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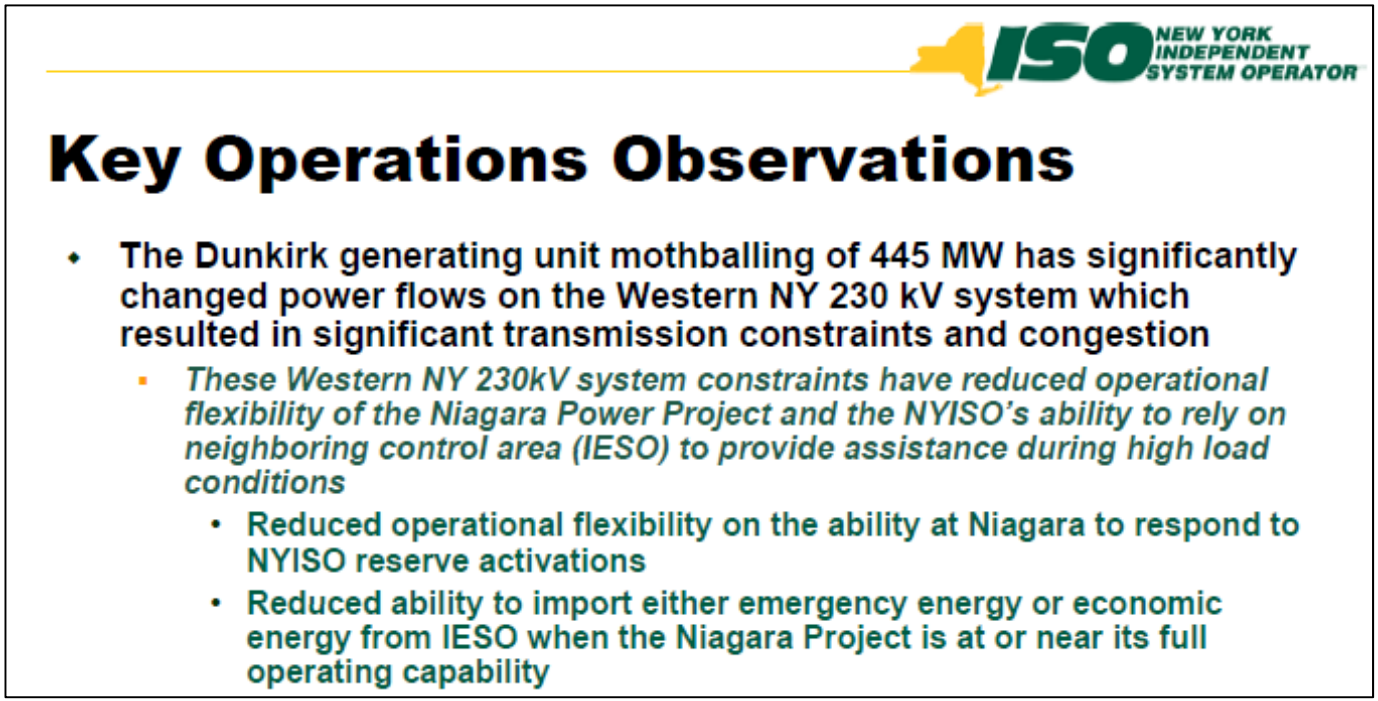
Western NY Congestion Issue

October 31, 2013

Revised 11/6/13 – To Include 2014 Results Addendum

Background – Congestion Issue

- NYISO identified the issue in its August 15, 2013 presentation to the Operating Committee on the July 15-19, 2013 Heat Wave



NEW YORK INDEPENDENT SYSTEM OPERATOR

Key Operations Observations

- **The Dunkirk generating unit mothballing of 445 MW has significantly changed power flows on the Western NY 230 kV system which resulted in significant transmission constraints and congestion**
  - ***These Western NY 230kV system constraints have reduced operational flexibility of the Niagara Power Project and the NYISO's ability to rely on neighboring control area (IESO) to provide assistance during high load conditions***
    - **Reduced operational flexibility on the ability at Niagara to respond to NYISO reserve activations**
    - **Reduced ability to import either emergency energy or economic energy from IESO when the Niagara Project is at or near its full operating capability**

- Reliability - Fewer "tools" available to operators to manage system
- Economic - Congestion results in higher energy costs

Background – Congestion Issue

- NYISO Summer Operating Study found that transfer capability on the "Highway" would be reduced by 725 MW

Western NY Transmission Constraints

- Prior to Dunkirk unit 1,3,4 mothball, Dysinger East thermal limitation was defined by the loss of 345 kV Niagara-Rochester 1 onto the 345 kV Somerset-Rochester 2. This constraint would bind for high IESO imports coincident with high Niagara generation
  - *2012 NYISO Summer Operating Study indicated 2775 MW Normal Thermal Limitation (3075 MW Emergency)*
- Post Dunkirk 1,3,4 mothball, Dysinger East thermal limitation is defined by loss of 230 kV Huntley-Gardenville 79 onto 230 kV Huntley-Gardenville 80
  - *2013 NYISO Summer Operating Study indicated 2050 MW Normal Thermal Limitation (2725 MW Emergency). NYISO is suggesting 2650 MW to ICS WG for 2014 IRM studies*

Background – Congestion Issue

- Huntley and Dunkirk are the most effective resources for managing the limiting constraint
- Alternative is reducing imports from Ontario or Niagara Generation

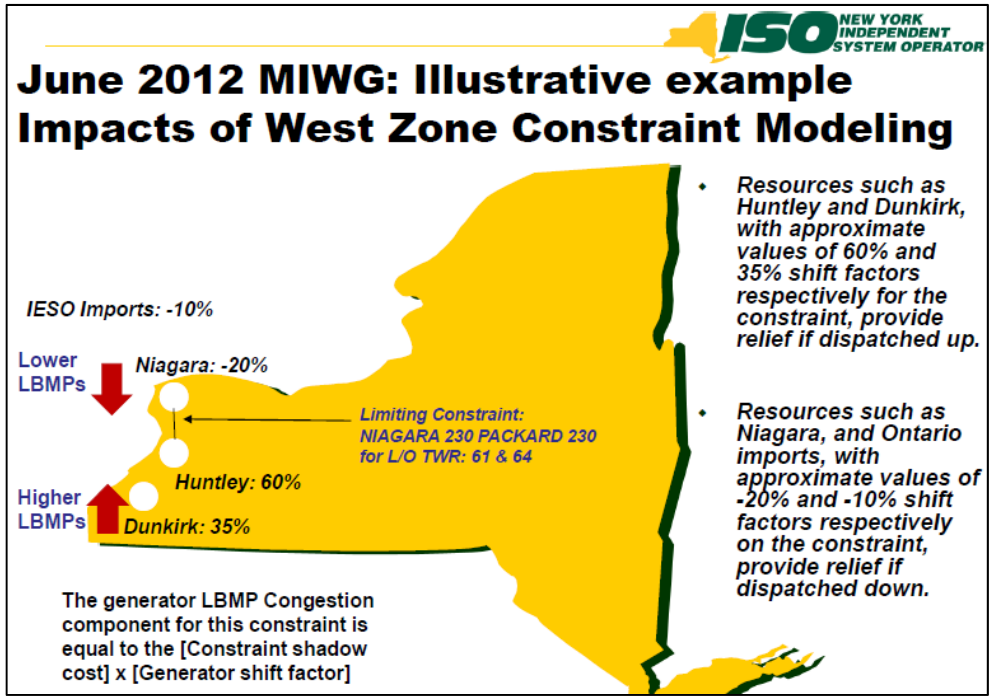
Example:

To solve a 60 MW overload on the transmission line

Increase Huntley output by 100 MW

OR

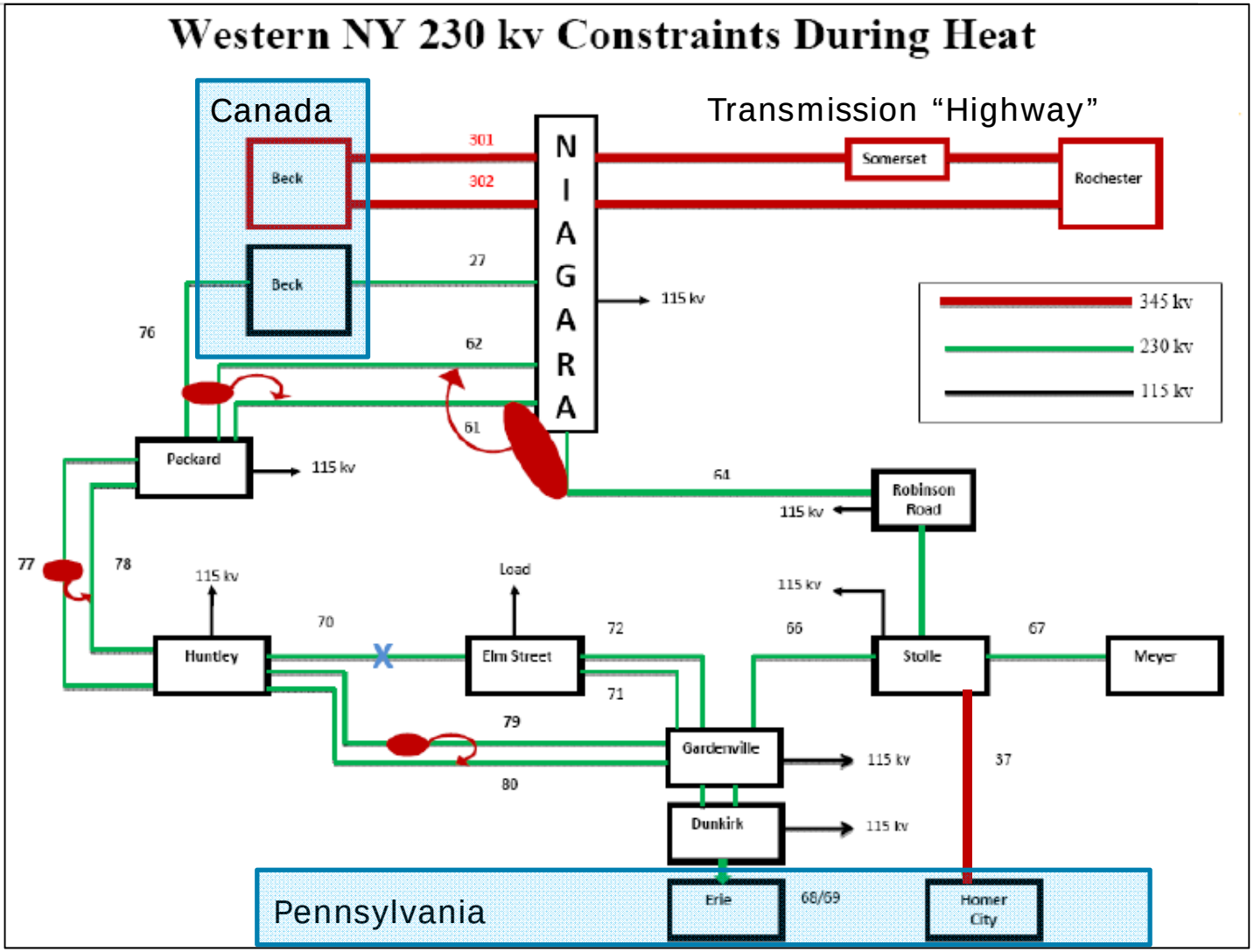
Reduce Niagara Hydro by 300 MW



Increasing generation dispatch at Huntley and Dunkirk increases the transfer capability of the system and enable use of Niagara and Ontario supplies

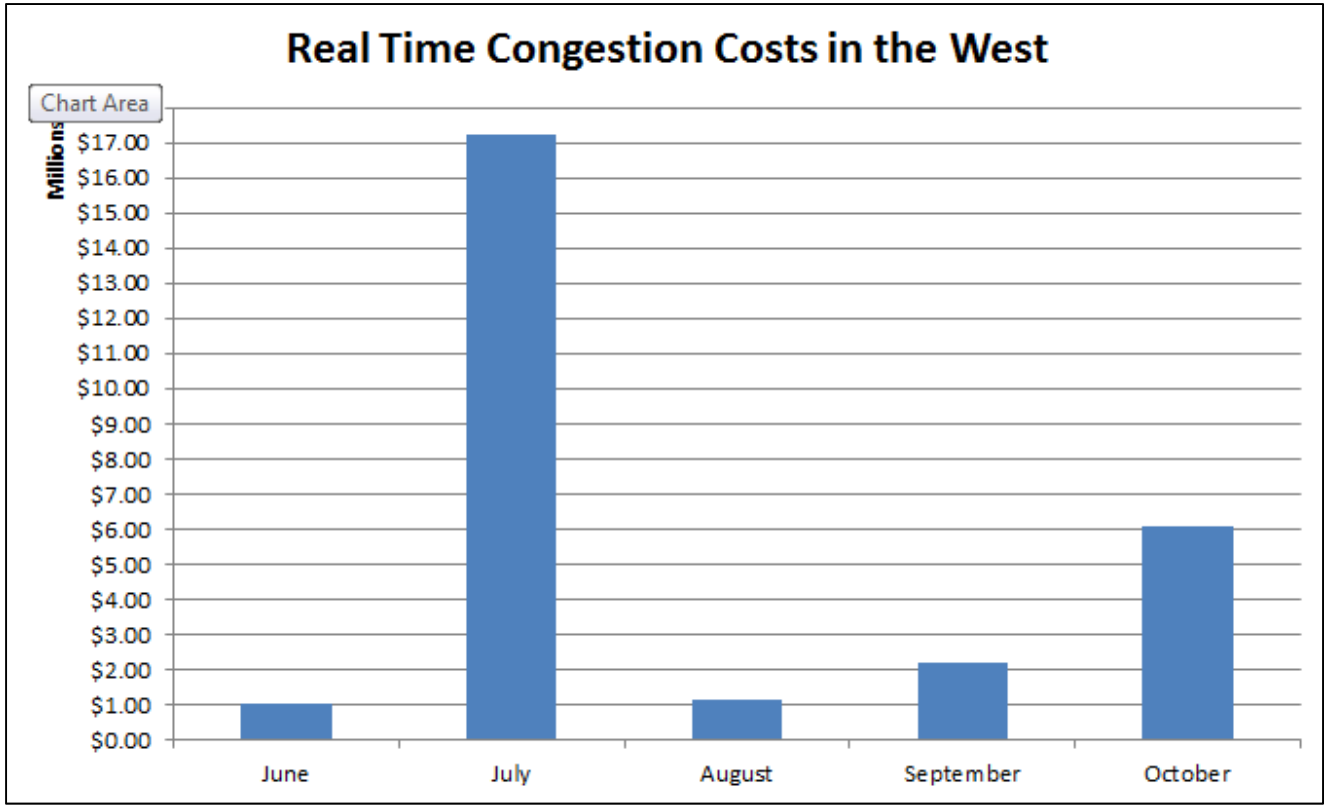
How Huntley & Dunkirk Generation Helps Transmission Flows

- Power from Niagara is injected at the 230 and 115 kV level
- Niagara power flows onto the 115 and 230 kV system rather than on the 345 kV highway
- Injections from Huntley & Dunkirk "push back" Niagara power to the stronger 345 kV lines
- Relieves overloads on lines south of Niagara
- Enhanced usage of lower cost power reduces congestion and benefits consumers



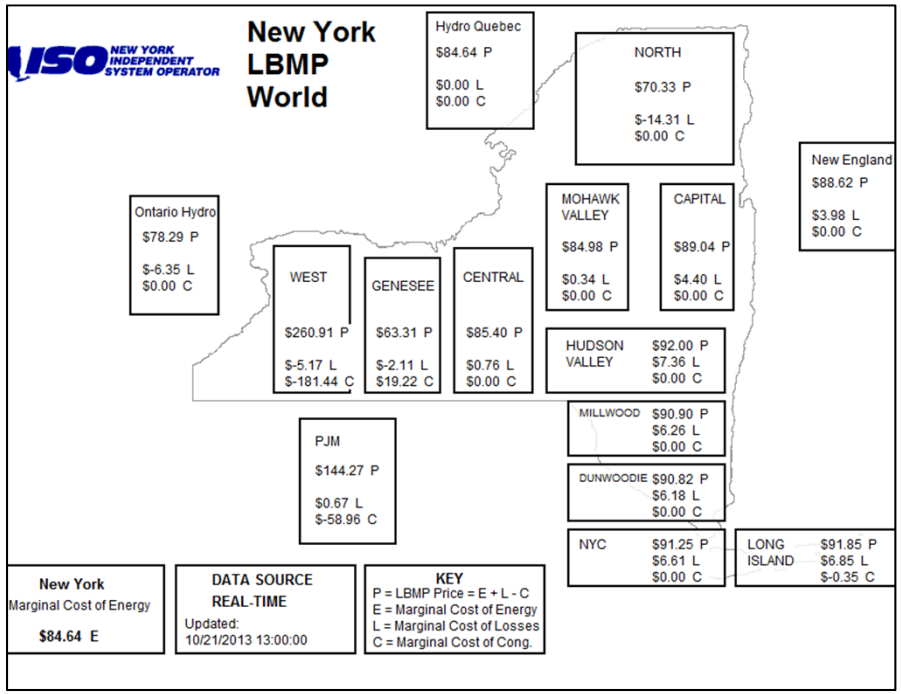
Actual Experience This Year

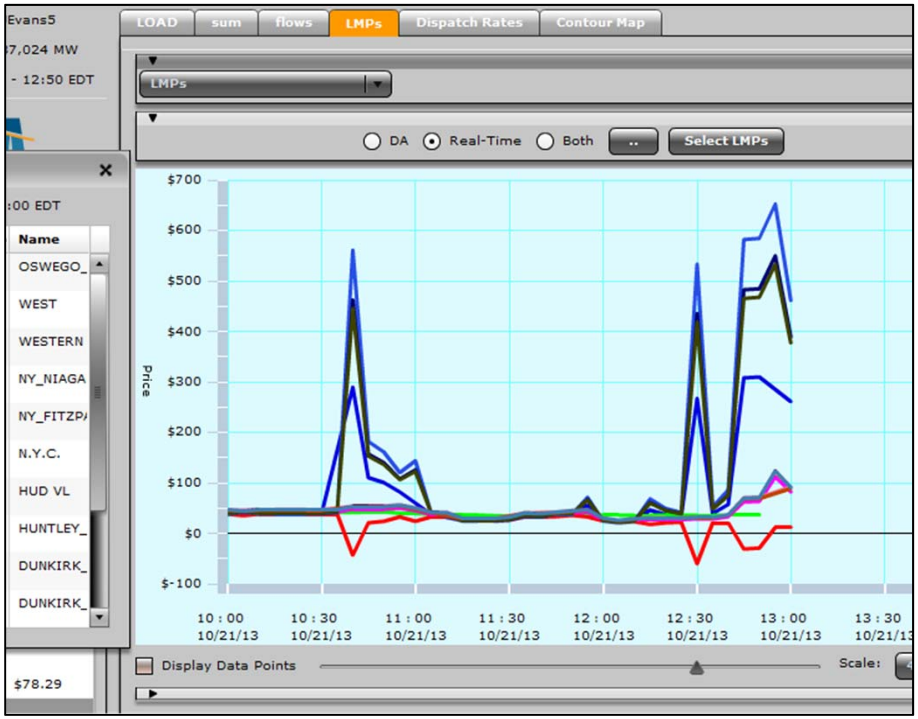
- West Zone Congestion since June 2013 has totaled $27.7 million
- Prices higher in Buffalo at times than New York City



Actual Experience This Year

- NYISO is experiencing price spikes in Western NY because of the absence of generation even during moderate load periods





Western NY Market Simulation
NRG
Approach and Results

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NRG Western NY Congestion Studies

- Objectives
  - Understand the reason for Western NY (Zone A) congestion driven price increases
  - Gauge the congestion effect of a full Dunkirk shutdown with reliability based transmission upgrades
  - Explore congestion mitigation impact and economic benefits of the Dunkirk Combined Cycle Repowering with sensitivities around Huntley dispatch scenarios
  - Provide more scenarios and details than possible in the NYISO production cost study scope
- Approach
  - PowerGEM PROBE market simulation software for several scenarios and horizon years
  - Mimic and expand on the NYISO congestion study process as much as possible
  - A 2023 network model was developed based on the NYISO 2013 FERC form 715 filing
  - The 2013 Gold Book baseline (50/50) coincident peak forecast was used

What is PROBE?

- PROBE Electricity Market Simulator
  - Mirror of actual day-ahead or real time market clearing
  - Generation & demand bids with full, detailed grid model
  - 24 hour resource commitment to securely minimize production cost
  - Reports cost, LMP, grid and resource usage in great detail
  - 5 major ISO's and others are PROBE users
- Simulation Data
  - Niagara represented by their average hourly historic bid pattern
  - Other generators represented by bids
  - Cost and generator characteristics from SNL Financial data service
  - Grid and other economic data from FERC filings, CARIS
- Annual simulation is result of 365 linked optimized 24 hour periods
  - 365 day full NYCA simulation time 4 hours
  - Calibrated model to historic congestion patterns, prices, and generator reported performance

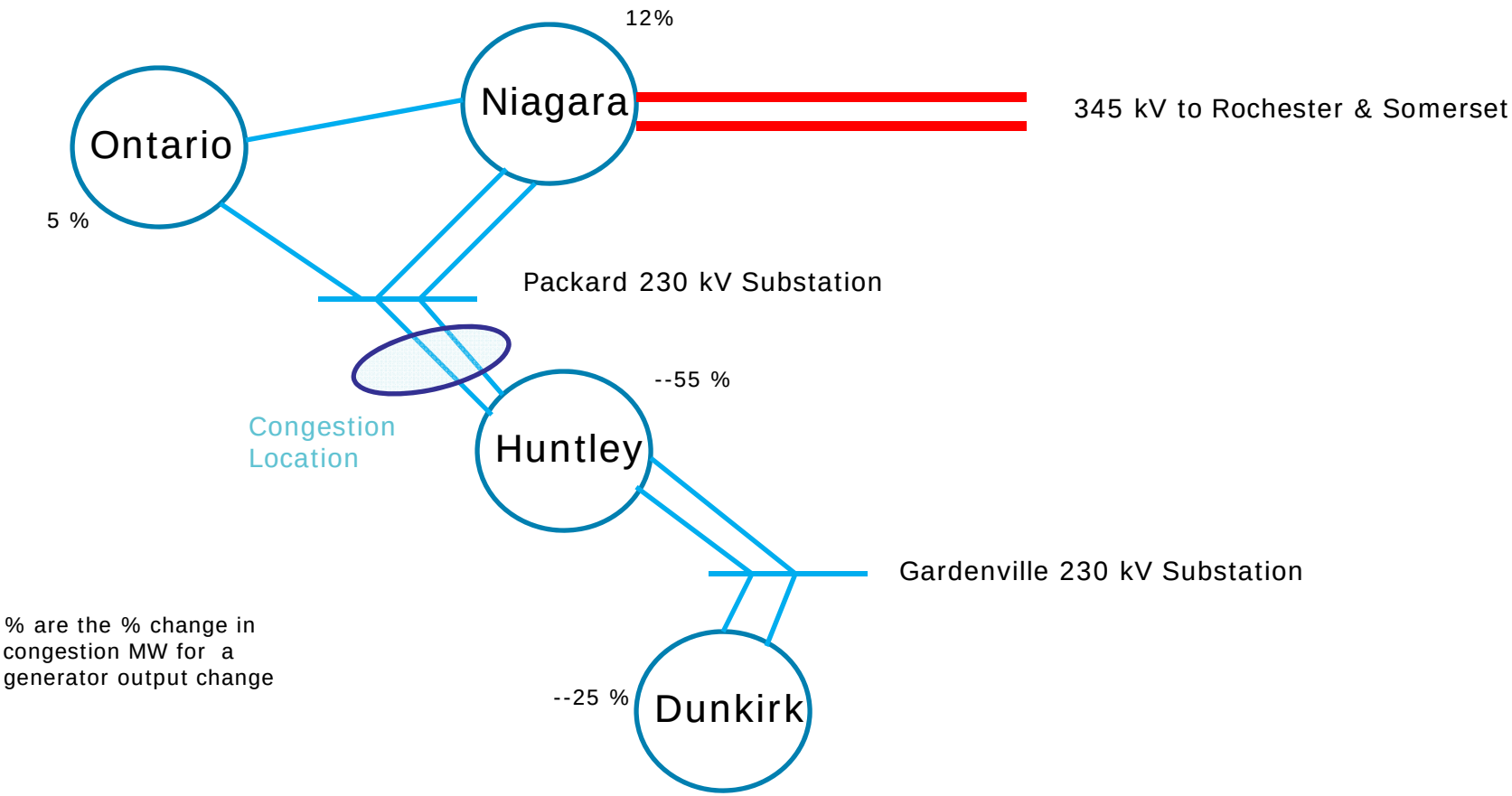
NRG Western NY Congestion Studies - Scenarios

Scenario	Dunkirk 115 kV Gen MW	Dunkirk 230 kV Gen MW	Huntley MW	Reliability Based Transmission
Base	0	0	on	in
2	0	0	off	in
3	0	422	on	out
4	0	422	off	out

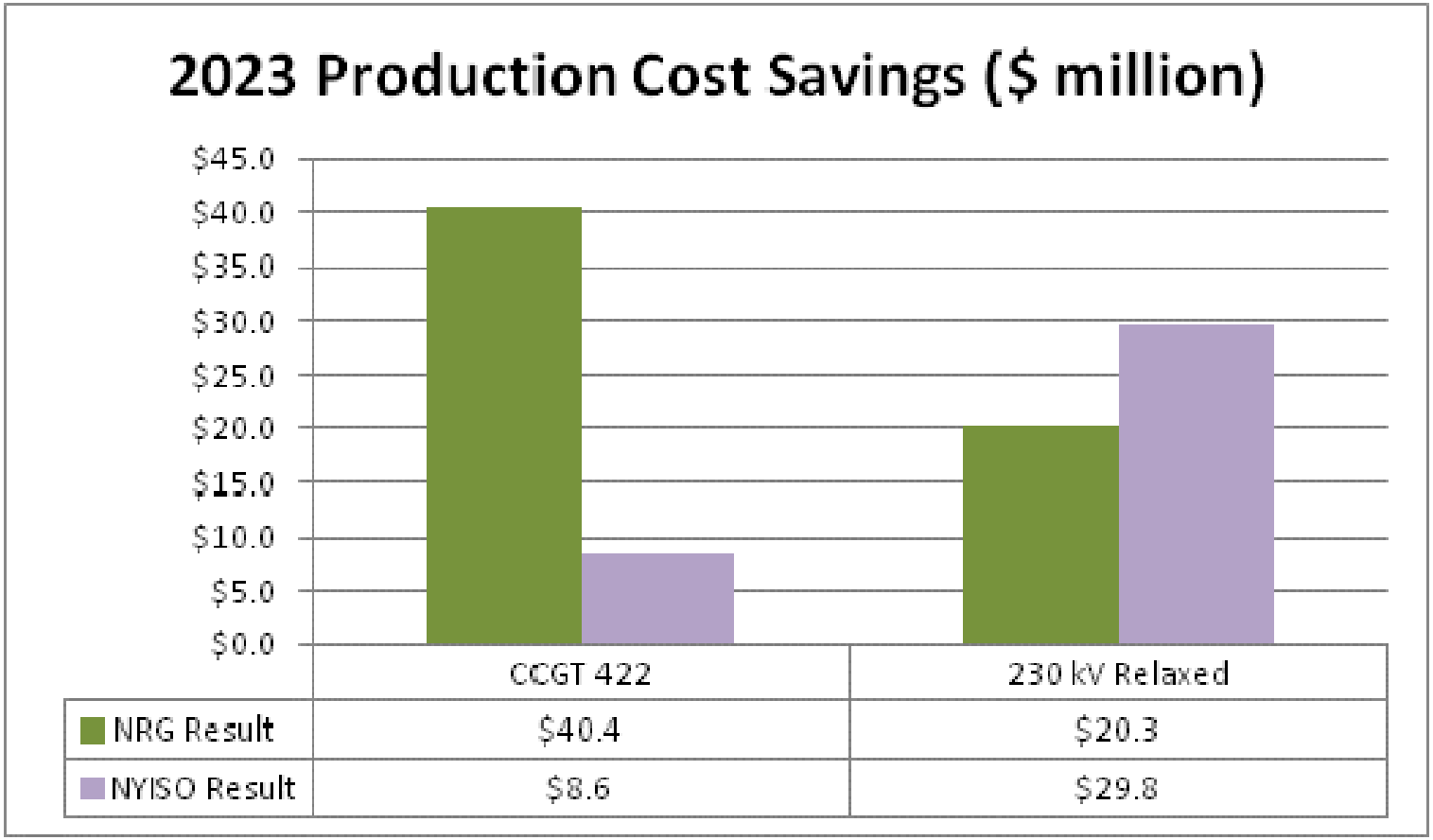
NRG & NYISO Western NY Congestion Studies

- Different Simulation Tools
  - PowerGEM – PROBE market model based on secure minimum production cost calculation
  - NYISO - GE MAPS production cost simulator
- Grid and resource model are the same but differ in some ways
- Salient simulation difference is the assumed Niagara market participation
  - PowerGEM – ***All resources are bid-in market players, including Niagara***
  - NYISO – ***Niagara is a price taker and will operate at full MW available***
- Horizon years and scenarios aligned as well as possible within time available
- Results definitions are the same
- Earlier model result comparisons have similar qualitative but different quantitative results
  - PROBE tends to result in more congestion cost and transmission limit production cost impact

NRG Western NY Congestion Studies – The Grid & Major Players

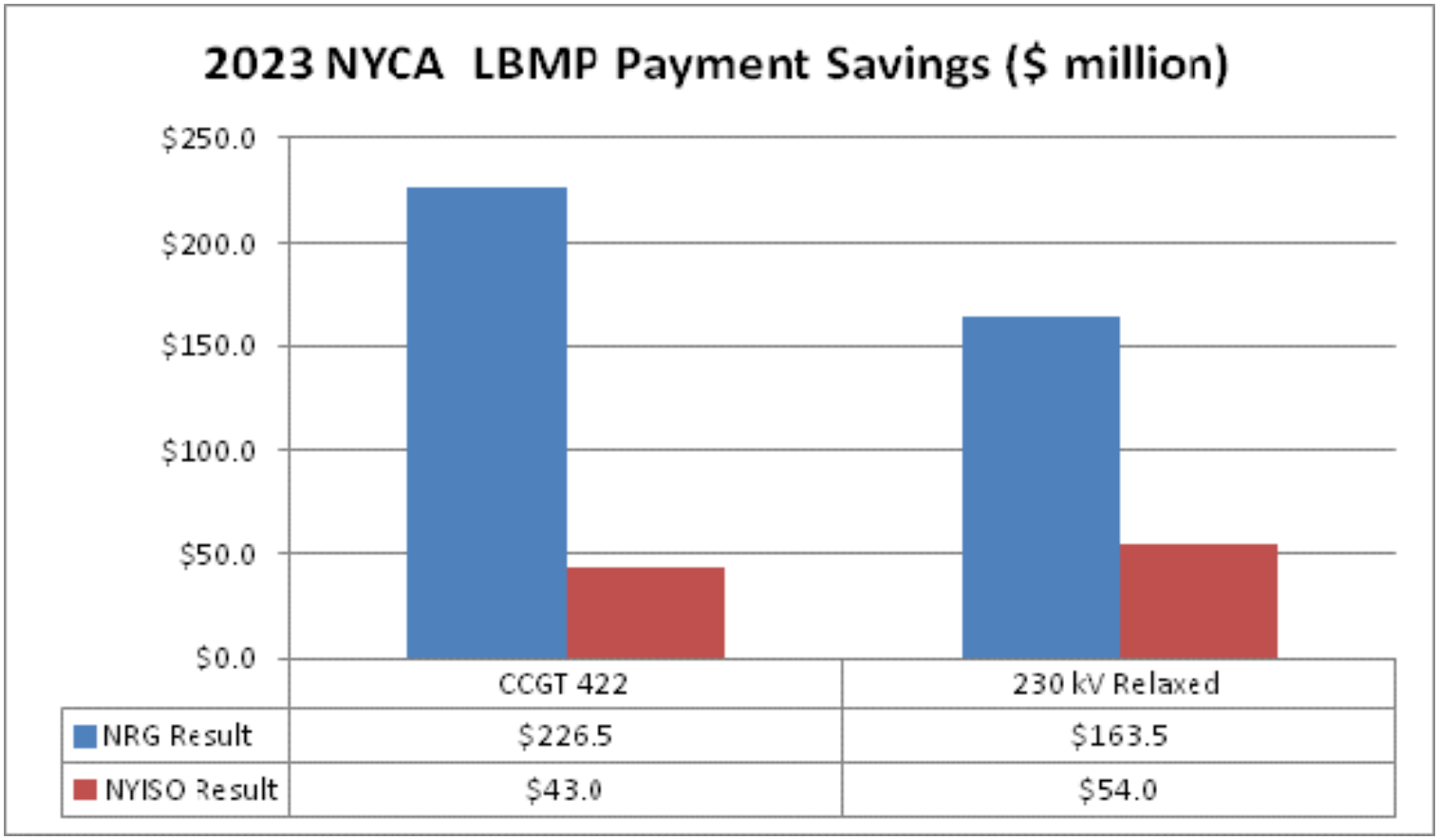


NRG Western NY Congestion Studies Results: Production Cost Saving



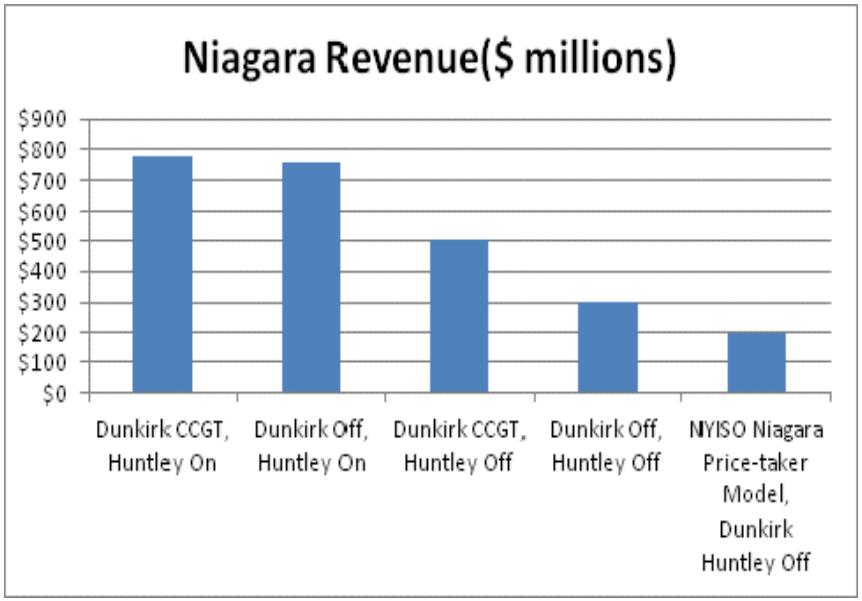
Change from base case scenario with no Dunkirk generation and Huntley is dispatched on

NRG Western NY Congestion Studies Results: NYCA Load Congestion Saving



Change from base case scenario with no Dunkirk generation and Huntley is dispatched on

NRG Western NY Congestion Studies Results: Other Results



- A Dunkirk Combined Cycle would moderate Zone A prices and enhance Niagara's output
- The loss of Dunkirk generation if Huntley units were not available for dispatch will:
  - Result in significantly higher LMPs
  - Adversely impact Niagara generation revenues by hundreds of millions of dollars
- Electric customers in the West zone would suffer even more severe price spikes than they are currently experiencing today

Scenario Compared to Base (Dunkirk Off, Huntley On)	Hours 230 kV Congested Change	Zone A Congestion Payment Change ($ million)	Zone A Average LMP Change ($/MWHr)	Niagara Revenue Change ($ million)	Niagara Revenue Change (%)
422 MW Dunkirk Repowering	-1,047	-$108	-$3.20	$22	3%
Huntley Off	4,027	$1,296	$38.55	-$457	-60%
Huntley Off 422 MW Dunkirk Repowering	2,680	$655	$19.69	-$254	-34%

Change from base case scenario with no Dunkirk generation and Huntley is dispatched on

NRG Western NY Congestion Studies Observations

- NRG Market Simulations Show More Dunkirk Repowering Savings than was found in NYISO Studies
  - $40 million *vs* $9 million in Production Cost Savings
  - $226 million *vs* $43 million in NYCA Congestion Payments
- The Zone A Congestion Concern is a 230 kV Problem
  - The 115 kV Transmission Upgrades for Reliability Did Not Affect Congestion Study Results
- Dunkirk CCGT Addition Saved More than Eliminating 230 kV Transmission Limitations
  - $40 million *vs* $20 million in Production Cost Savings
- A Combined Huntley & Dunkirk Off-Line Configuration Causes a Major Cost and Congestion Impact

NRG Western NY Congestion Studies Observations

- NYPA losses are significant and will increase in order to force dispatch with the 230kV constraints

- The WNY economy is suffering price volatility that will be exacerbated without generation replacements on the system

- Generation can efficiently solve these two issues AND solve the reliability issues that National Grid has raised

2014 Results Addendum

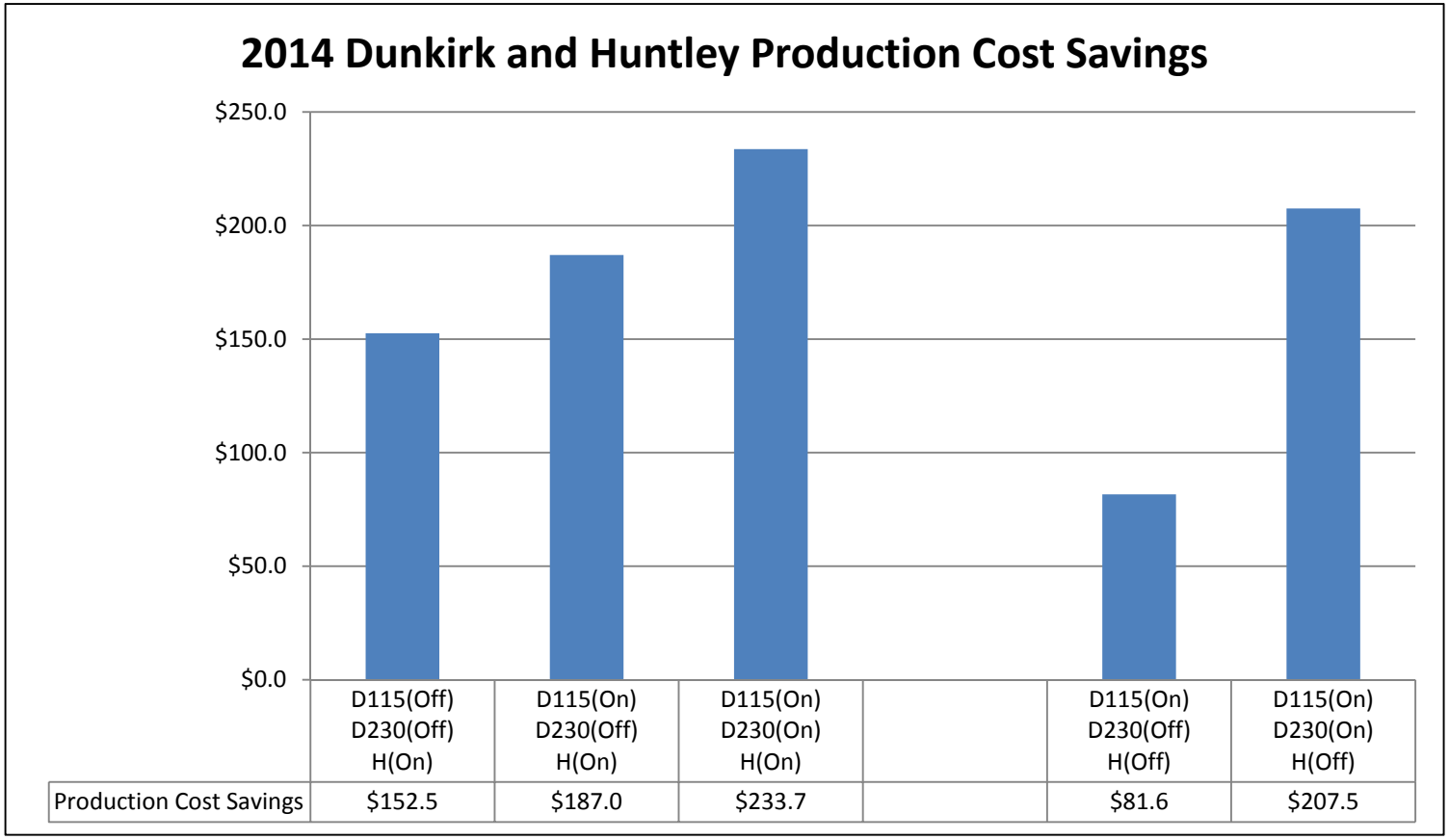
• Approach and Results

— 2014 Results assume more Niagara Power and less IESO power available than in NRG 2023 and NYISO calculations

- o 2014 Cases were run using actual historic offer MW profiles to establish the quantity available for dispatch from Niagara and Ontario.
- o 2023 Cases were run to approximate the NYISO's modeling approach which increased Ontario imports (2X) and reduced Niagara offered MW (25%) over a daily period from the 2014 cases.
- o The increase in higher cost Ontario supply and diminished Niagara output reduces the amount of lower cost MW available for dispatch and tend to reduce the level of congestion and production cost savings calculated by the modeling tools.

— Comparison of study results and extrapolation between 2014 and 2023 should be used to indicate trends only

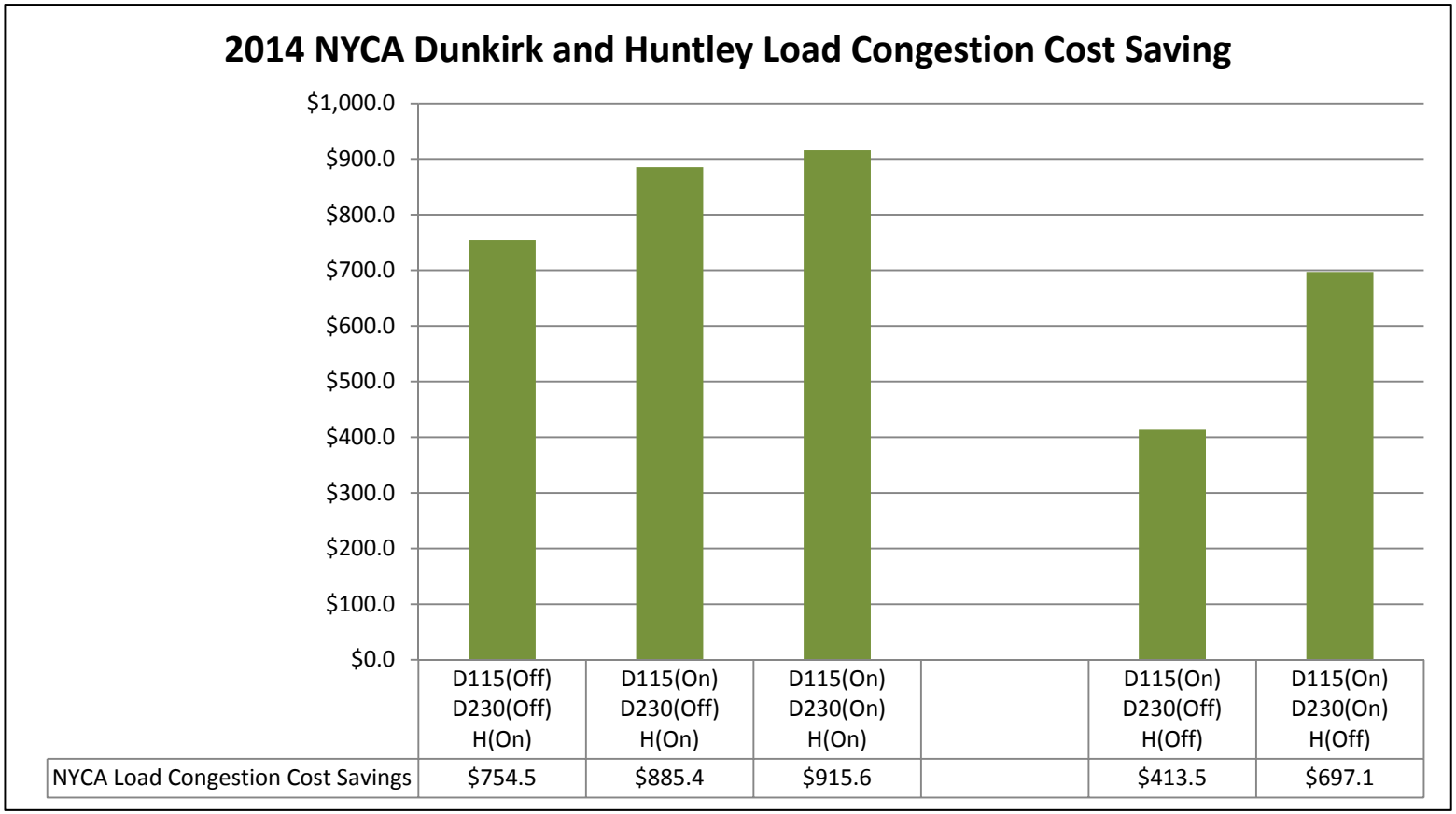
NRG Western NY Congestion Studies Results: 2014 Production Cost Savings



	D115(Off) D230(Off) H(On)	D115(On) D230(Off) H(On)	D115(On) D230(On) H(On)		D115(On) D230(Off) H(Off)	D115(On) D230(On) H(Off)
Production Cost Savings	$152.5	$187.0	$233.7		$81.6	$207.5

Change from base case scenario with Dunkirk and Huntley dispatched off

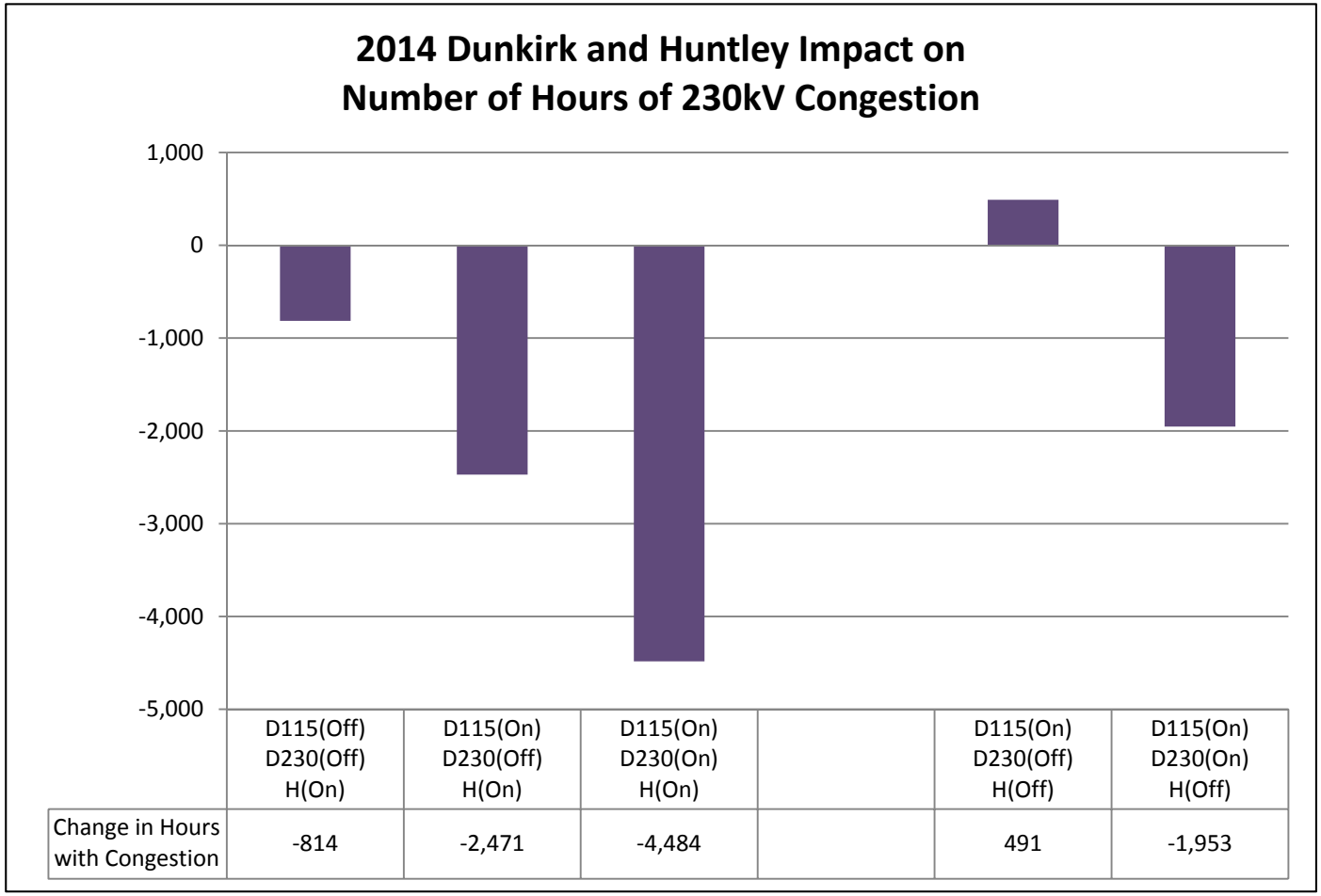
NRG Western NY Congestion Studies Results: 2014 NYCA Load Congestion Savings



	D115(Off) D230(Off) H(On)	D115(On) D230(Off) H(On)	D115(On) D230(On) H(On)		D115(On) D230(Off) H(Off)	D115(On) D230(On) H(Off)
NYCA Load Congestion Cost Savings	$754.5	$885.4	$915.6		$413.5	$697.1

Change from base case scenario with Dunkirk and Huntley dispatched off

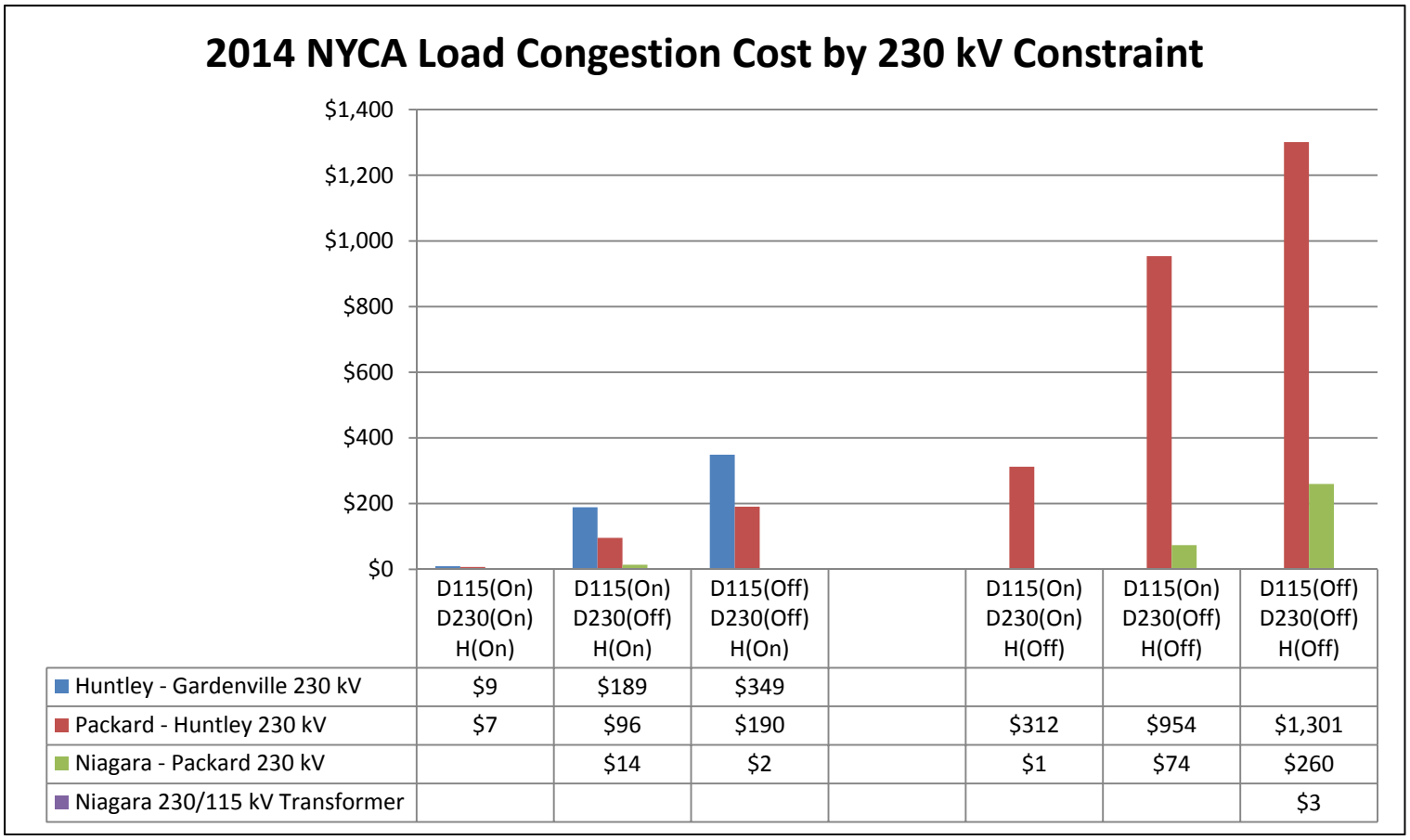
NRG Western NY Congestion Studies
Results: 2014 Change in 230 kV Congested Hours



	D115(Off) D230(Off) H(On)	D115(On) D230(Off) H(On)	D115(On) D230(On) H(On)		D115(On) D230(Off) H(Off)	D115(On) D230(On) H(Off)
Change in Hours with Congestion	-814	-2,471	-4,484		491	-1,953

Change from base case scenario of 5167 hours
With Dunkirk and Huntley dispatched off

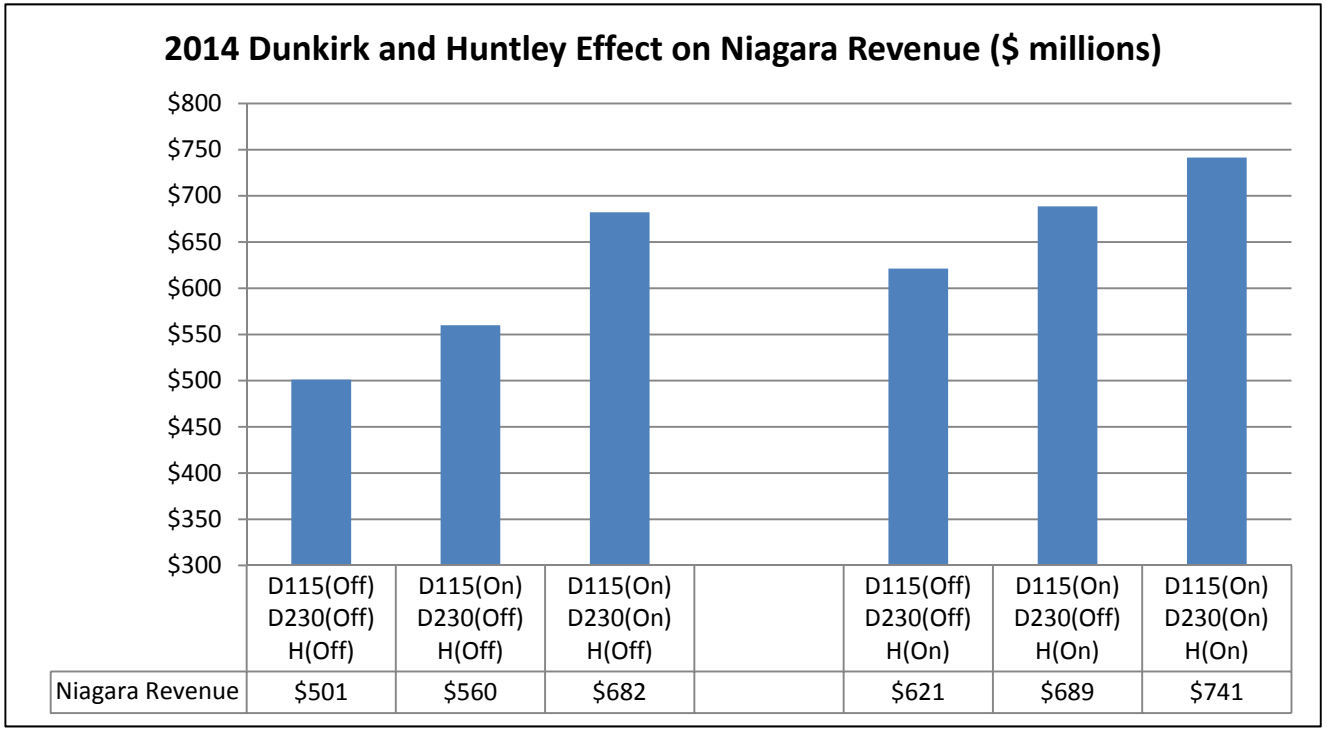
NRG Western NY Congestion Studies
Results: NYCA Congestion by 230 kV Constraint



	D115(On) D230(On) H(On)	D115(On) D230(Off) H(On)	D115(Off) D230(Off) H(On)		D115(On) D230(On) H(Off)	D115(On) D230(Off) H(Off)	D115(Off) D230(Off) H(Off)
Huntley - Gardenville 230 kV	$9	$189	$349				
Packard - Huntley 230 kV	$7	$96	$190		$312	$954	$1,301
Niagara - Packard 230 kV		$14	$2		$1	$74	$260
Niagara 230/115 kV Transformer							$3

This shows that the location of the constraint shifts with changes in Dunkirk and Huntley dispatch such that both are critical to managing this 230 kV corridor

NRG Western NY Congestion Studies Results: Other 2014 Results



Scenario Compared to Base (Dunkirk and Huntley Off)	Hours 230 kV Congested Change	Zone A Congestion Payment Change ($ million)	Zone A Average LMP Change ($/MWHr)	Niagara Revenue Change ($ million)	Niagara Revenue Change (%)
D115(On) D230(Off) H(Off)	491	$293	$1.36	$59	8%
D115(On) D230(On) H(Off)	-1,953	$691	$9.36	$181	24%
D115(Off) D230(Off) H(On)	-814	$602	$4.43	$120	16%
D115(On) D230(Off) H(On)	-2,471	$713	$7.27	$188	25%
D115(On) D230(On) H(On)	-4,484	$822	$7.89	$240	32%