



EESAT 2005



Electric Energy Storage Opportunities and Challenges in New York

Presented by

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Outline

- ❖ Overview of NY Electricity Market
- ❖ EES Technologies for wholesale markets
 - Requirements for participation
- ❖ EES in NY electricity markets
 - Opportunities
 - Challenges
- ❖ NY Market Analysis
- ❖ Q & A





About NYISO

- ❖ New York Independent Systems Operator (NYISO) is a not-for-profit corporation established in Dec 1999 to administer NY's wholesale energy markets and operate the HV transmission system.
- ❖ NYISO's market volume was \$7.2 billion in 2004.
- ❖ NYISO Peak Load was 32,075 MW in 2005
- ❖ NYISO handles 50% of the energy trades through Day Ahead and Real Time markets
- ❖ Unique challenge: New York City is one of the world's biggest and most complex load pockets.





NYISO Markets

- ❖ Energy Markets
 - Day Ahead
 - Real Time
- ❖ Ancillary Services Market
 - Regulation and Frequency Support
 - Operating Reserve Services
 - 10 Min Synchronous Spinning Reserve
 - 10 Min Non Synchronous Spinning Reserve
 - 30 Min Operating Reserve
 - Voltage Support
 - Black Start Service





NYISO Markets

- ❖ Installed Capacity Market (ICAP)
 - Locational requirement
 - New York City (NYC): 80%
 - Long Island (LI): 99%
- ❖ Demand Side Response (DSR) Programs
 - Emergency Demand Response Program
 - Day Ahead Demand Response Program
 - ICAP/ Special Case Resources





Other Markets

❖ Emission Trading

- SO₂
- NO_x
- Greenhouse Gases (GHG)

❖ Renewable Energy Credits

- Executive Order 111 requires state agencies to purchase at least 10% non-hydro renewable energy sales by 2010.
- RPS requires 25% of energy sold in New York State to be generated by clean, renewable energy by 2013.

❖ Bilateral Contracts

- Accounts for 50% energy sales in NY





Market Participants & EES

- ❖ **NY Independent System Operator**
 - Reliability and System Efficiency Improvements
- ❖ **Utilities / Load Serving Entities (LSEs)**
 - T&D Cost Deferral
 - Capacity resource
 - Load Shifting / Energy Sales
- ❖ **Curtailement / Demand Response Service Providers**
 - Demand Side Response resource
- ❖ **Renewable Energy Developers**
 - Improving dispatchability and energy revenues
- ❖ **End Users**
 - Power Quality and Reliability





EES Technology Criteria

- ❖ Minimum size for market participation
 - 100 KW for DSR Program Participation
 - 2 MW for Regulation and Frequency Support Services
- ❖ EES capable of providing 4+ consecutive hours of energy
 - can receive ICAP credits under the Energy Limited Resource (ELR) option or as ICAP-Special Case Resource
- ❖ Most of the EES technologies can also provide
 - regulation / frequency support
 - 10 min non spinning
 - 30 min operating reserves





Possible Technology Options

- ❖ Sodium Sulfur (NAS)
- ❖ Vanadium Redox (VRB)
- ❖ Zinc-Bromine (ZBB)
- ❖ Long-duration Flywheels
- ❖ Compressed Air Energy Storage (CAES)





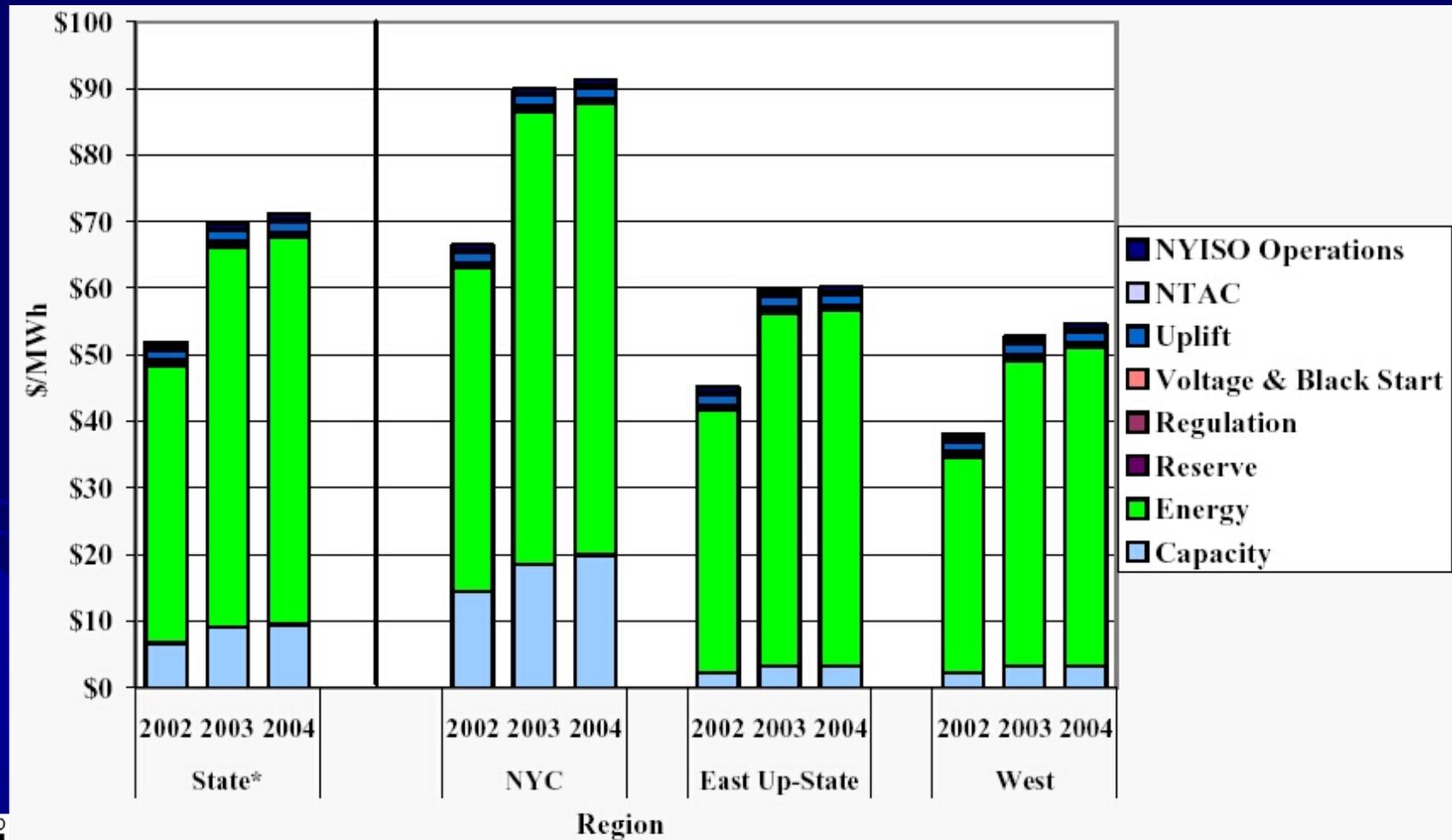
Opportunities

- ❖ Profits from Location Based Marginal Price (LBMP) differential between On Peak and Off Peak
- ❖ Ancillary Services
 - Regulation and Frequency Response Service
 - 10 Min Spinning or Non Spinning Reserves
 - Operating Reserve (30 Mins)
- ❖ Demand Response Revenues
- ❖ Installed Capacity (ICAP) Revenues
- ❖ Deferral of capital investment in
 - Generation
 - Transmission & Distribution
- ❖ Supporting Renewable Energy Sources





Average Energy Prices

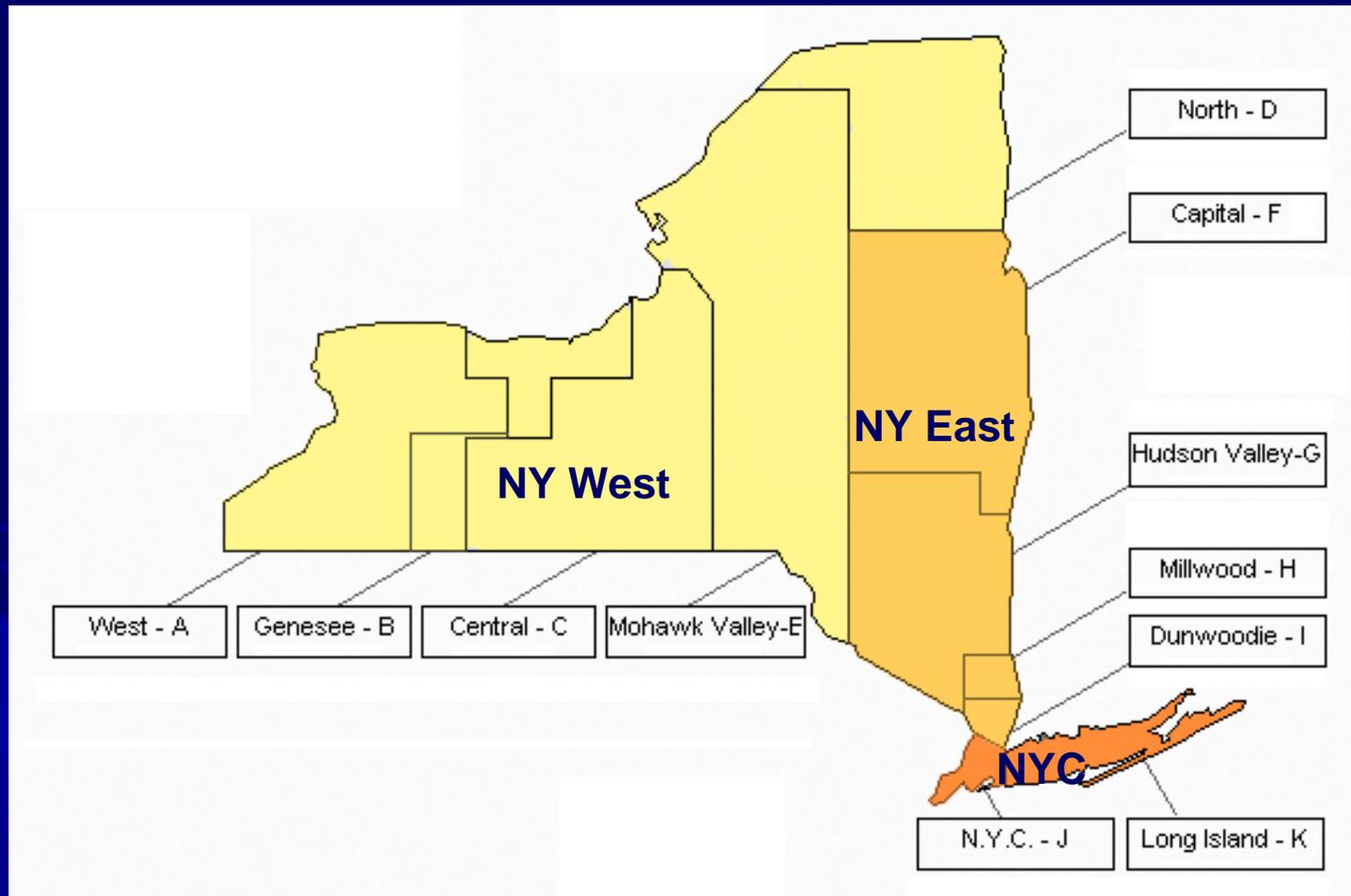


*Capacity portion of state price excludes Long Island.

Source: NYISO State of the Market Report 2004



NYISO Zones / Regions



Modified from NYISO OASIS LBMP zonal map





NYISO Regional LBMP Price Distribution

LBMP prices are mean values		Peak			Off Peak		
Region	Zone	All year	Summer	Winter	All Year	Summer	Winter
NYC	Long Island	\$65.77	\$66.83	\$64.69	\$46.47	\$46.50	\$46.44
	NYC	\$66.43	\$67.22	\$65.64	\$44.12	\$43.99	\$44.25
NY-East	Hudson Valley	\$55.23	\$55.96	\$54.50	\$38.60	\$37.26	\$39.97
	Capital	\$54.09	\$54.11	\$54.07	\$38.44	\$36.91	\$40.01
	Dunwoodie	\$56.13	\$57.09	\$55.15	\$38.84	\$37.60	\$40.09
	Millwood	\$55.32	\$56.26	\$54.38	\$38.34	\$37.06	\$39.65
NY-West	Genesee	\$47.46	\$46.98	\$47.95	\$33.91	\$32.27	\$35.58
	North	\$48.07	\$47.22	\$48.94	\$35.23	\$33.41	\$37.08
	MH Valley	\$49.72	\$49.16	\$50.29	\$35.87	\$34.17	\$37.60
	Central	\$48.36	\$47.93	\$48.79	\$34.65	\$33.02	\$36.31
	West	\$45.40	\$45.31	\$45.49	\$32.45	\$30.98	\$33.94



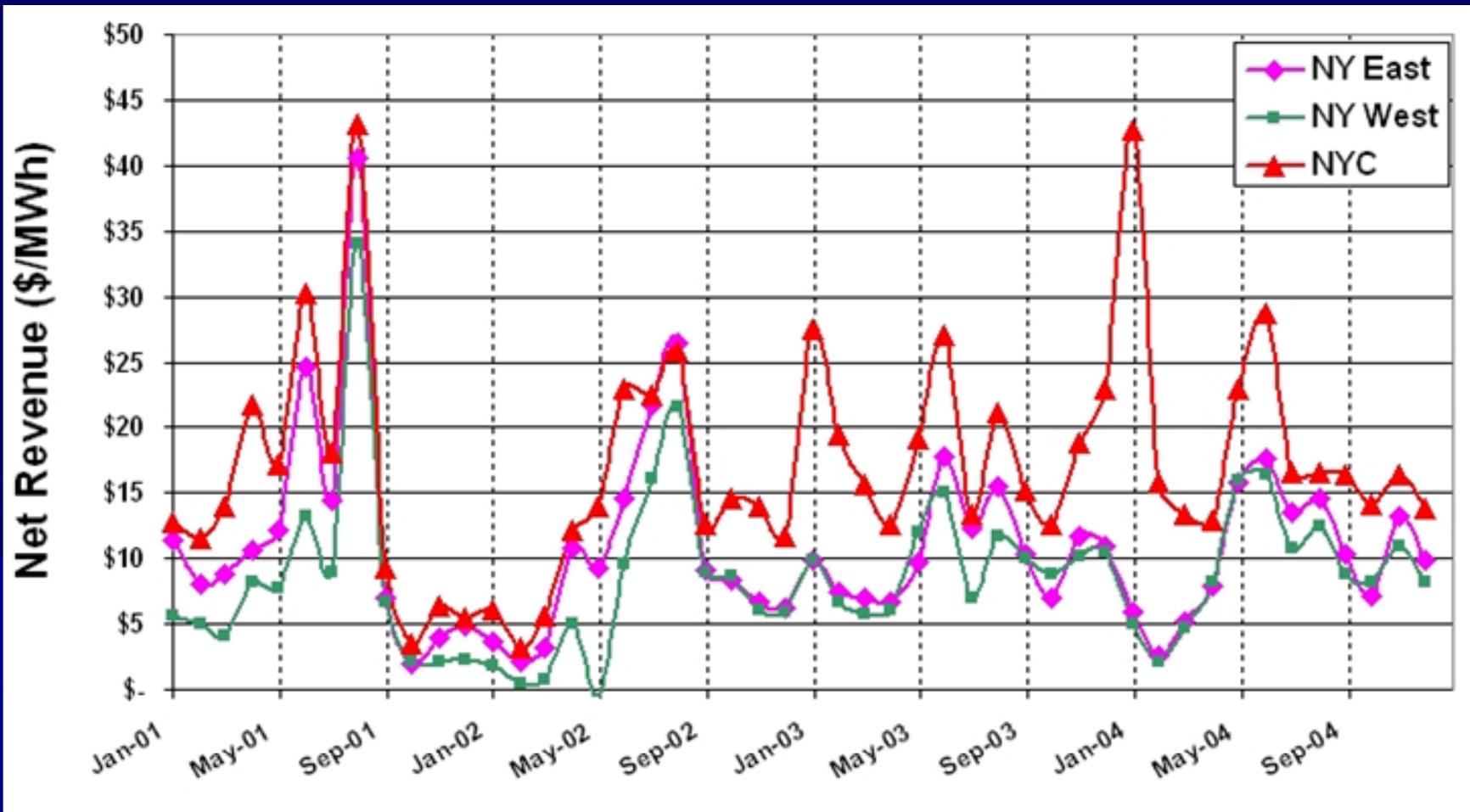
Energy Sale

- ❖ Revenue potential depends on location and transmission constraints in different regions
 - **Average Net Revenue (\$/MWh) for 10 hr energy sale (2001-04)**
 - NY West : \$12.40 - \$18.65
 - NY East : \$16.46 - \$21.52
 - NYC region : \$20.93 - \$31.29
 - **Average Net Revenue for 4 hr energy sale (2001-04)**
 - NY West : \$19.58 - \$29.86
 - NY East : \$25.74 - \$33.78
 - NYC region : \$31.57 - \$44.40
 - **Average Net Revenue for 2 hr energy sale (2001-04)**
 - NY West : \$21.71 - \$33.29
 - NY East : \$24.05 - \$37.56
 - NYC region : \$33.75 - \$48.11





10 Hr Energy Sale : Average Net Revenues

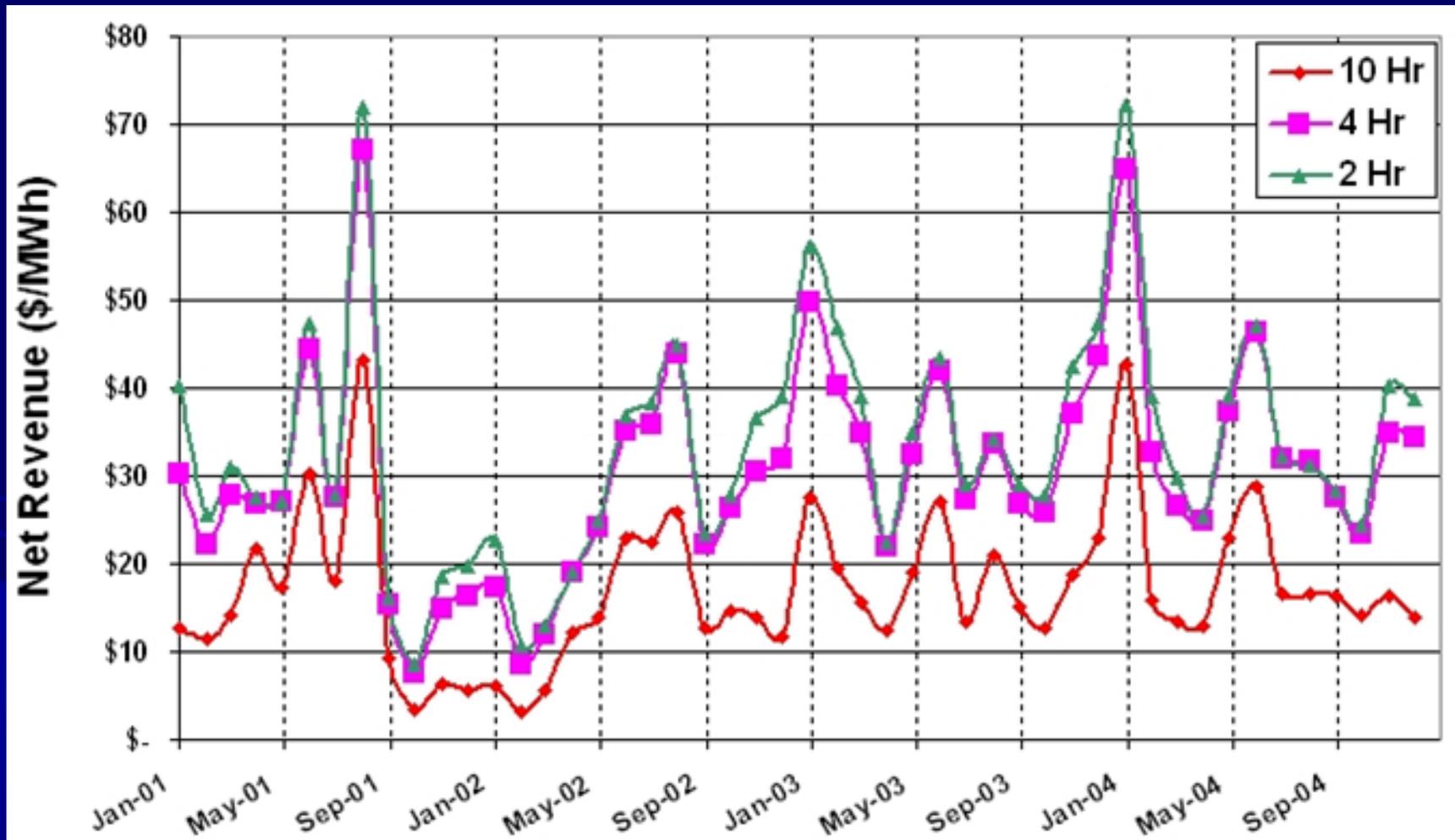


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Energy Sale : Average Net Revenues for NYC

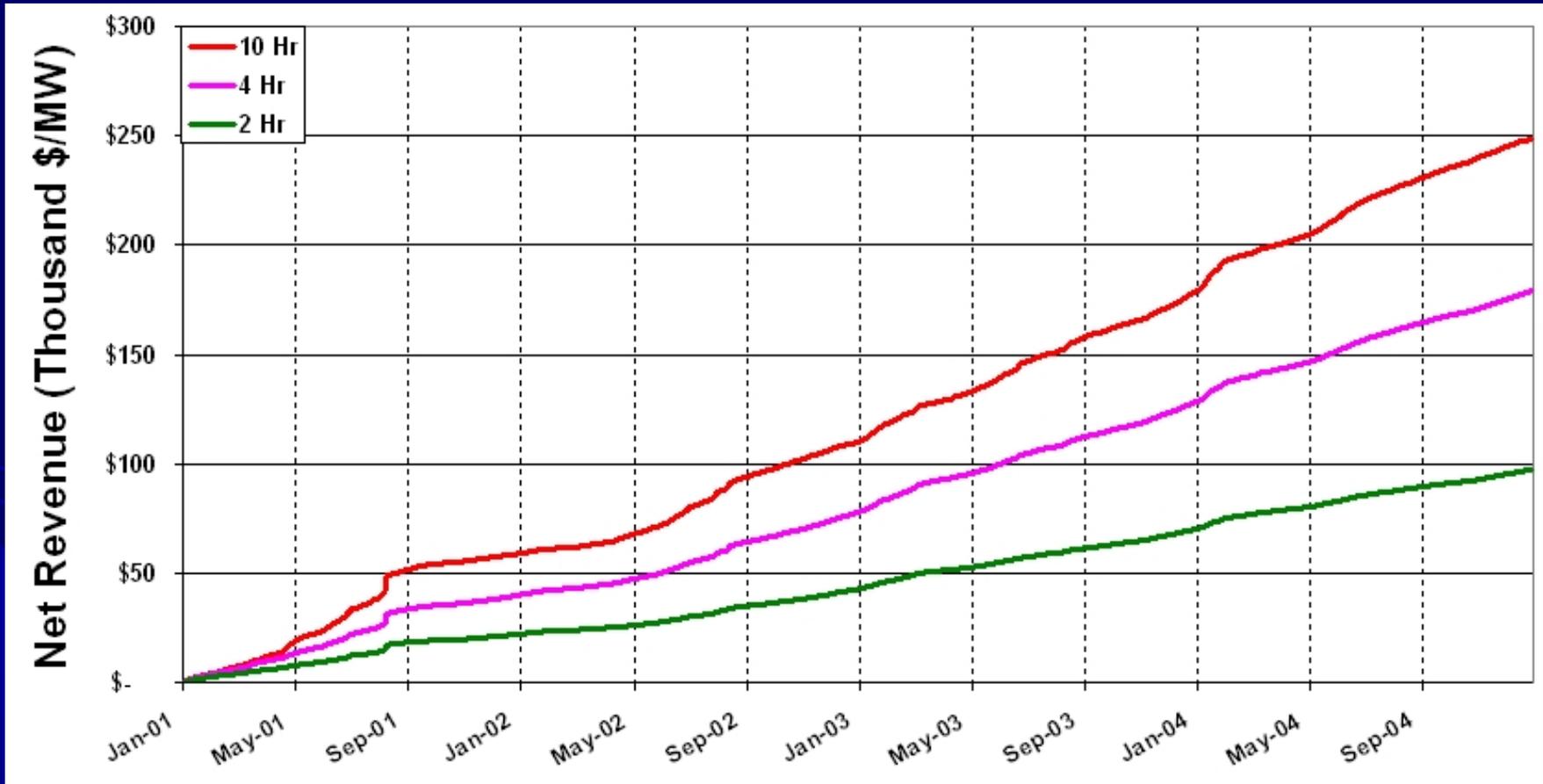


Based on 2001-04 Zonal LBMP Data for NYC





Energy Sale Net Revenues for NYC



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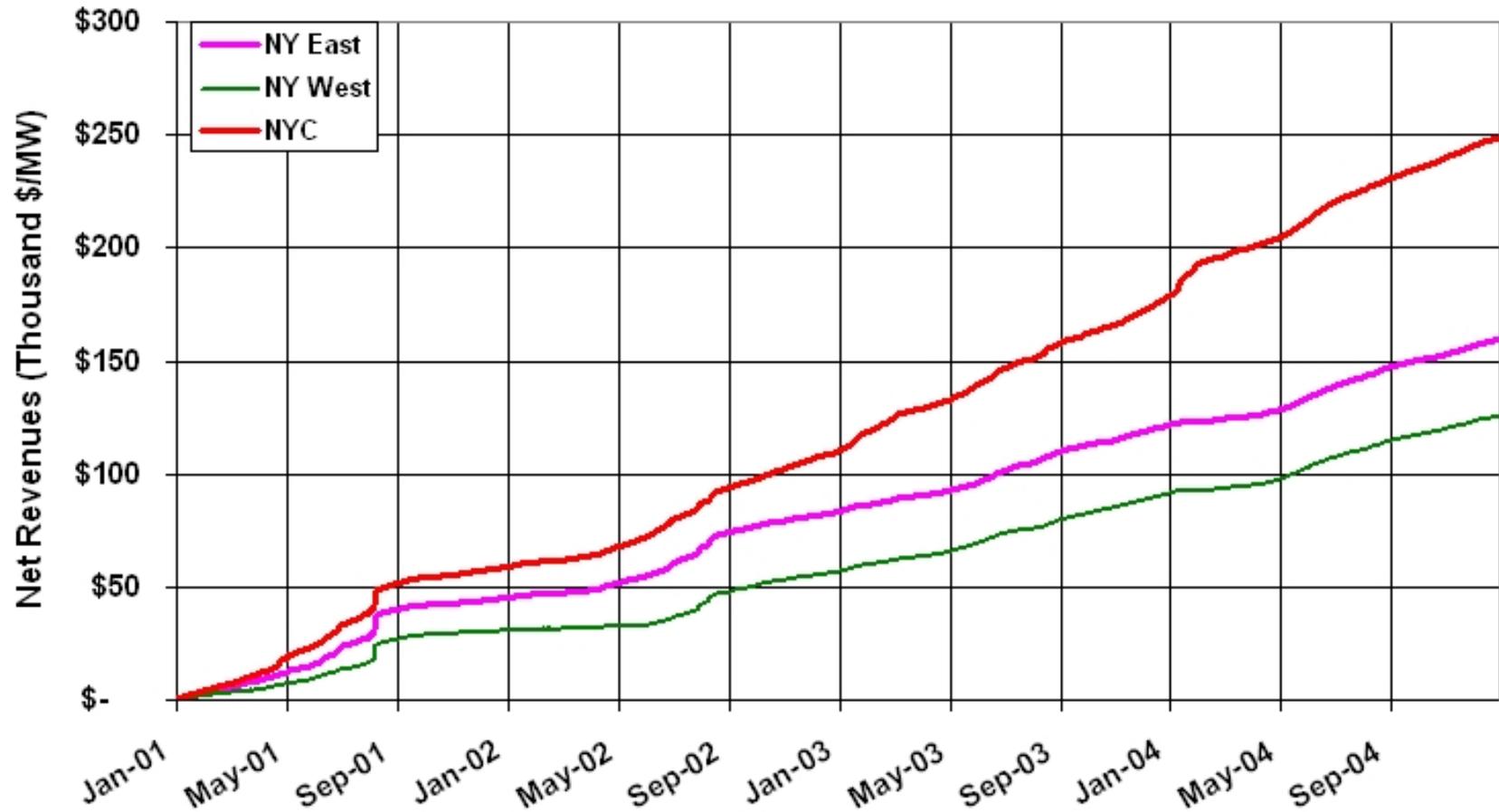


Based on 2001-04 Zonal LBMP Data for NYC





10 Hr Energy Sale: Net Revenues

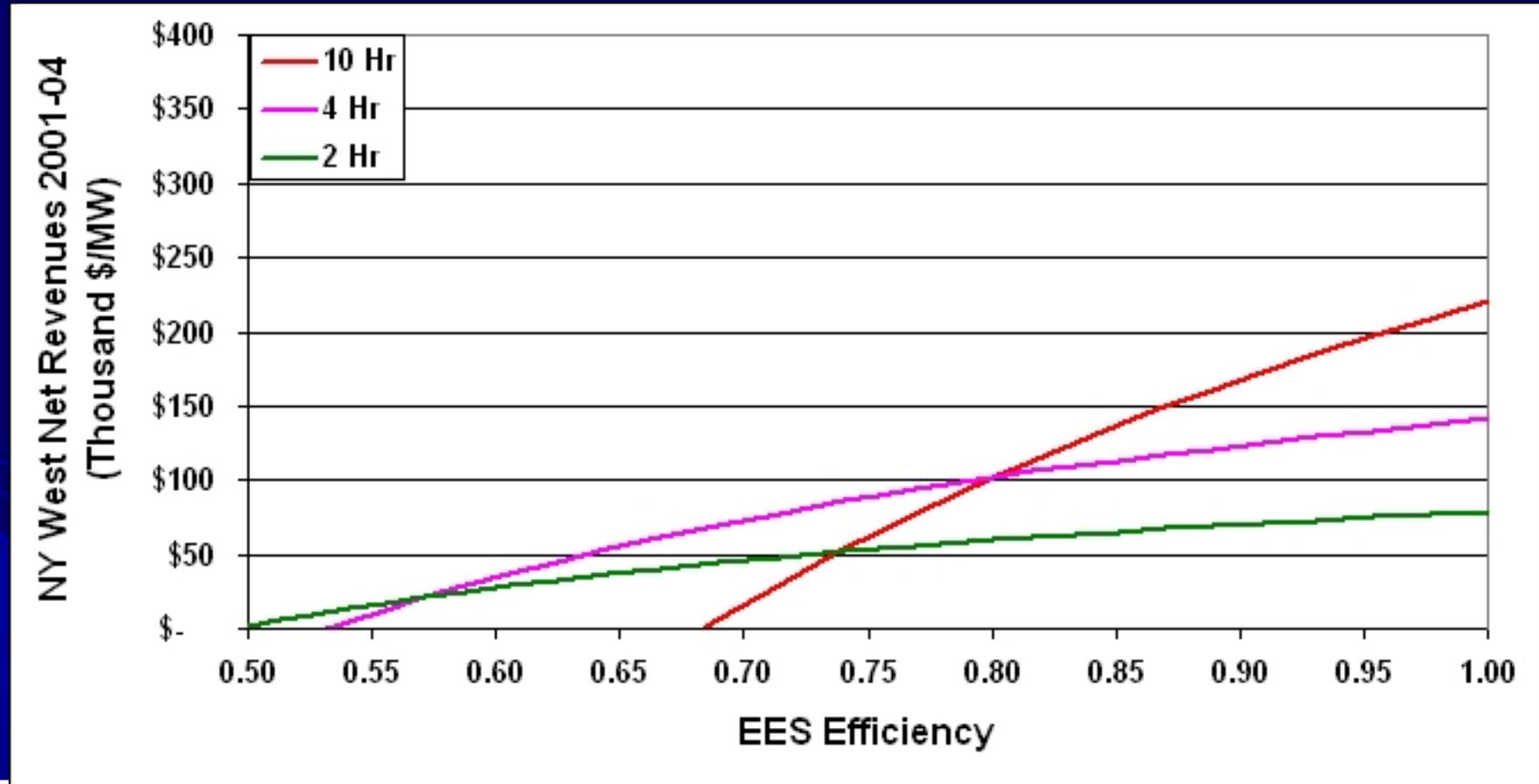


Based on 2001-04 Zonal LBMP Data for Hudson Valley, Central and NYC.





Energy Sale Net Revenue vs EES Efficiency



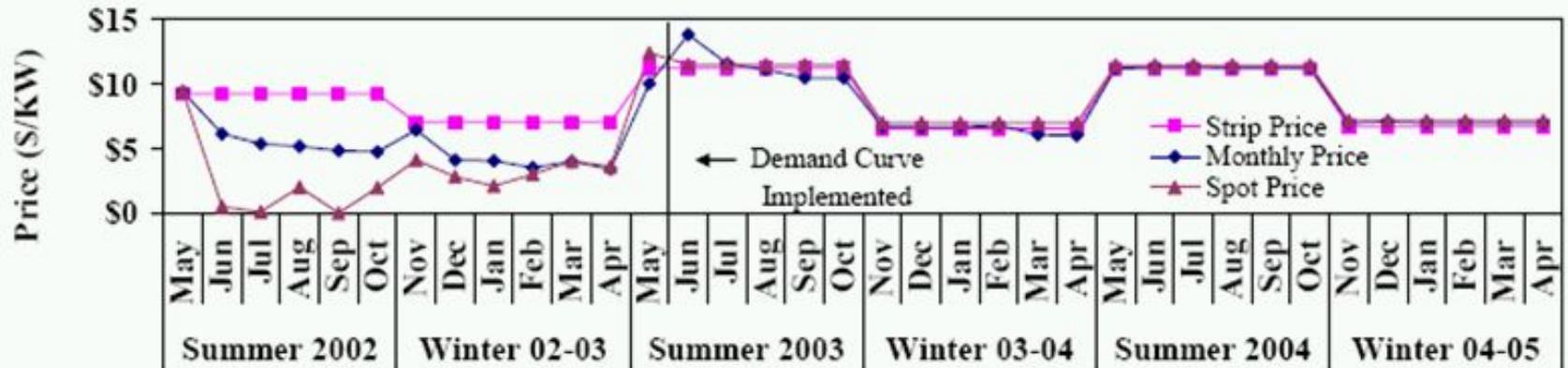
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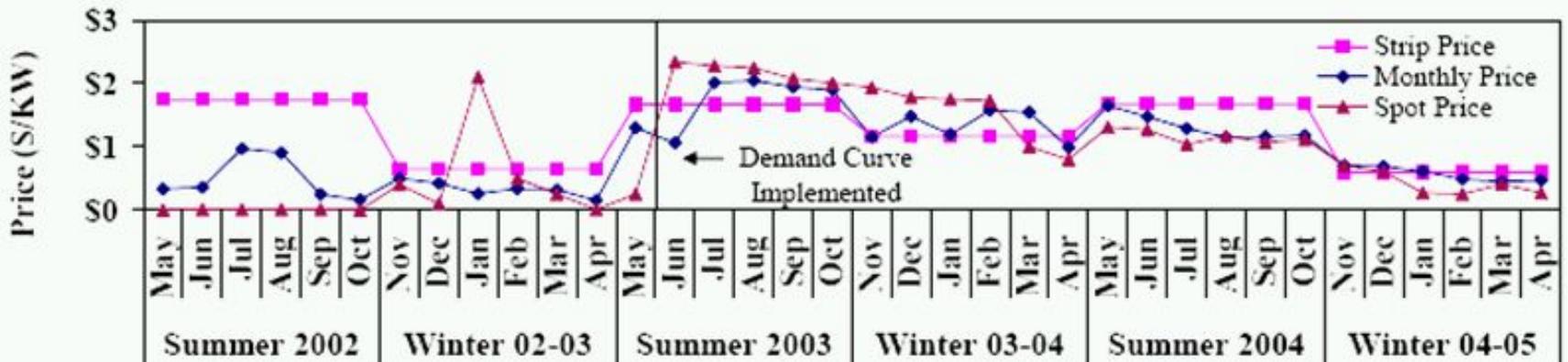


Capacity Credit

Unforced Capacity Market - NYC



Unforced Capacity Market - Rest of the State



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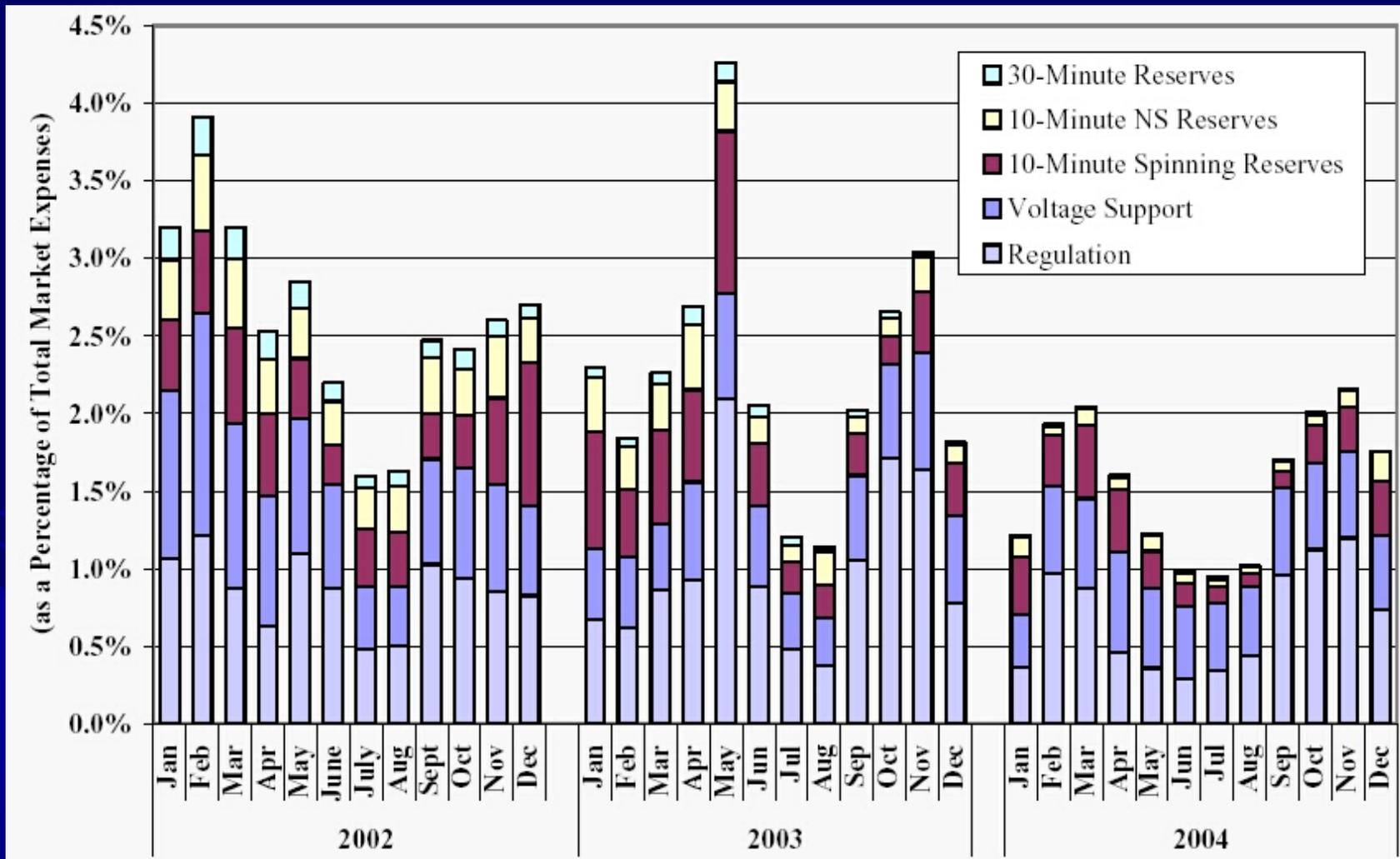


Source: NYISO State of the Market Report 2004





Ancillary Services Expenditure



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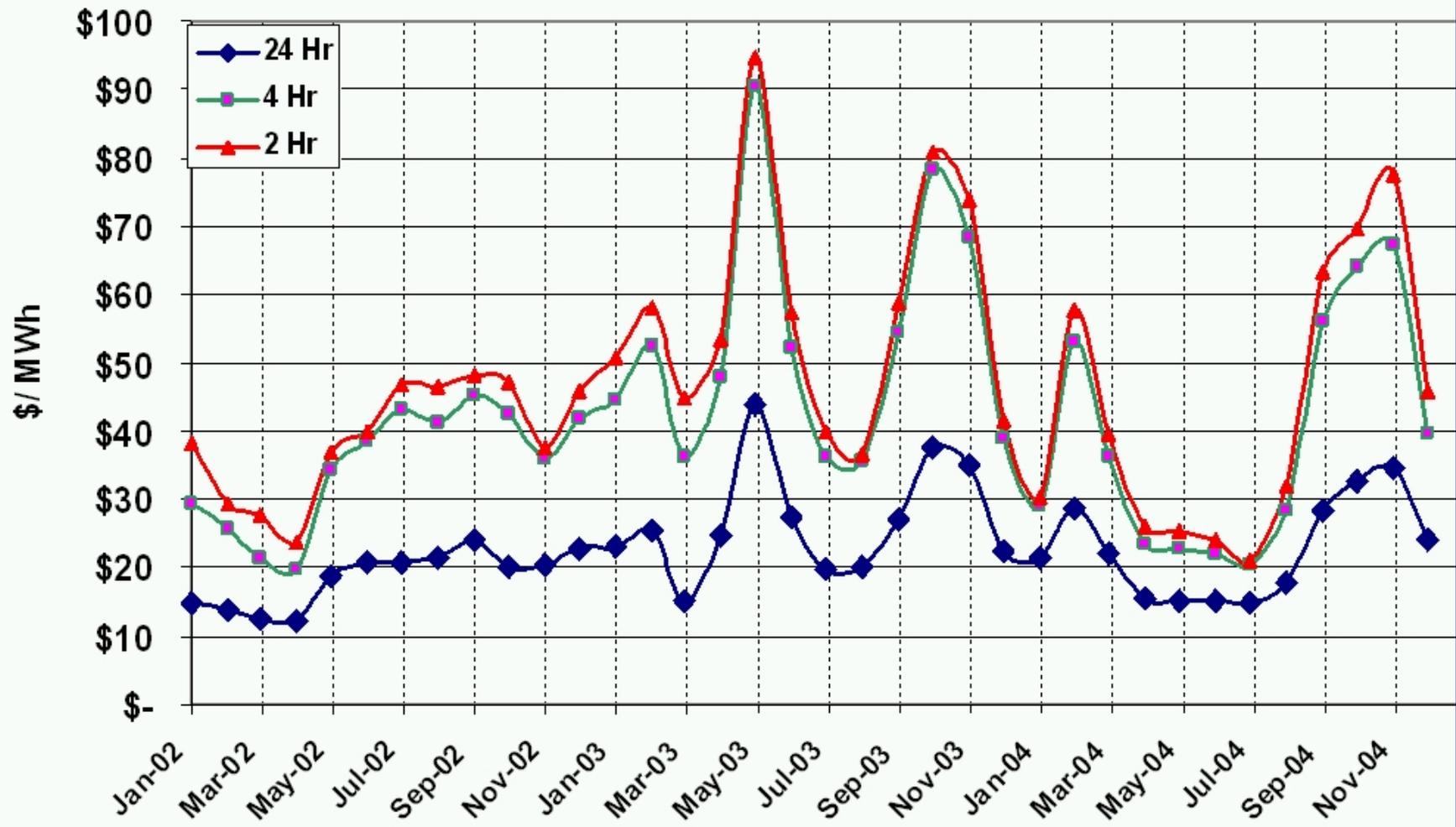


Source: NYISO State of the Market Report 2004





Average Regulation Prices



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Based on 2002-04 Regulation prices for NY-East





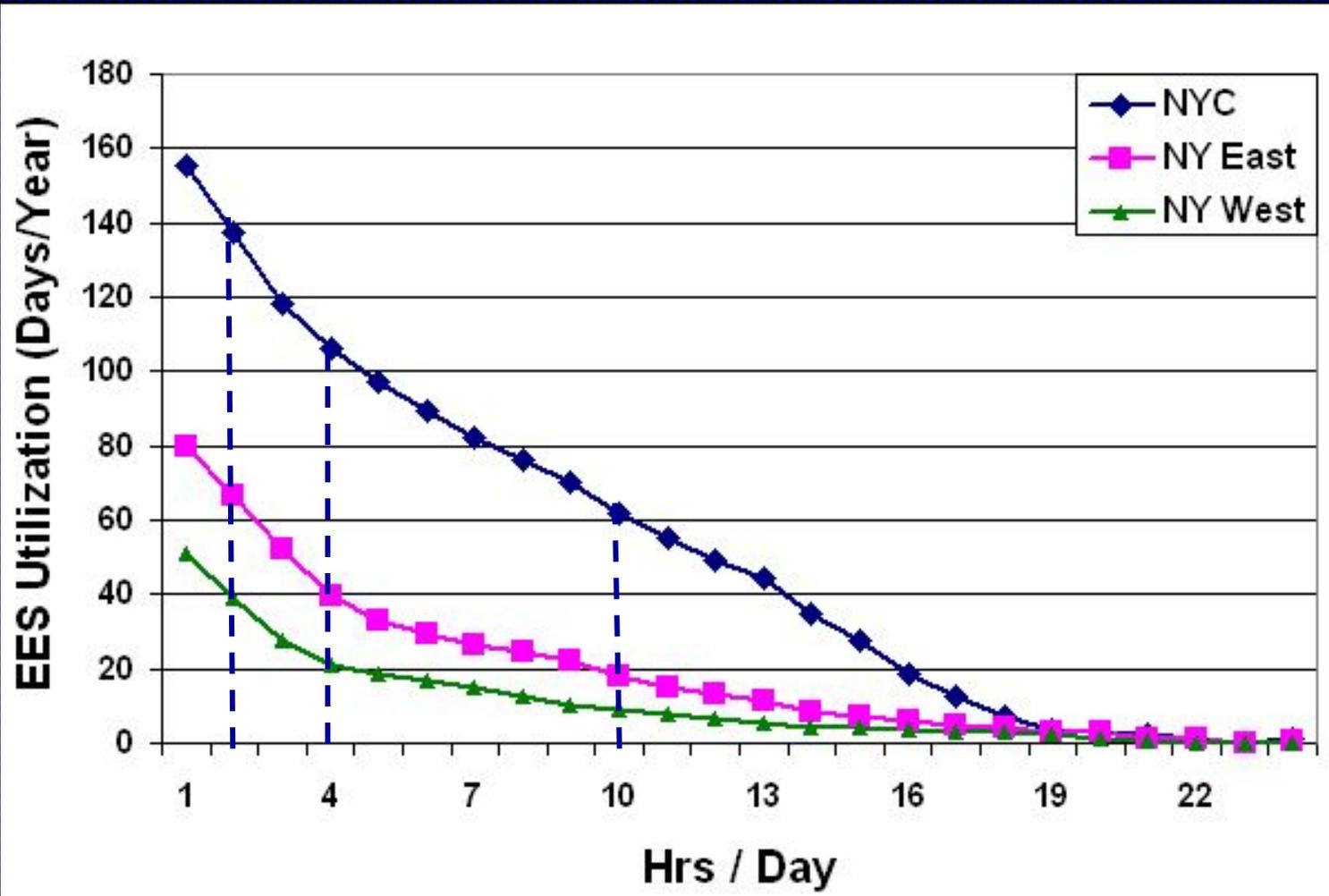
Demand Side Response

- ❖ Can participate in Day Ahead Demand Response Program (DADRP) when wholesale market prices go above \$75/MWh under the Economic Demand Response Program
- ❖ Opportunities and Revenues will depend on location on the grid
- ❖ NYISO has paid \$15,000,000 to DSR resource during 2001-05
- ❖ Demand Response Providers have received \$75,000,000 in Capacity Revenues in 2001-05



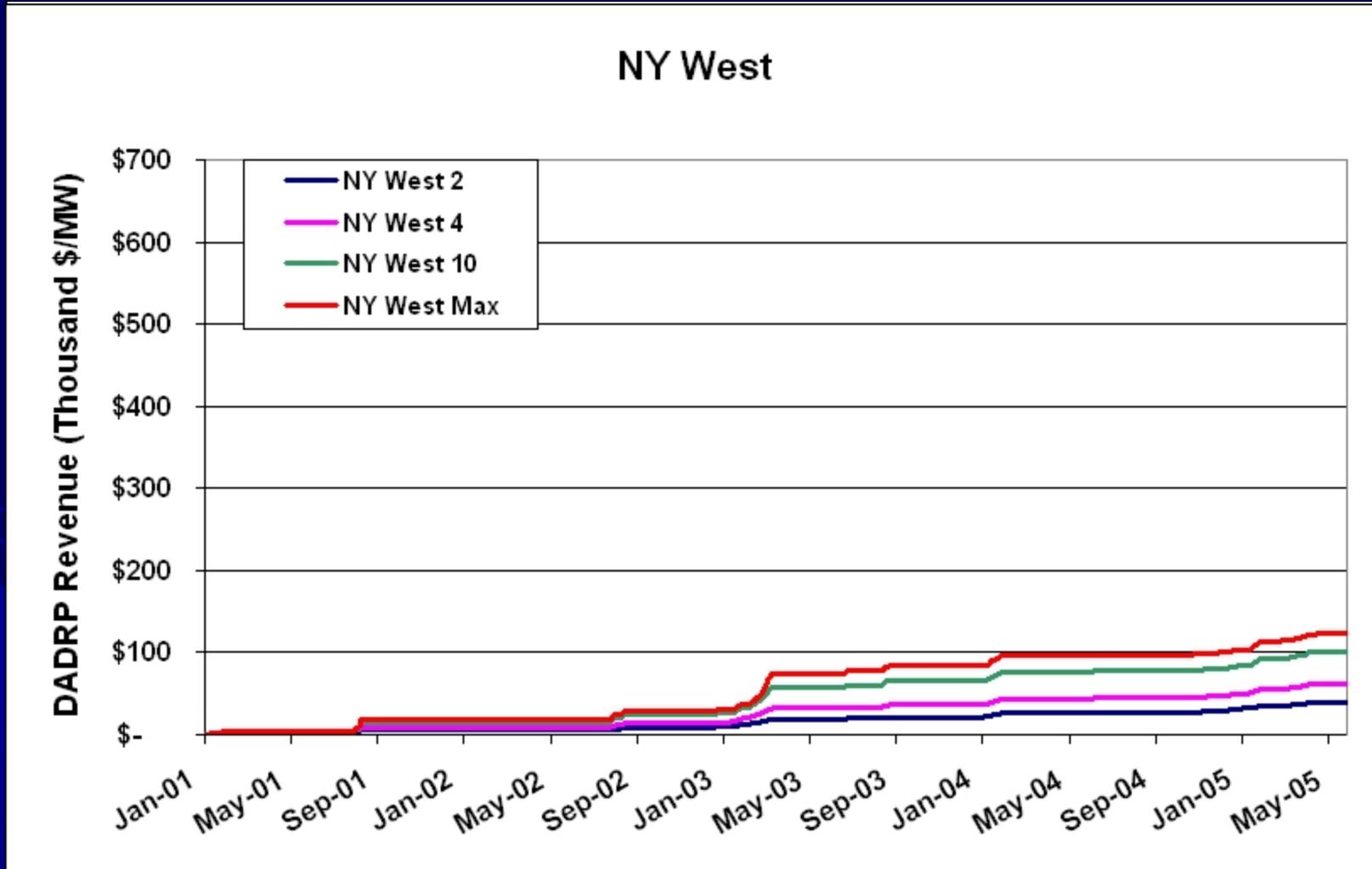


DSR Opportunity and EES Utilization





DADRP Revenue and EES Duration



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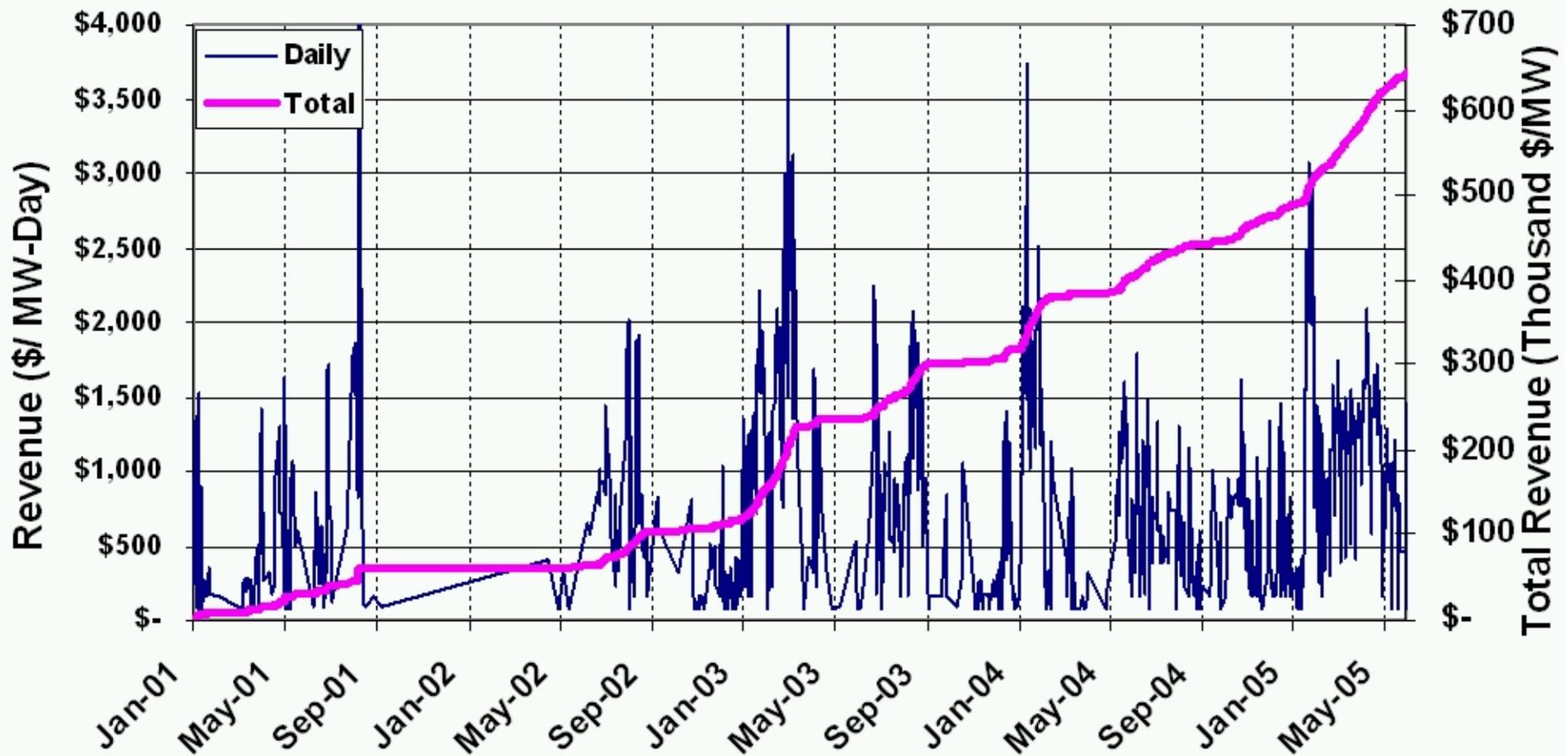


Based on 2001-04 Zonal LBMP Data for Hudson Valley, Central and NYC.





DADRP Revenues - NYC



Based on 2001-04 Zonal LBMP Data for NYC.





Supporting Renewables

- ❖ Increasing Capacity Revenues
 - Renewables (wind / solar) may get only 13-40% capacity credit
 - This would result in potential loss of revenue in the range of \$40,000-\$125,000 / MW-yr
- ❖ Increasing Energy Revenues
 - As a non dispatchable energy source, renewables may lose significant amount of energy revenues
 - Wind farms may need to curtail wind energy output due to transmission curtailments
- ❖ Potential revenues from emission credits / RECs





Challenges

- ❖ Understanding the market dynamics and rules
- ❖ Most of the opportunities could be location specific, thus identifying the right sites is critical
- ❖ No market for power quality at wholesale level, thus focus on energy, capacity & ancillary services revenue
- ❖ Need to develop applications to tap into multiple revenue sources
- ❖ May need to combine the wholesale market revenues with power quality benefits provided to end users to justify the investments.





Challenges

- ❖ EES may increase the total emissions for NY state by displacing natural gas peakers while using coal plants for off peak energy source.
- ❖ Technology maturity and commercialization
- ❖ Siting and security may be a concern in NYC region





Potential Future Work

- ❖ Detailed technical analysis for energy storage technologies for specific market applications.
- ❖ Sizing and duty-cycle criterion for break-even point economic analysis.





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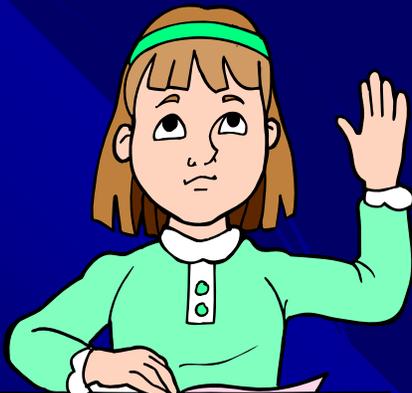
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Thank You!!!!

