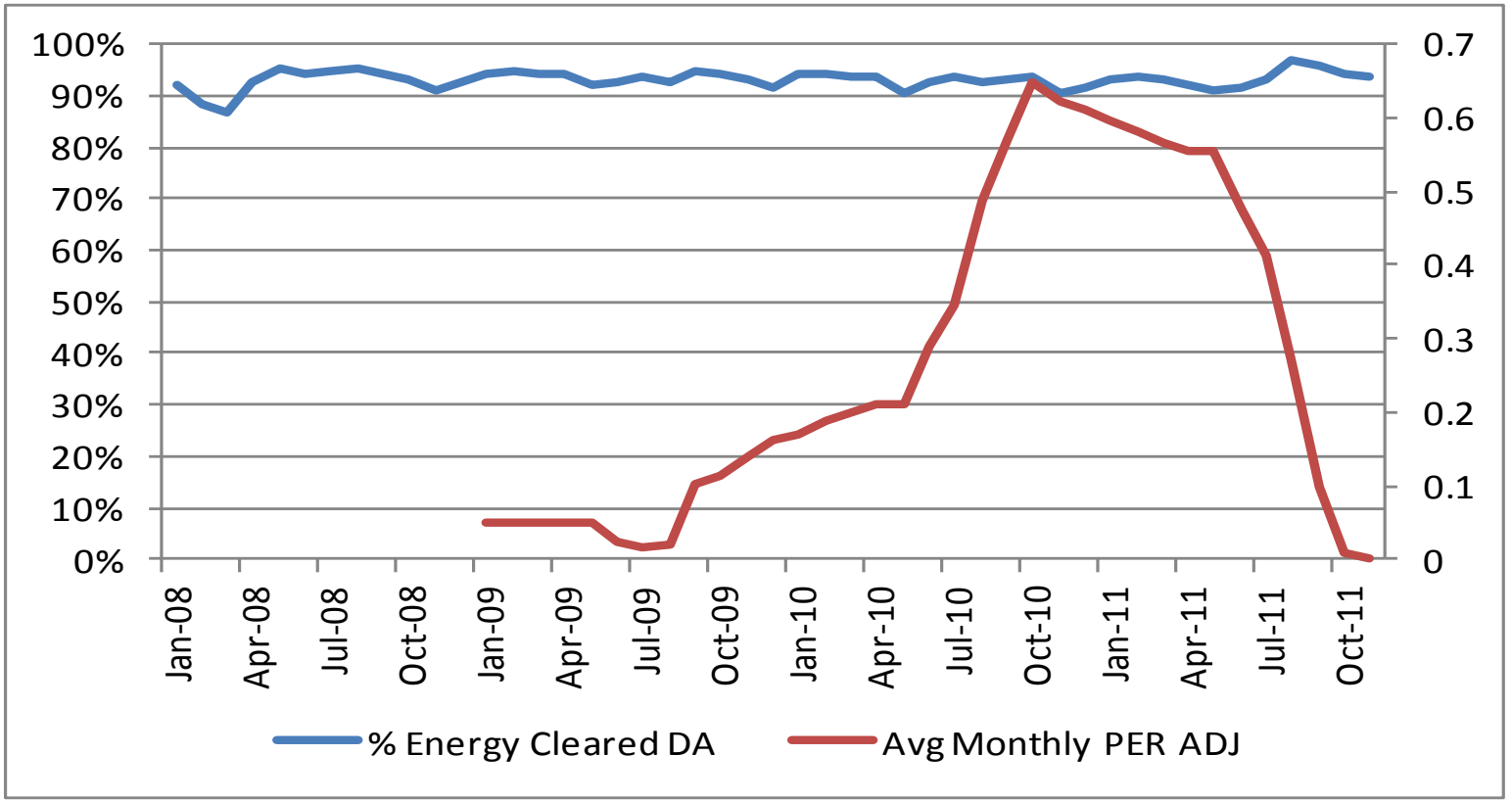
Existing PER Adjustment:
Observation #5

- Some argue that the imbalance between the PER Adjustment credit and the peak energy rents paid by consumers reduces the incentive for consumers to avoid real time price spikes by bidding DA and creates an incentive for consumers to engineer RT price spikes.
  - However, a combination of virtual trading in the DA market and the risk associated with buying power at volatile real time prices to serve standard offer customers appears to mitigate this incentive.
    - Percent of load cleared DA has been relatively stable over time despite the changes in the size of PER Adjustment.

Proportion of Energy Cleared Day Ahead vs. Average Monthly PER Adjustment

DA%Total

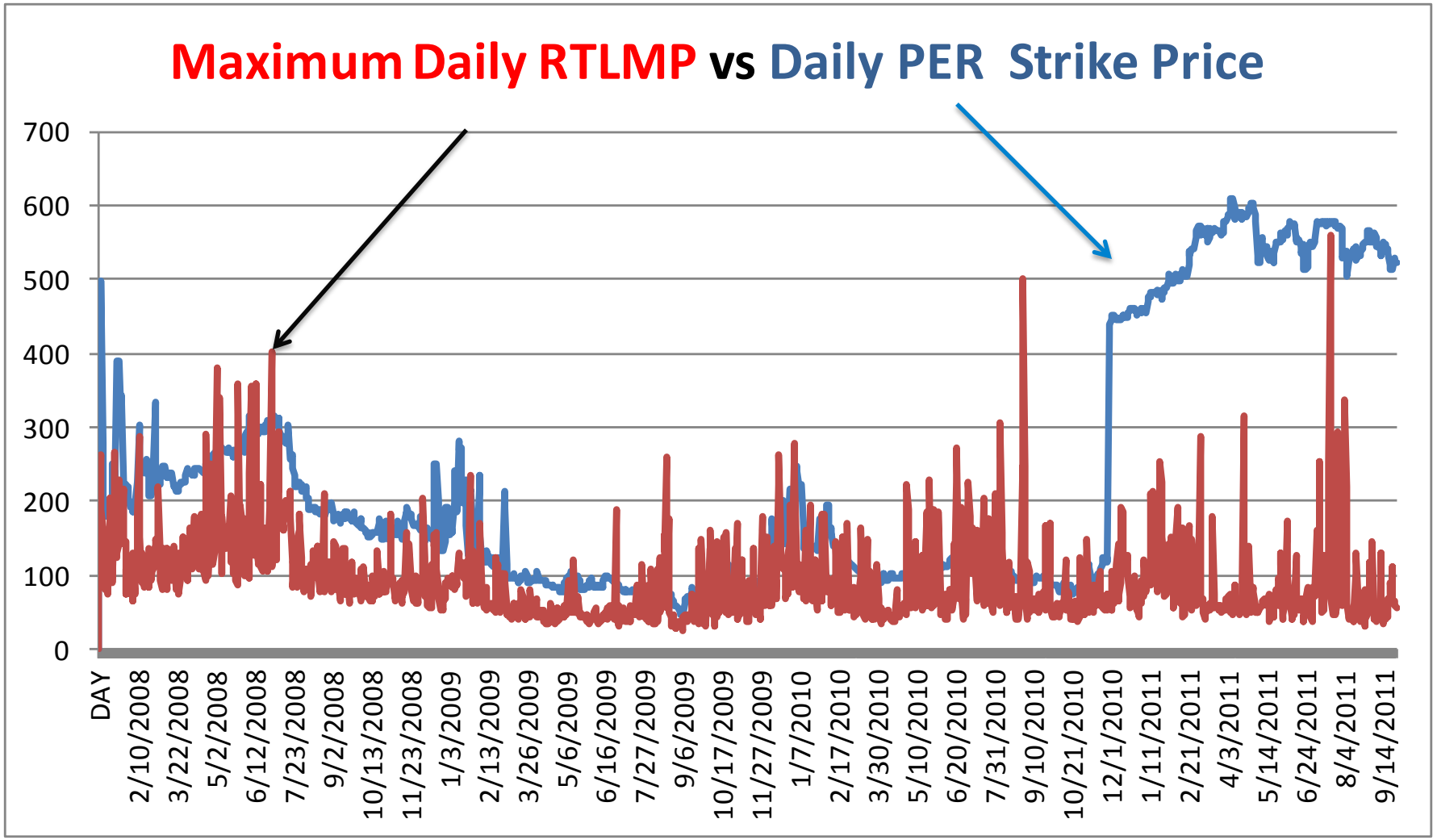
PER ADJ
$/kW-month



Existing PER Deduction:
Observation #6

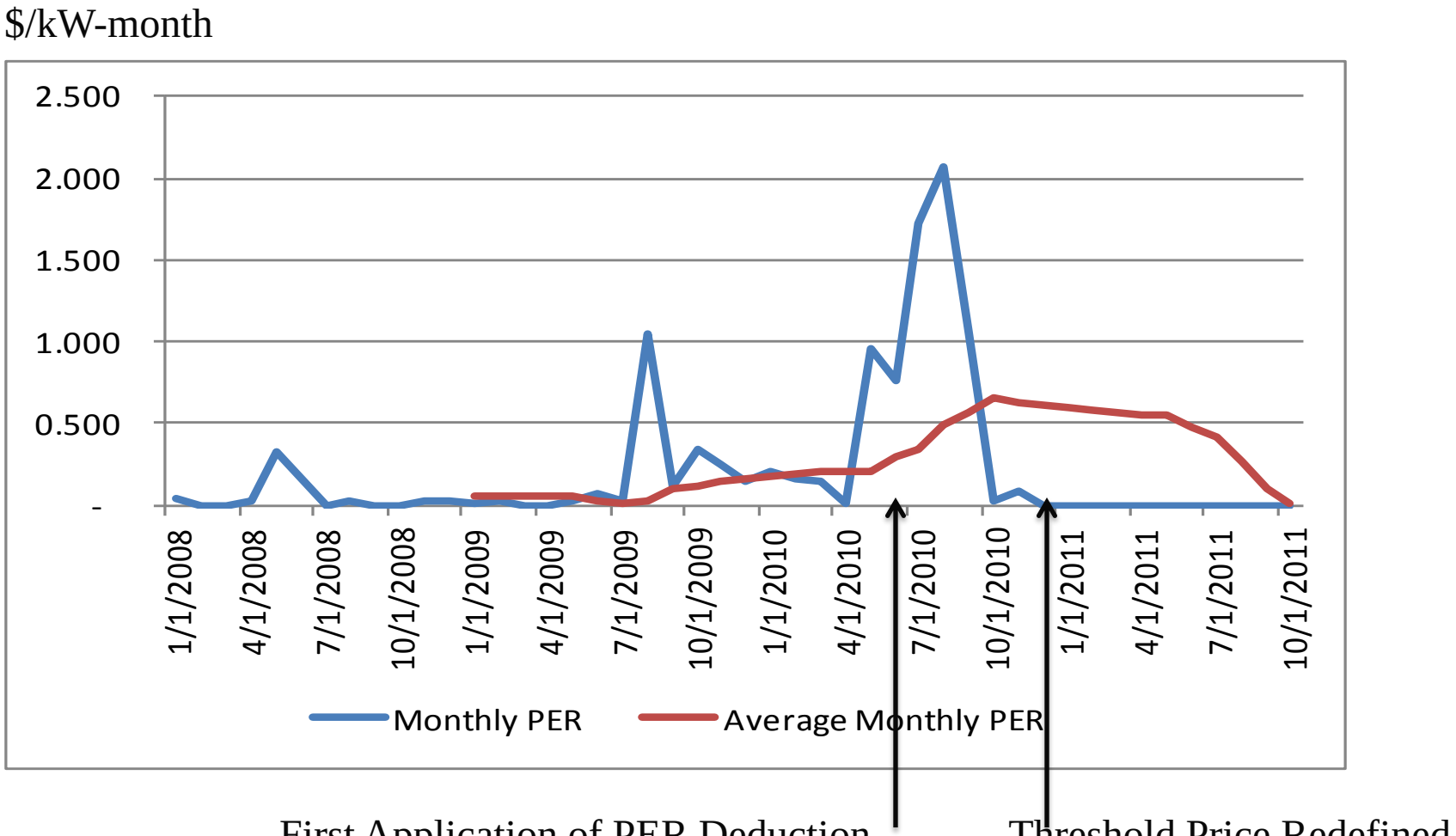
- Changing the method used to calculate the fuel cost of the 'proxy unit' in December, 2010 was well-founded based on the decoupling of gas and oil prices
- This change caused a sharp increase in the strike price used to calculate the PER Adjustment.
  - Hourly PER deduction has been zero since December 1, 2010--even during the OP-4 event July 22, 2011, a peak demand day
  - Average Monthly PER deduction has been declining since December 2010 and is now zero.

Historical View of Key PER Components



Existing PER Adjustment:

Historical View of monthly PER and Average Monthly PER



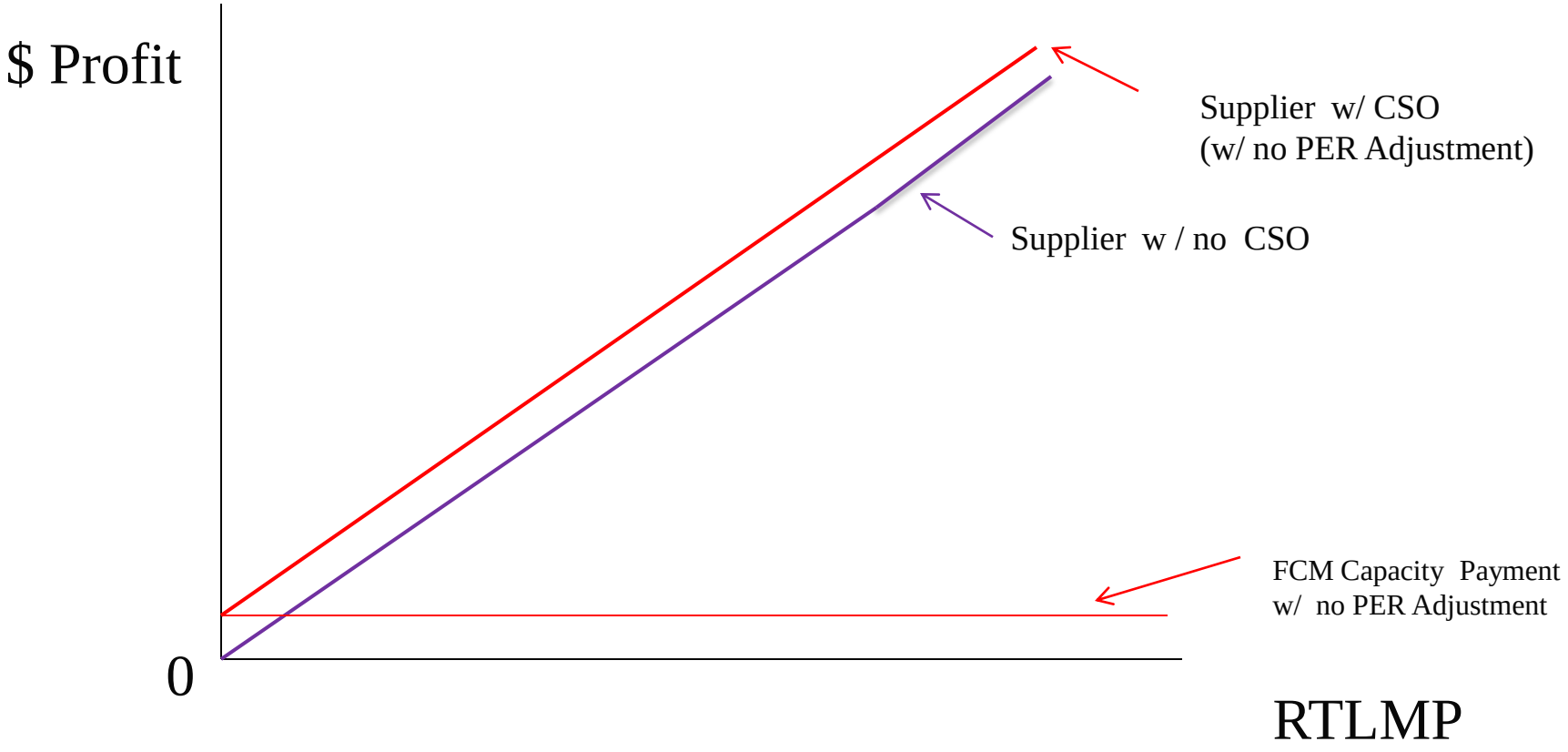
Existing PER Adjustment:
Observation #7

- The sharp increase in strike price used to calculate the PER Adjustment in December, 2010
  - Reduces the effectiveness of the PER Adjustment in curbing the exercise of market power in the real time energy market
  - Reduces the protection that the PER Adjustment affords customers against high energy prices
  - Simplifies generators FCM bidding strategies
    - Generators' minimum offer strategy for FCM6 and beyond is now closer to a 'No PER Deduction' Case (See Slide 29) since the expected PER Adjustment is effectively zero

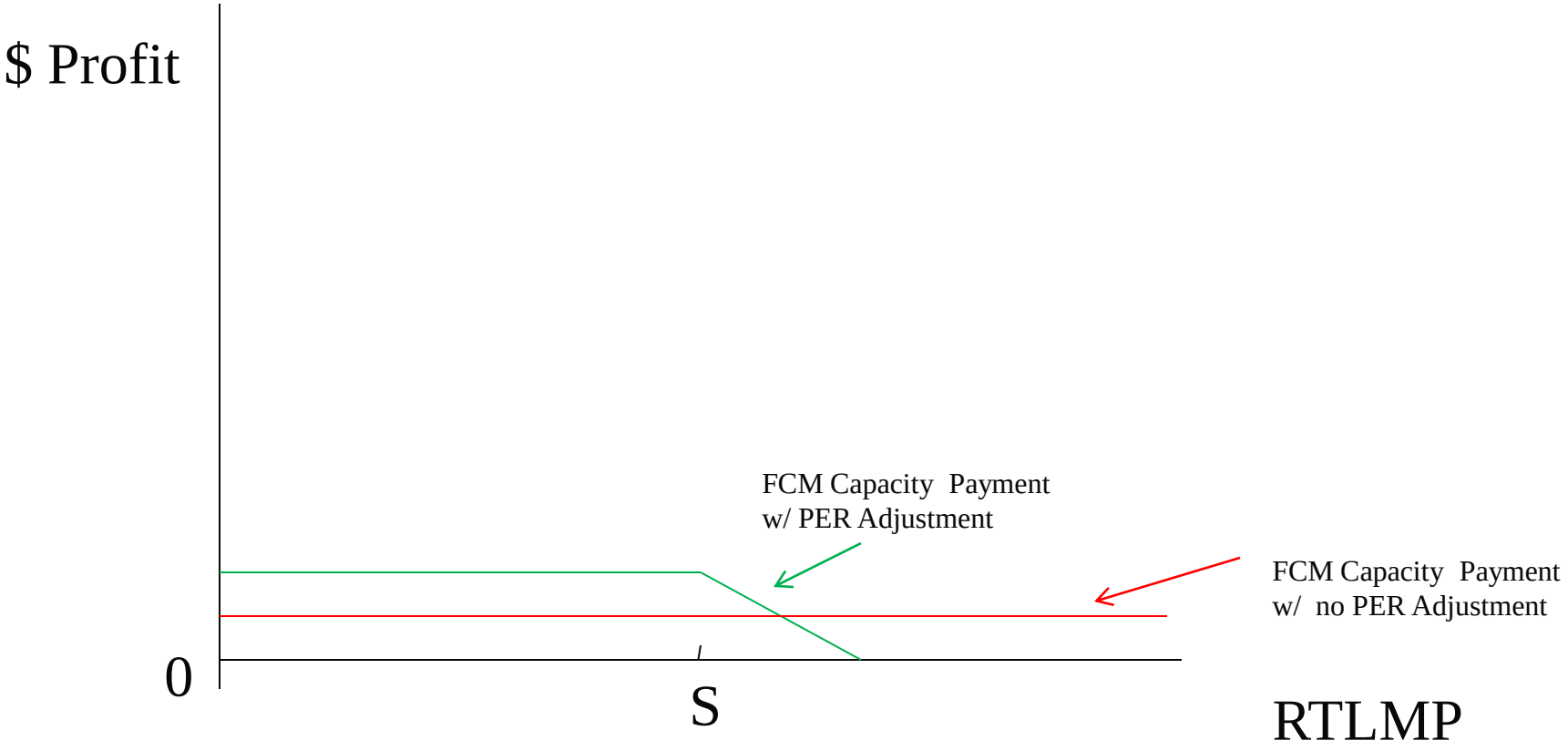
Existing PER Adjustment:
Observation #8

- The sharp increase in strike price used to calculate the PER Adjustment in December 2010 reduces the value of the reliability call option
  - The following diagrams show how:
    - FCM capacity price impacts a suppliers profit function
    - PER Adjustment impacts FCM capacity price (value of reliability option) and a suppliers profit function
    - Change in PER strike impacts capacity price and supplier profit function

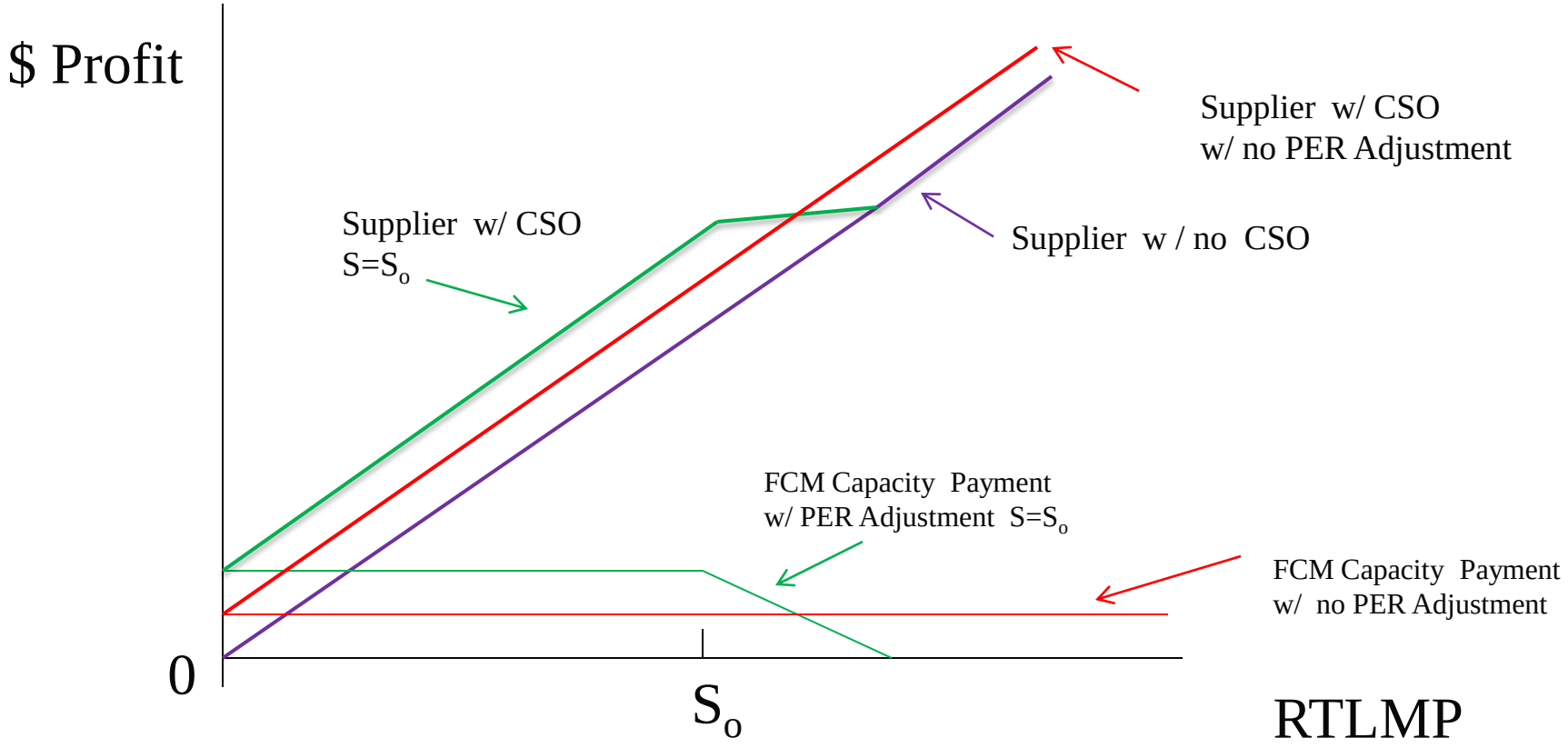
FCM Capacity Payment and Supplier Profit Function



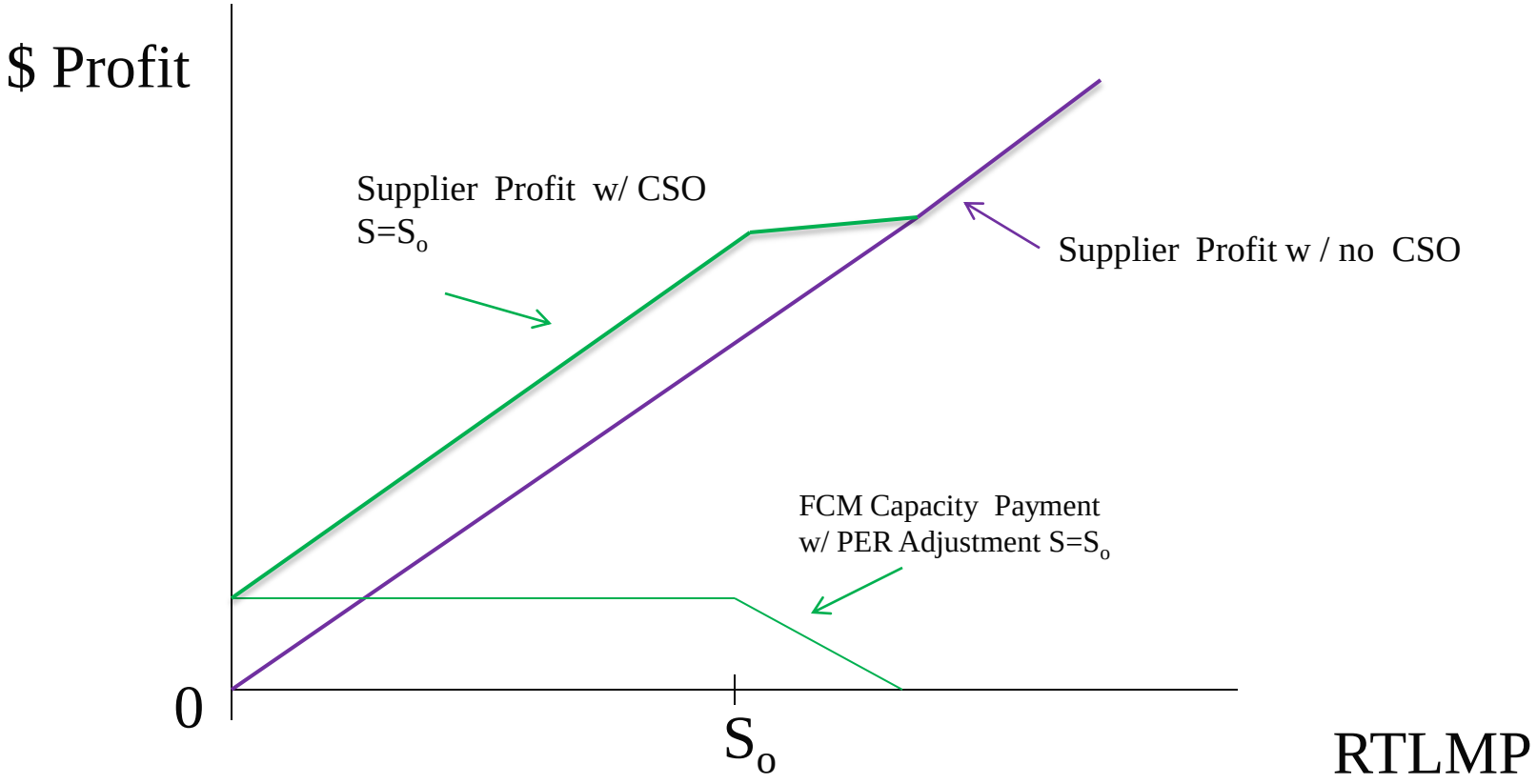
PER Adjustment and FCM Capacity Payment



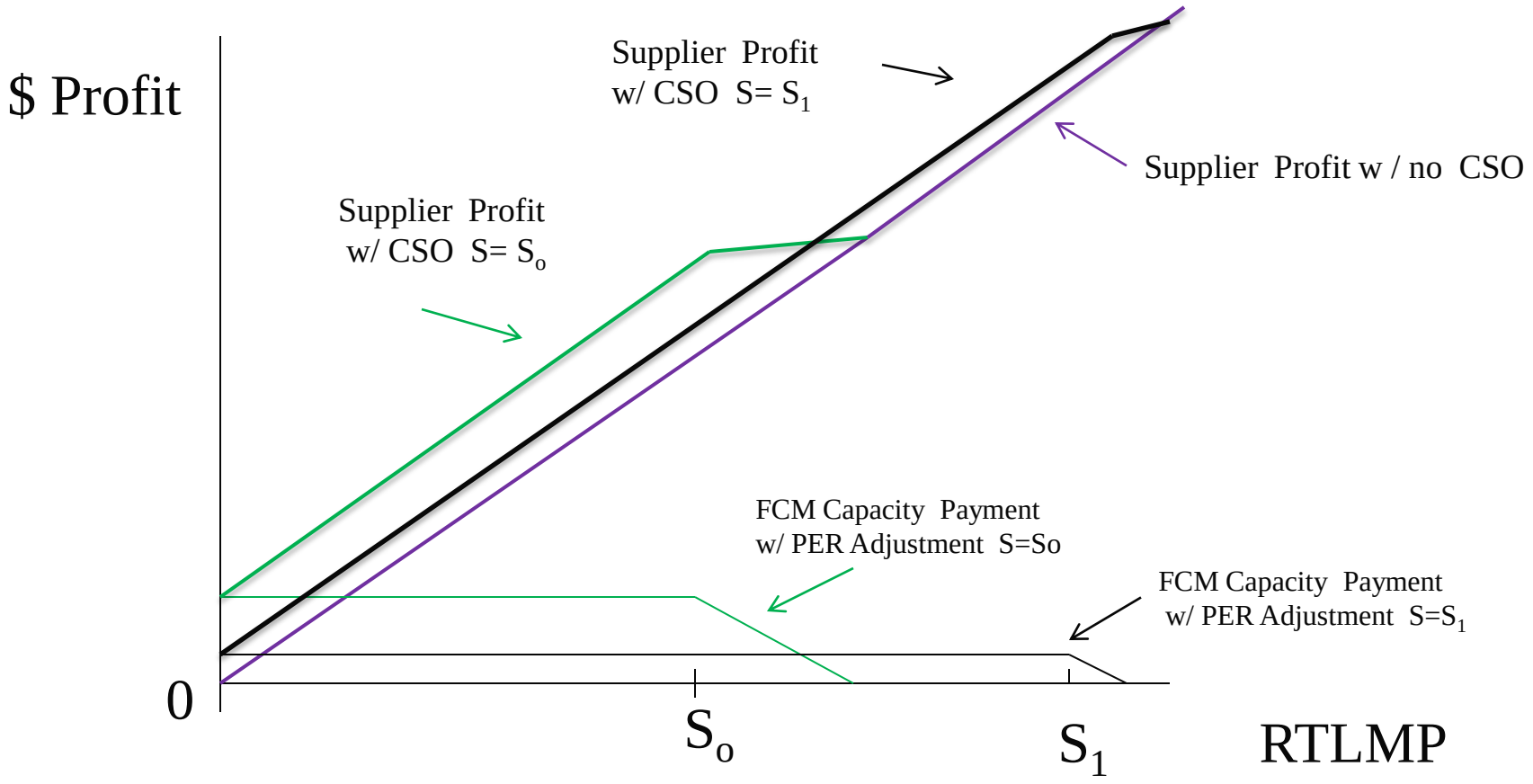
PER Adjustment and Supplier Profit Function



PER Adjustment and Supplier Profit Function: A Simpler View



Impact of Change in PER Strike Price on Supplier Profit Function



Existing PER Adjustment:
Observations #9

- Heat rate used to calculate the PER Adjustment strike price may be too high
  - The Settlement Agreement states that "For the first Commitment period, the PER proxy unit shall be deemed to have a 22,000 BTU/kWh heat rate. This assumption shall be periodically reviewed after the first Commitment period by the ISO to ensure that the heat rate continues to reflect a level slightly higher than the marginal generating unit in the region that would be dispatched as the system enters a scarcity condition…"
  - Existing peaking plants in New England have heat rates that are closer to 18,000 BTU/kWh —20% less than the 22,000 BTU/kWh heat rate currently used to calculate the strike price.

Existing PER Adjustment:
Summary Observations

- Curbs incentive to exercise market power.
- Does not distort DA/RT bidding strategies.
- Adds an extra step and risk to FCM bidding
- Expected cost of PER Adjustment should be recovered by capacity suppliers through higher than otherwise clearing prices
- Scale factor complicates the calculation of the Expected PER Adjustment needed for FCM bidding
- Does not hinder DR Providers from participating in the capacity market (treated comparable to generation resources)
- Partially protects consumers from high prices.
- Current strike price may be too high
- Increase in strike price since 12/2010 has weakened the PER Adjustment's effectiveness in curbing the incentive to exercise market power and in protecting customers from high energy prices, but has simplified and reduced suppliers' risk in FCM bidding