Nodal Financial Contracts (incs and decs) Primer

Dave Picarelli

April 15, 2009

What are they?

- Nodal (point) financial contracts that obligate the buyer to the revenue, positive or negative, associated with the difference between day-ahead and real-time prices at a pricing node (PNODE)
- Pure financial contract: need not be associated with a physical asset

Characteristics

- Type
  - Decrement (decs) look like load in DA, generation in BAL
  - Increment bids (incs) look like generation in DA, load in BAL
- Quantity (MW)
- Bid Price ($/MW)
  - Decs are max prices
  - Incs are min prices
- Location

Uses

- Can be used by themselves or against physical or other financial assets
  - By themselves to speculate on DA v. RT prices
    - If you believe that DA is priced high v. RT, bet with a inc, priced low a dec
  - Against physical or other financial assets
    - to provide a hedge against RT v. DA price differences
    - to move them from one market to another

Ancillary Benefit to the Market

- They provide price convergence between DA and RT markets
- Robust two-settlement system cannot exist without them
- Much of the improvement in market efficiency provided by financials contracts accrues to physical assets that were undervalued
- Financial transactions profits paid by market participants that benefited, either undervalued generators or overpriced load

How they work
Clearing Example #1

10 MW, $50/MWH Western Hub dec

	DA		RT
Prices (LMPs)	$40		$50
Revenue	-$400		$500

$100 net revenue

Also 10 MW*($50-$40) = $100 profit

Clears because DA price is less than (max) bid price

How they work
Clearing Example #2

10 MW, $30/MWH Western Hub dec

	DA		RT
Prices (LMPs)	$40	WH	$50
Revenue	$0		$0

Nil net revenue

Also 0 MW*($50-$40) = nil revenue

Does not clear because DA price exceeds max bid

How they work
Clearing Example #3

10 MW, $50/MWH Western Hub **inc**

	DA		RT
Prices (LMPs)	$40		$50
Revenue	$0		$0

Nil net revenue

Also 0 MW*($50-$40) = nil revenue

Does not clear because DA price is less than min bid

How they work
Clearing Example #4

10 MW, $30/MWH Western Hub inc

	DA		RT
Prices (LMPs)	$40		$50
Revenue	$400		-$500

-$100 net revenue

Also -10 MW*($50-$40) = $100 loss

Clears because DA price is more than (min) bid price

How they work
Clearing Example #5

10 MW, $50/MWH Western Hub dec

	DA		RT
Prices (LMPs)	$40		$30
Revenue	-$400		$300

-$100 net revenue

Also 10 MW*($30-$40) = $100 loss

Why did this dec lose money?

Fundamental Rule

- Incs/decs are bets on the relative prices between DA and RT
  - Dec a node if your bet is the DA price is going to be less than RT, that is DA is undervalued vis-à-vis RT
  - Inc a node if your bet is DA price is going to be higher than RT, that is DA is overvalued
- Make money if right, but lose if wrong

How they work
Clearing Example #5

10 MW, $50/MWH Western Hub dec

	DA		RT
Prices (LMPs)	$40		$30
Revenue	-$400		$300

-$100 net revenue

Also 10 MW*($30-$40) = $100 loss

Why did this dec lose money?

Because dec bet that DA would be undervalued v. RT was wrong

How they work
Clearing Example #6

10 MW, $50/MWH Western Hub inc

	DA		RT
Prices (LMPs)	$40		$60
Revenue	$400	WH	-$600

-$200 net revenue

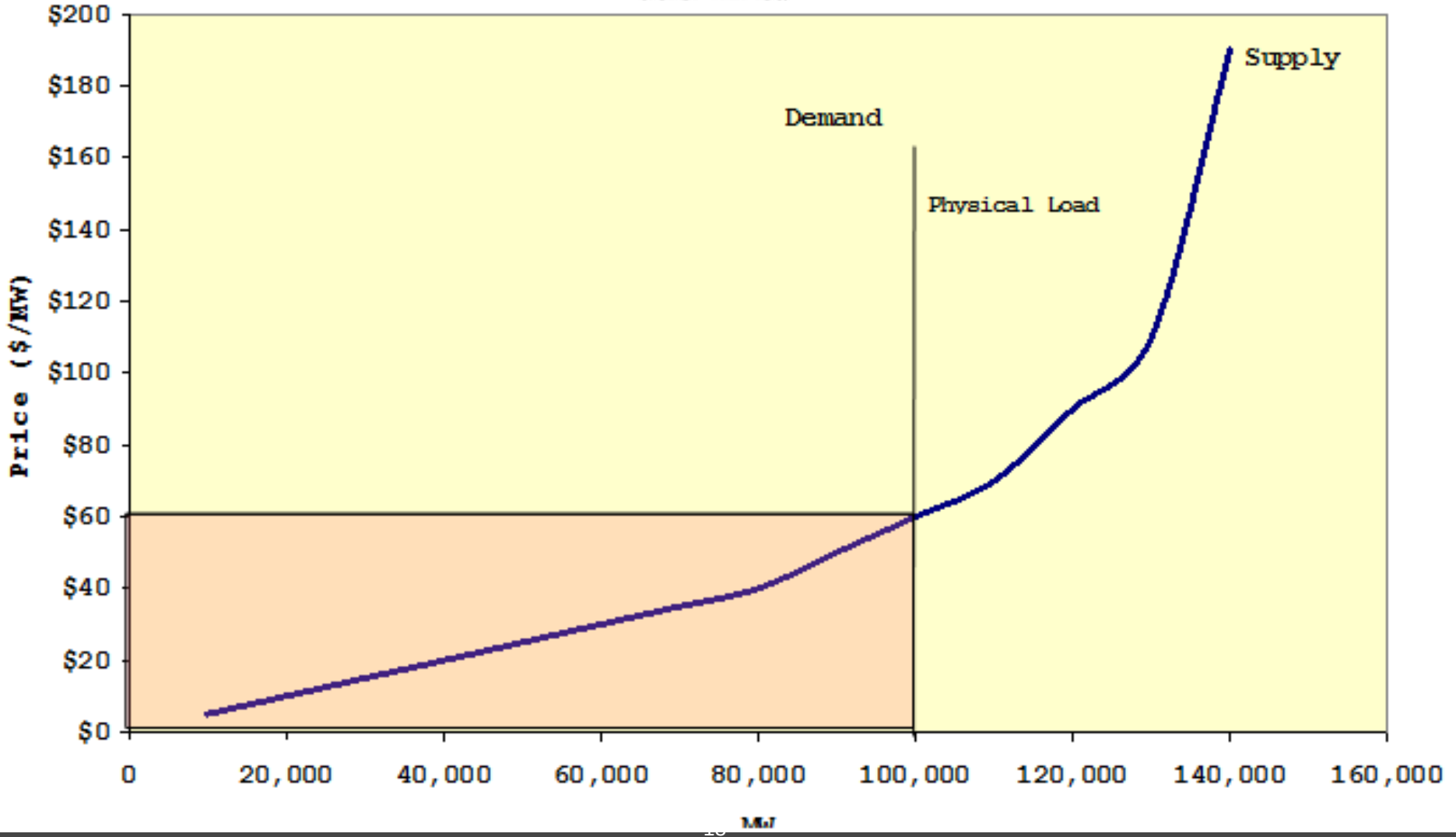
Also -10 MW*($60-$40) = $200 loss

This inc bet that DA was overvalued v. RT and was wrong

Market Convergence

- Discussed how market participants can benefit (and not benefit) using financial contracts
- Shift focus to what benefit they bring to the market
  - Robust two-settlement system cannot exist without them

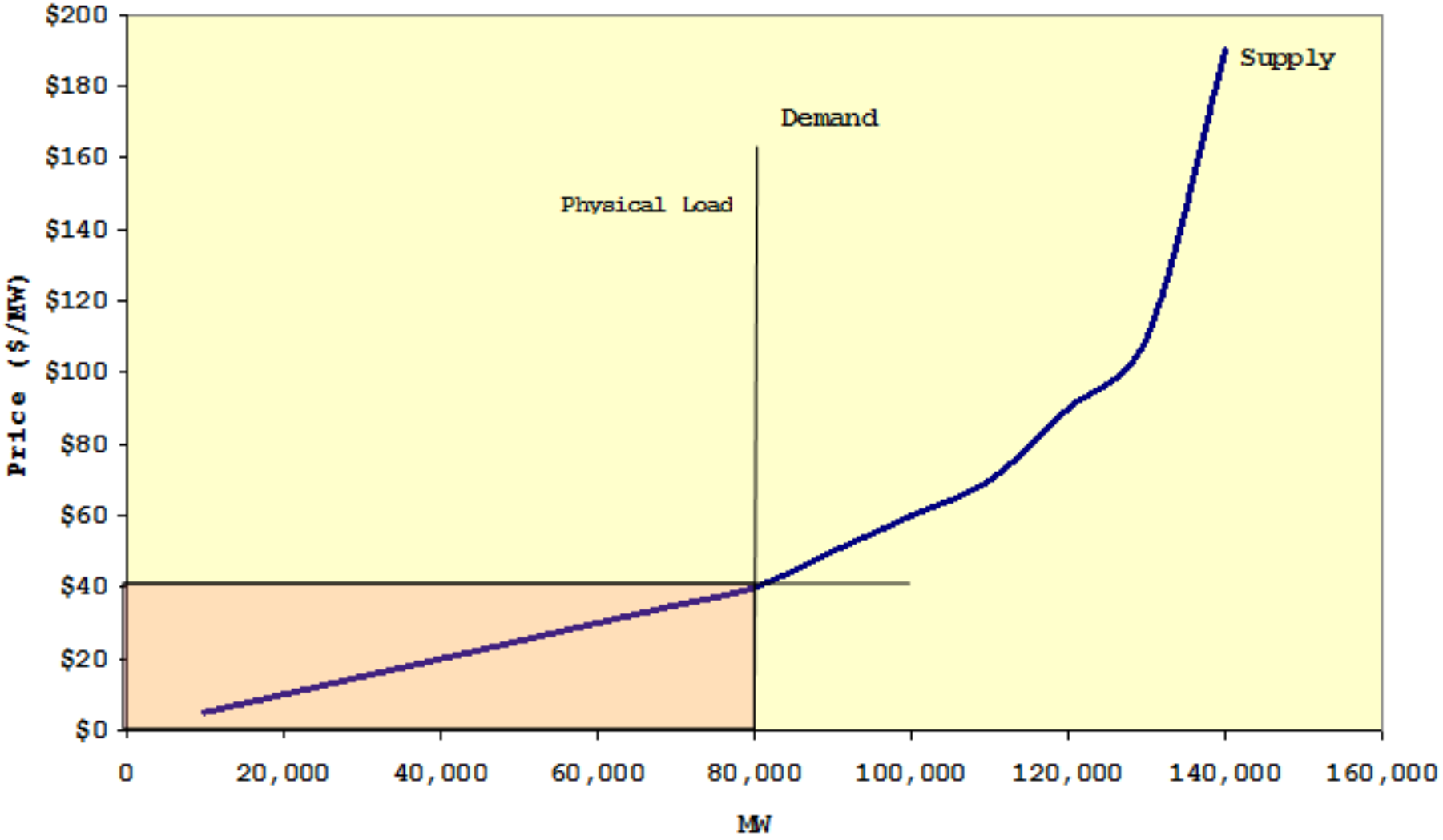
Case 1: Single Settlement, Physical Regime



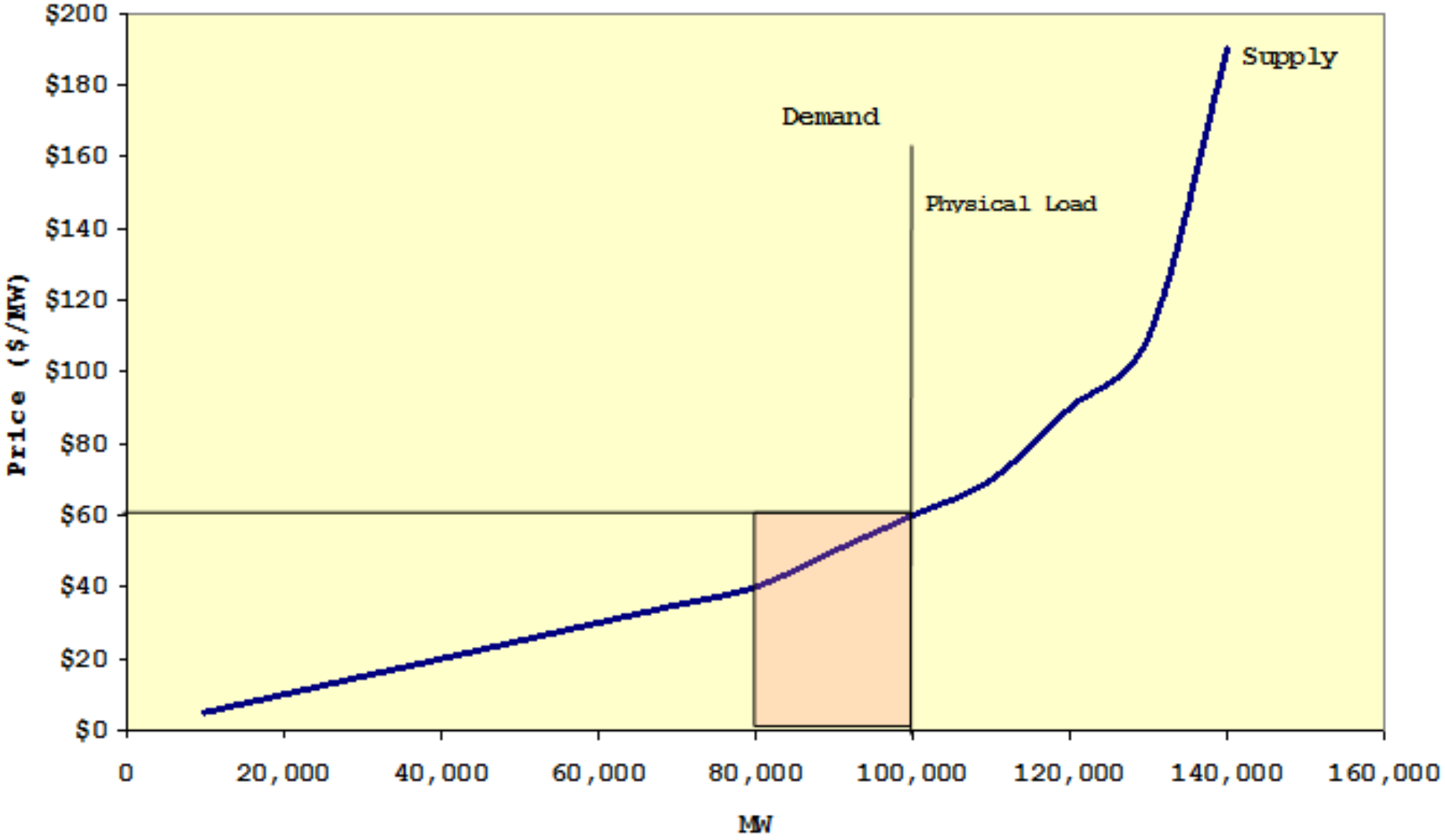
Case 1: Single Settlement, Physical Regime

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward Market							
Physical	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		0	$0	0	$0	0	$0
Real-time Market							
Physical	60	-100,000	($6,000,000)	100,000	$6,000,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		-100,000	($6,000,000)	100,000	$6,000,000	0	$0
Real-time Total							
Physical	$60	-100,000	($6,000,000)	100,000	$6,000,000	0	$0
Financials		0	$0	0	$0	0	$0
Total		-100,000	($6,000,000)	100,000	$6,000,000	0	$0

Case 2a: Two Settlement, Physical Regime (no financial contracts) Day-ahead Market



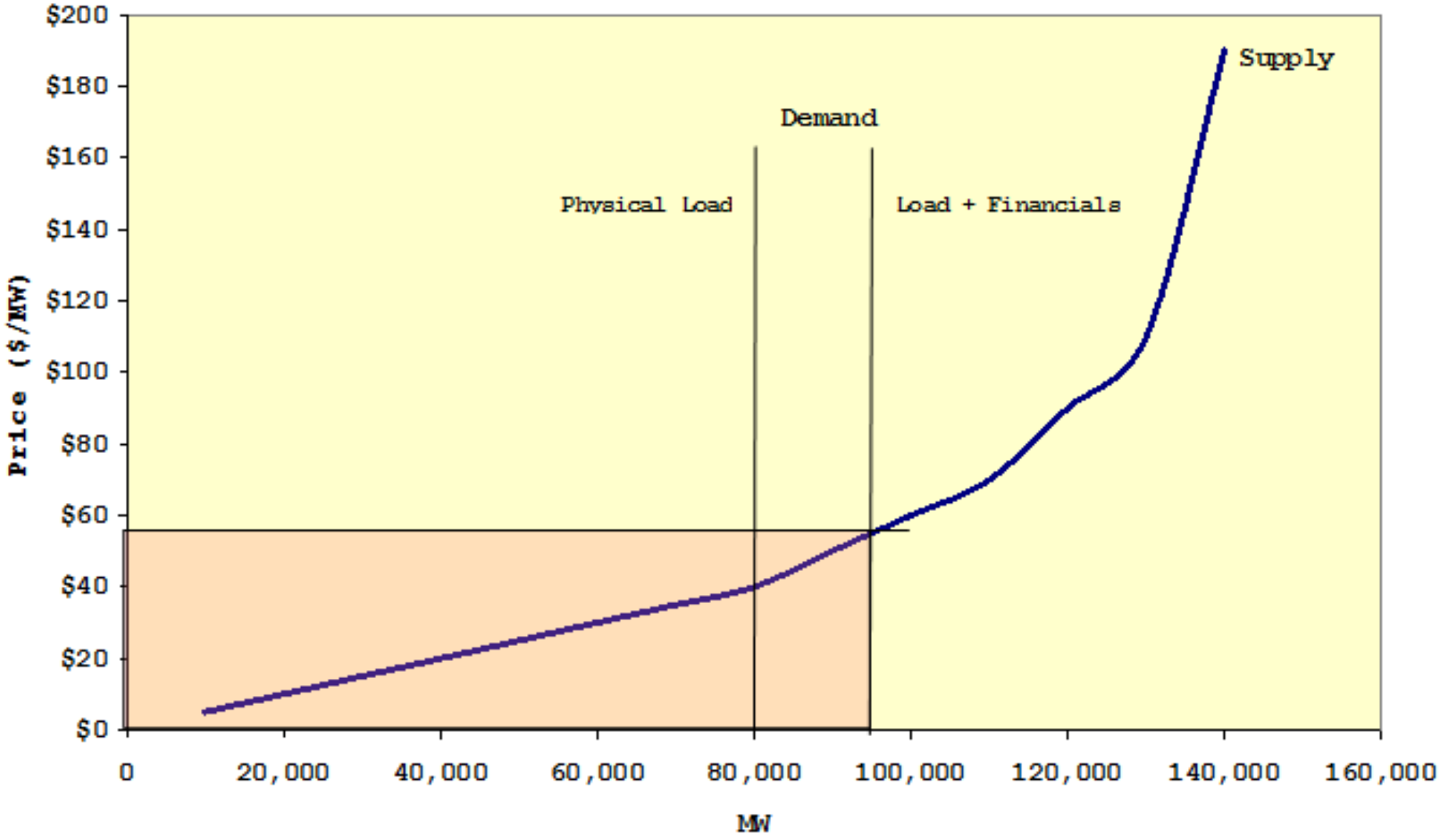
Case 2b: Two Settlement, Physical Regime (no financial contracts) Balancing Market



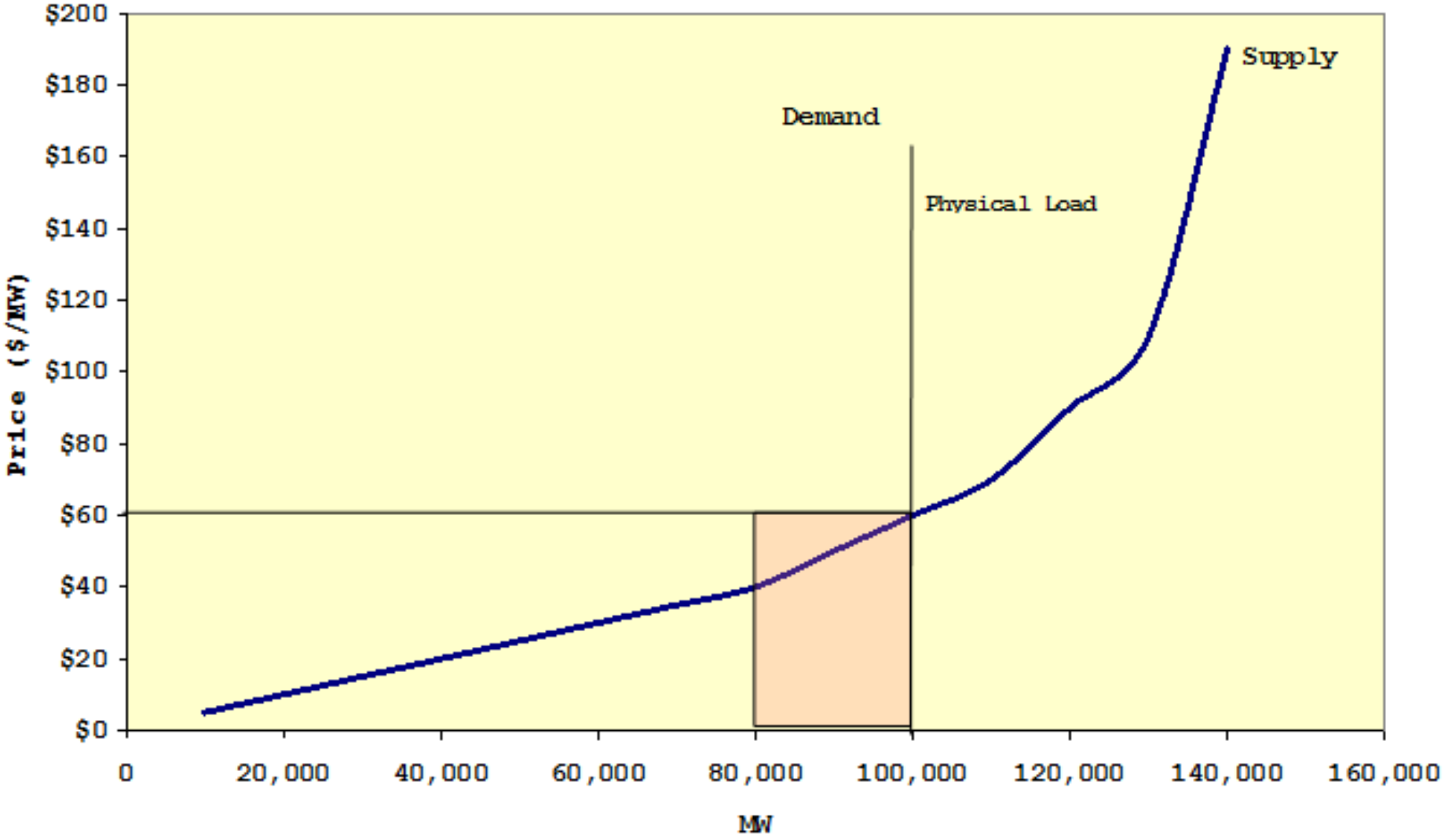
Case 2: Two Settlement, Physical Regime (no financial contracts)

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward Market							
Physical	$40	80,000	($3,200,000)	80,000	$3,200,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		80,000	($3,200,000)	80,000	$3,200,000	0	$0
Balancing Market							
Physical	$60	20,000	($1,200,000)	20,000	$1,200,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Forward and Balancing Total							
Physical	$44	100,000	($4,400,000)	100,000	$4,400,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		100,000	($4,400,000)	100,000	$4,400,000	0	$0

Case 3a: Two Settlement, Financial Regime Day-ahead Market



Case 3b: Two Settlement, Financial Regime Balancing Market



Case 3: Two Settlement, Financial Regime

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward Market							
Physical	$55	80,000	($4,400,000)	95,000	$5,225,000	15,000	$825,000
Financials		15,000	($825,000)	0	$0	-15,000	($825,000)
Total		95,000	($5,225,000)	95,000	$5,225,000	0	$0
Balancing Market							
Physical	$60	20,000	($1,200,000)	5,000	$300,000	-15,000	($900,000)
Financials		0	$0	15,000	$900,000	15,000	$900,000
Total		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Forward and Balancing Total							
Physical	$56	100,000	($5,600,000)	100,000	$5,525,000	0	($75,000)
Financials		15,000	($825,000)	15,000	$900,000	0	$75,000
Total		115,000	($6,425,000)	115,000	$6,425,000	0	$0

Market Regime Comparisons

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Single Settlement, Physical Regime							
Physical	$60	-100,000	($6,000,000)	100,000	$6,000,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		-100,000	($6,000,000)	100,000	$6,000,000	0	$0
Two Settlement, Physical Regime (no financial contracts)							
Physical	$44	100,000	($4,400,000)	100,000	$4,400,000	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		100,000	($4,400,000)	100,000	$4,400,000	0	$0
Two Settlement, Financial Regime							
Physical	$56	100,000	($5,600,000)	100,000	$5,525,000	0	($75,000)
Financials		15,000	($825,000)	15,000	$900,000	0	$75,000
Total		115,000	($6,425,000)	115,000	$6,425,000	0	$0

Market Regime Comparisons

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Two Settlement, Physical Regime v. Single Settlement, Physical Regime							
Physical	($16)	200,000	$1,600,000	0	($1,600,000)	0	$0
Financials		N/A	N/A	N/A	N/A	N/A	N/A
Total		200,000	$1,600,000	0	($1,600,000)	0	$0
Two Settlement, Financial Regime v. Single Settlement, Physical Regime							
Physical	($4)	200,000	$400,000	0	($475,000)	0	($75,000)
Financials		15,000	($825,000)	15,000	$900,000	0	$75,000
Total		215,000	($425,000)	15,000	$425,000	0	$0

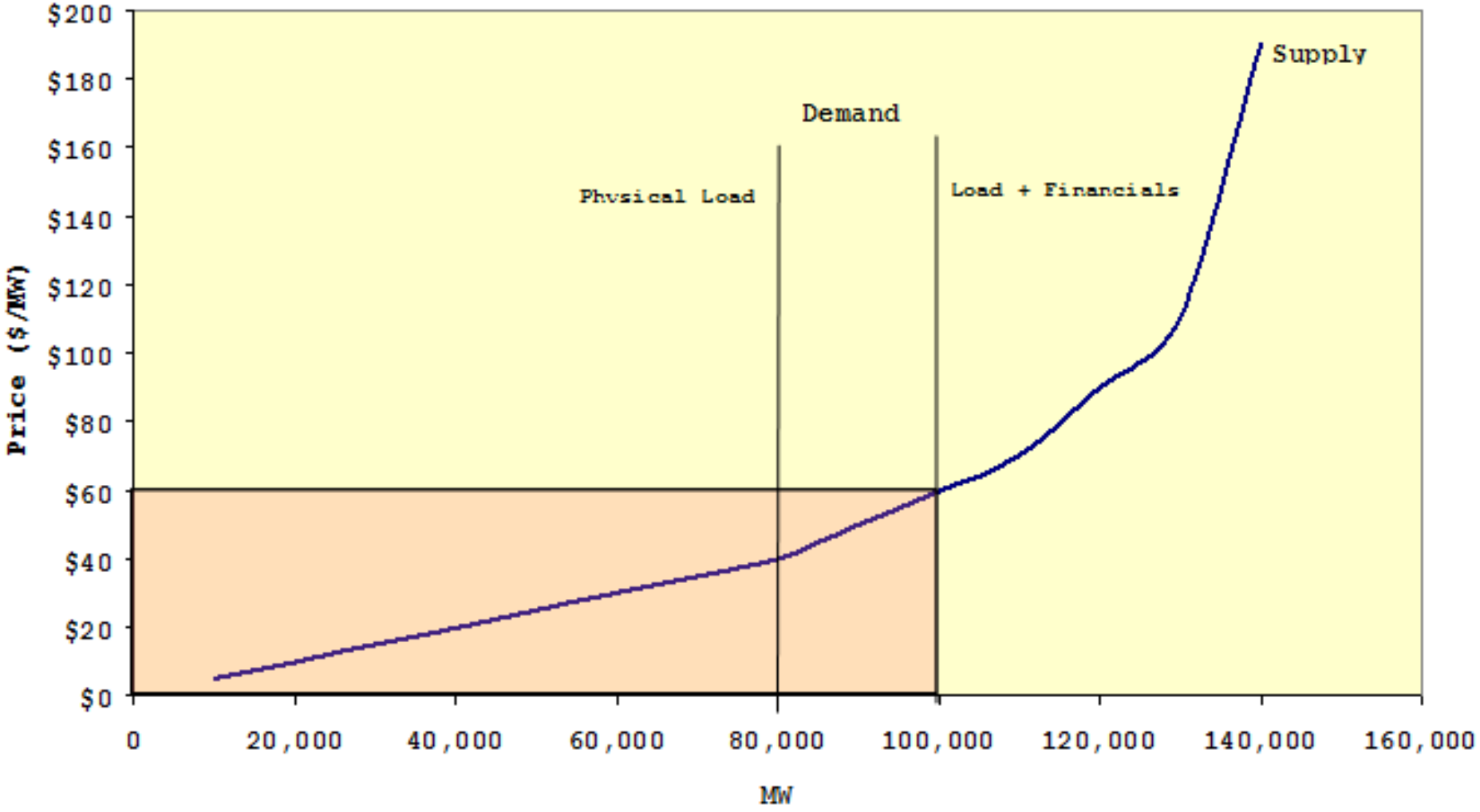
Market Convergence

- Price for physical delivery was $60/MWH in single settlement, physical regime (Case 1)
- Two settlement dropped price to $44/MWH and introduced $1.6 million of inefficiency (Case 2)
- Introduction of financials moved DA price closer to physical at $56/MWH and eliminated $1.15 million of undervalue and inefficiency (Case 3)

Market Convergence

- Financial transactions moved undervalued day-ahead closer to real-time
- $1,250,000 of market inefficiency and undervalue eliminated for $75,000
- Financial transactions profits paid by market participants that benefited, in this case generators
  - 99% of gain in market efficiency accrued to generators
  - 1% of gain in market efficiency accrued to financial transactions. They were 13% of market volume

Case 4: Two Settlement, Financial Regime Perfect Market Convergence



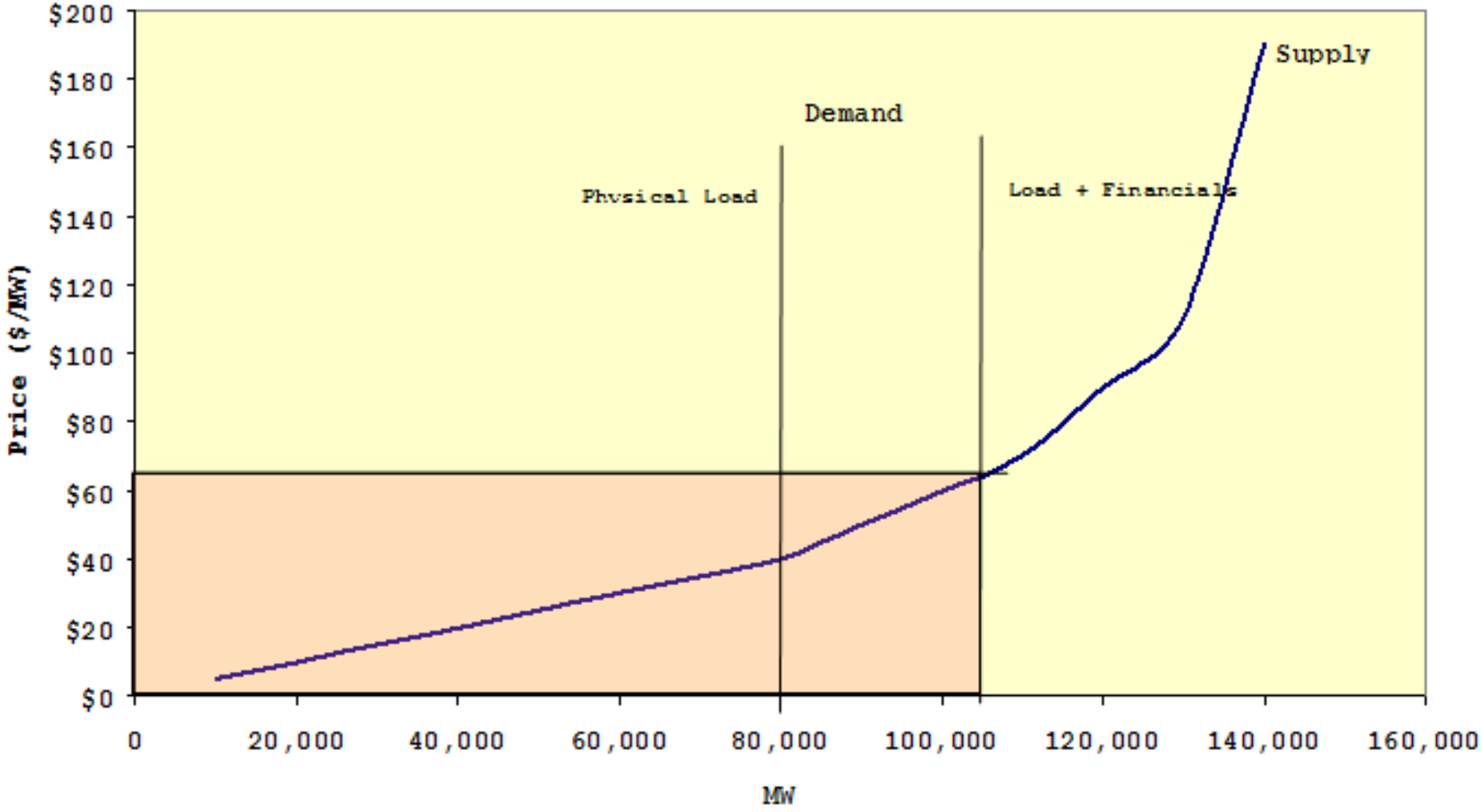
Case 4: Two Settlement, Financial Regime Perfect Market Convergence

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward Market							
Physical	$60	80,000	($4,800,000)	100,000	$6,000,000	20,000	$1,200,000
Financials		20,000	($1,200,000)	0	$0	-20,000	($1,200,000)
Total		100,000	($6,000,000)	100,000	$6,000,000	0	$0
Balancing Market							
Physical	$60	20,000	($1,200,000)	0	$0	-20,000	($1,200,000)
Financials		0	$0	20,000	$1,200,000	20,000	$1,200,000
Total		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Forward and Balancing Total							
Physical	$60	100,000	($6,000,000)	100,000	$6,000,000	0	$0
Financials		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Total		120,000	($7,200,000)	120,000	$7,200,000	0	$0

Case 4: Perfect Market Convergence

- Dec bids moved DA clearing price up supply curve
- DA price converged to $60/MWH RT physical price
- Generation received full value, $6,000,000
- Load paid full value, $6,000,000
- Financial contracts provided perfect market convergence but received nothing in return
  - Case where a “B” grade beats an “A”

Case 5: Two Settlement, Financial Regime Market Convergence Overcorrection



Case 5: Two Settlement, Financial Regime Market Convergence Overcorrection

		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward Market							
Physical	$64	80,000	($5,120,000)	105,000	$6,720,000	25,000	$1,600,000
Financials		25,000	($1,600,000)	0	$0	-25,000	($1,600,000)
Total		105,000	($6,720,000)	105,000	$6,720,000	0	$0
Balancing Market							
Physical	$60	20,000	($1,200,000)	-5,000	($300,000)	-25,000	($1,500,000)
Financials		0	$0	25,000	$1,500,000	25,000	$1,500,000
Total		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Forward and Balancing Total							
Physical	$63	100,000	($6,320,000)	100,000	$6,420,000	0	$100,000
Financials		25,000	($1,600,000)	25,000	$1,500,000	0	($100,000)
Total		125,000	($7,920,000)	125,000	$7,920,000	0	$0

Case 5: Two Settlement, Financial Regime Market Convergence Overcorrection

- Dec bids moved DA clearing price up supply curve
- DA price finished at $64/MWH, $4/MWH above $60/MWH RT physical price
- Generation received $420,000 in excess of $6,000,000 full value
- Load paid $320,000 in excess of full value
- Financial contracts lost $100,000 (penalty for overcorrecting DA price and adding inefficiency to market)

Case 5 v. 4: Overcorrection v. Perfect Convergence

Case 4 v. 1: Perfect Convergence v. Physical							
		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward and Balancing Total							
Physical	$0	200,000	$0	0	$0	0	$0
Financials		20,000	($1,200,000)	20,000	$1,200,000	0	$0
Total		220,000	($1,200,000)	20,000	$1,200,000	0	$0

Case 5 v. 4: Overcorrection v. Perfect Convergence							
		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward and Balancing Total							
Physical	$0	0	($320,000)	0	$420,000	0	$100,000
Financials		5,000	($400,000)	5,000	$300,000	0	($100,000)
Total		5,000	($720,000)	5,000	$720,000	0	$0

Differences							
		Load		Generation		Net	
	Price	MW	Revenue	MW	Revenue	MW	Revenue
Forward and Balancing Total							
Physical	$0	-200,000	($320,000)	0	$420,000	0	$100,000
Financials		-15,000	$800,000	-15,000	($900,000)	0	($100,000)

Self-correcting Feature

- Financial transactions compensated when they provide convergence
  - That is move DA price toward RT price
- Financial transactions penalized when they lessen convergence
  - Move DA price away from RT price
- Paid handsomely under the “Microsoft Rule”
  - Case where a “B” grade beats an “A”

Self-correcting Feature

- $1,600,000 of market inefficiency and undervalue eliminated for free
  - $720,000 of overvalue provided to generators
  - $400,000 paid by financial transactions
  - $320,000 paid by load
- Financial transactions paid for most, not all, of market inefficiency they caused

Self-correcting Feature

- Financial transactions
  - Rewarded for removing market inefficiency
  - Penalized for any market inefficiency they add
  - Paid by market participants that benefited

Other Uses

- Against physical or other financial assets
  - to move them from one market to another
  - to provide a hedge against RT v. DA price differences

Other Uses

Move physical assets from one market to another: Generator

100 MW, $10/MWH Generator at PNODE "Gen1"

	DA	RT
Prices (LMPs)	$40	$50
Revenue	$4000	.

$4000 net revenue

Other Uses

Move physical assets from one market to another: Generator

100 MW, $10/MWH Generator at PNODE "Gen1"

		DA		RT
Prices (LMPs)		$40		$50
Generator				
	Revenue	$4000		$0
Total				
	Revenue	$4000		$0

$4000 net revenue

Other Uses

Move physical assets from one market to another: Generator

100 MW, $10/MWH Generator at PNODE "Gen1"

100 MW, $50/MWH Dec at PNODE "Gen1"

		DA		RT
Prices (LMPs)		$40		$50
Generator				
	Revenue	$4000		$0
Dec				
	Revenue	-$4000		$5000
Total				
	Revenue	$0		$5000

$5000 net revenue

Other Uses: Move financial assets from financial (day-ahead) to physical (real-time) market: FTR

100 MW FTR from PNODE "VF" to PNODE "PHL"

100 MW, $50/MWH Dec at PNODE "VF"

100 MW, $50/MWH Dec at PNODE "PHL"

VF

PHL

	DA		RT	
Pnode	**VF**	**PHL**	**VF**	**PHL**
LMP	**$30**	**$50**	**$30**	**$60**
FTR Rev	$2000			
Total Rev	$2000			

$2000 net revenue

But $3000 RT congestion

Other Uses: Move financial assets from financial (day-ahead) to physical (real-time) market: FTR

100 MW FTR from PNODE "VF" to PNODE "PHL"

100 MW, $40/MWH Inc at PNODE "VF"

100 MW, $60/MWH Dec at PNODE "PHL"

VF

PHL

	DA		RT	
Pnode	**VF**	**PHL**	**VF**	**PHL**
LMP	**$30**	**$50**	**$30**	**$60**
FTR Rev	$2000			
Inc Rev	$3000		-$3000	
DecRev		-$5000		$6000
Total Rev		$0		$3000

$3000 net revenue

Covers $3000 RT congestion

Takeaways: What are they?

- Nodal (point) financial contracts that obligate the buyer to the revenue, positive or negative, associated with the difference between day-ahead and real-time prices at a pricing node (PNODE)
- Pure financial contract: need not be associated with any physical asset, but can be

Takeaways: Uses

- Can be used by themselves or against physical or other financial assets
  - By themselves to speculate on DA v. RT prices
    - If you believe that DA is priced high v. RT, bet with a inc, priced low a dec
  - Against physical or other financial assets
    - to provide a hedge against RT v. DA price differences
    - to move them from one market to another

Takeaways: Ancillary Market Benefits

- They provide price convergence between DA and RT energy markets
- Robust two-settlement system cannot exist without them
- Much of the improvement in market efficiency provided by financials contracts accrues to physical assets that were improperly priced:
  - Overvalued load
  - Undervalued generation
- A small portion of the gain in value provided to undervalued assets accrues to financial transactions as payment for service provided

Takeaways: Profitability

Self-correcting feature hinders sustained financial transaction profits and precludes cherry-picking

- Financial transactions compensated when they provide convergence by moving DA price toward RT price
- Financial transactions penalized when they lessen convergence by moving DA price away from RT price
  - Rational behavior dictates that losses won't be sustained
- As convergence occurs it becomes harder to make money