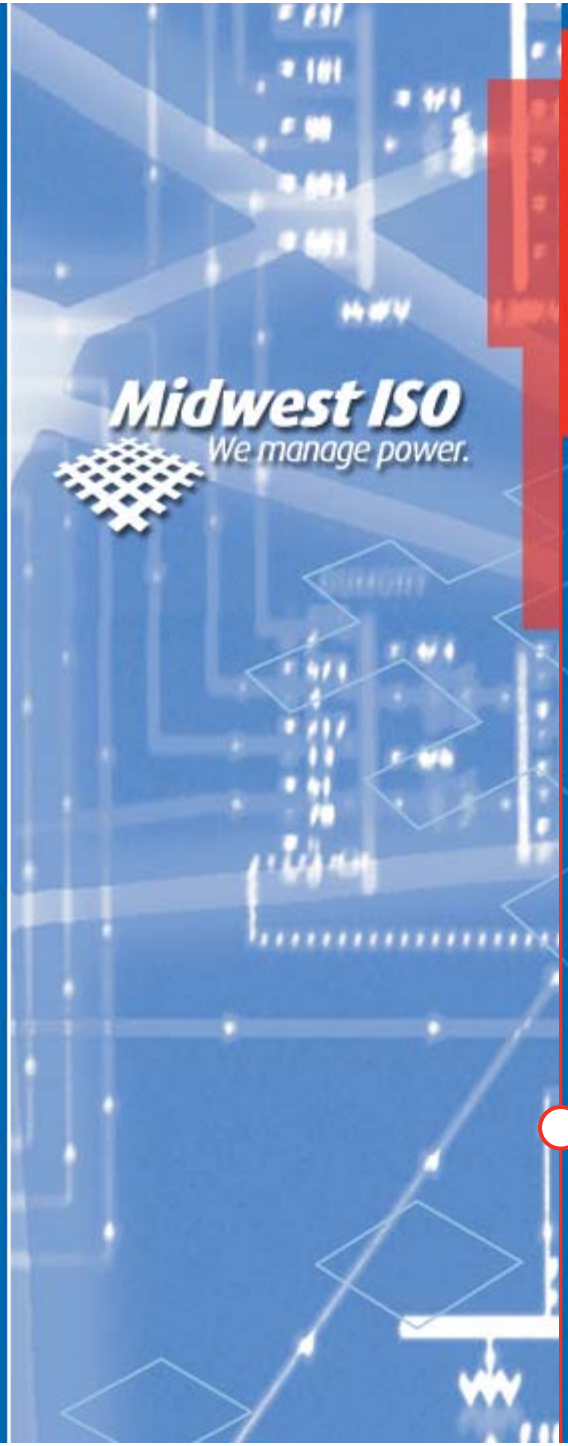
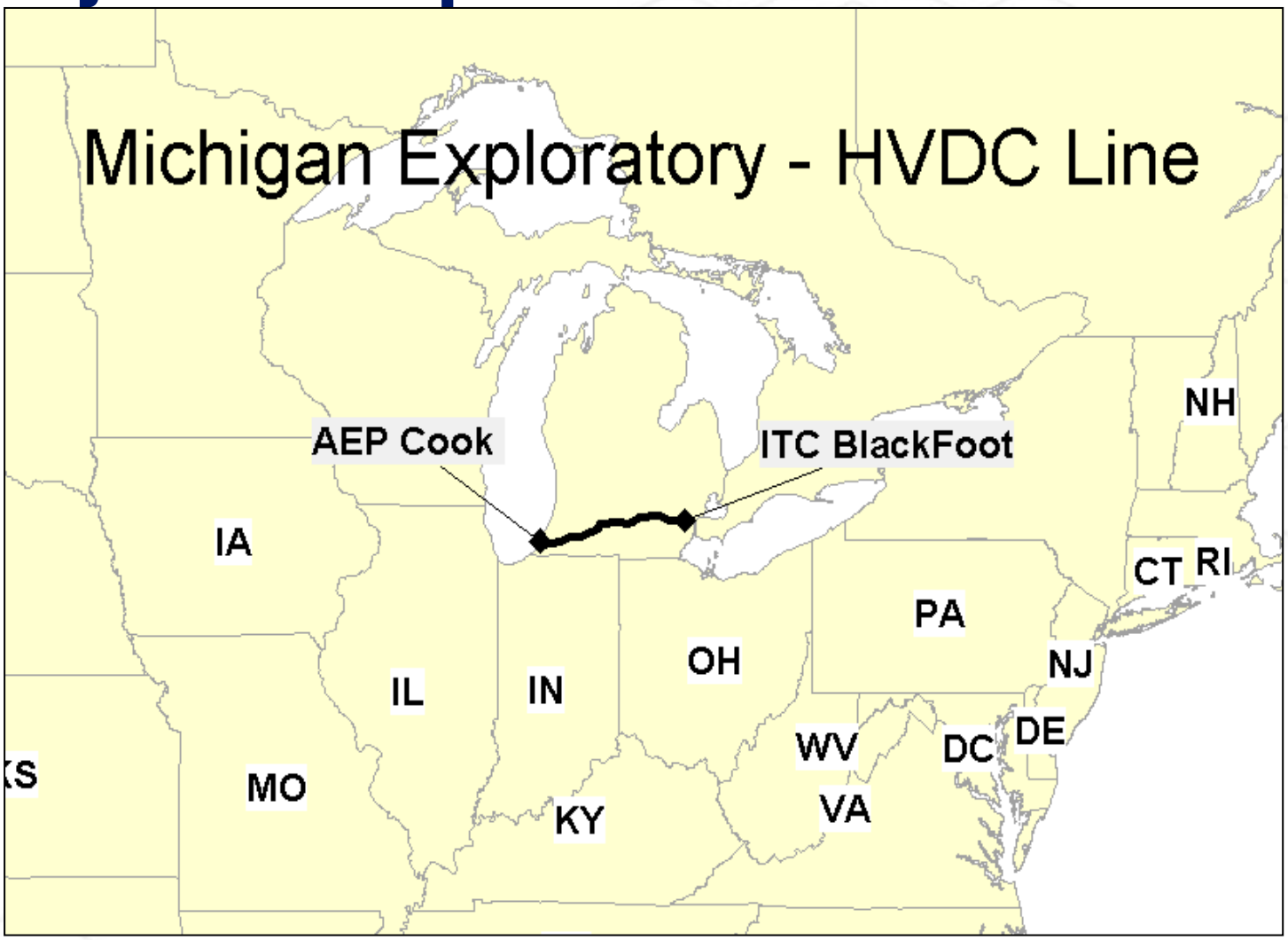


Michigan Exploratory Study

August 28, 2006

Dale Osborn, Jeffrey L. Wilson

Project Footprint



Topics

- Answers to questions about the CNF runs using PROMOD
  - HVDC
  - 765 kV
  - Equivalent CT generation constructed where the HVDC line would terminate.
- Need for LOLP and Transmission Service with CEP Forecast
- Strategist information
  - Most of the benefits over a 20 year period for a 2500 Mw transmission line are from the deferral of generation and not production cost savings.
  - Benefits determined with Strategist runs using CNF assumptions
  - Questions and Answers
  - Benefits determine with Strategist runs using CNF assumptions and the revised 21st Century Energy Plan forecast.
- Questions and Answers

Production Cost Benefits

- 2011 Study Year- MTEP forecast (CNF)
- PC Difference adjusted for sales- what the Michigan load would see as a benefit
  - HVDC- $32 M
  - 765 kV-$13 M
  - CT-$17 M
  - The differences are not significant from an Adjusted Production Cost viewpoint. The total production cost for Michigan is about $3,200M.

Economic Results for HVDC vs. Base Case

Convention is:	BASECASE minus HVDC Case			
SYSTEM	Δ Production Cost Savings	Δ Net Generation Revenue	Δ Load LMP Cost	Δ Adjusted Production Cost Savings
MISO	$93M	$36M	$97M	$41M
PJM*	($64M)	($40M)	$26M	$14M
IESO	$27M	$32M	$20M	($8M)
OTHER*	($24M)	$40M	$37M	$0.8M
MICH	$133M	$84M	$136M	$32M
Non-MICH MISO	($39M)	($47M)	($39M)	$9M
TOTAL	$33M	$69M	$180M	$47M
	Positive - cost reduction, good for load customers	Positive - a reduction less market power	Positive - cost reduction, good for load customers	Positive - cost reduction, good for load customers

Economic Results for 2720MW CTs vs. Base Case

Convention is:	BASECASE minus Combustion Turbine Case			
SYSTEM	Δ Production Cost Savings	Δ Net Generation Revenue	Δ Load LMP Cost	Δ Adjusted Production Cost Savings
MISO	$0.5M	$119M	$149M	$33M
PJM*	$5M	$121M	$125M	$1M
IESO	$2M	$10M	($5M)	($3M)
OTHER*	$4M	$56M	$56M	($2M)
MICH	($19M)	$22M	$45M	$17M
Non-MICH MISO	$20M	$97M	$104M	$17M
TOTAL	$11M	$306M	$325M	$29M
	Positive - cost reduction, good for load customers	Positive - a reduction less market power	Positive - cost reduction, good for load customers	Positive - cost reduction, good for load customers

Economic Results for 765kVAC vs. Base Case

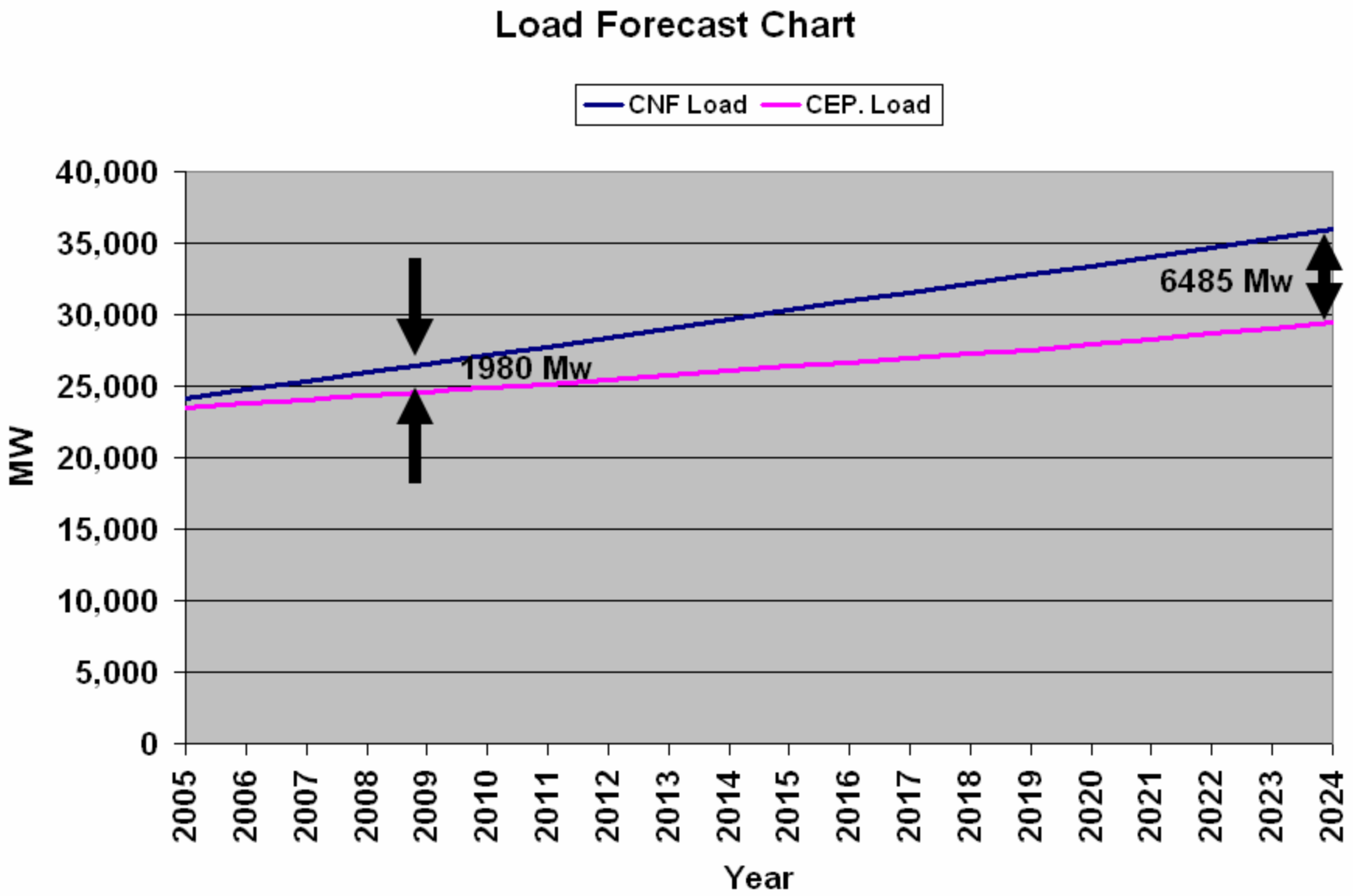
Convention is:	BASECASE minus HVDC Case			
SYSTEM	Δ Production Cost Savings	Δ Net Generation Revenue	Δ Load LMP Cost	Δ Adjusted Production Cost Savings
MISO	$82M	$146M	$189M	$32M
PJM*	($70M)	($42M)	($27M)	$4M
IESO	$12M	$4M	($13M)	($5M)
OTHER*	($14M)	$30M	$33M	$1M
MICH	$83M	$121M	$134M	$13M
Non-MICH MISO	($2M)	$25M	$55M	$19M
TOTAL	$9M	$137M	$183M	$32M
	Positive - cost reduction, good for load customers	Positive - a reduction less market power	Positive - cost reduction, good for load customers	Positive - cost reduction, good for load customers

Economic Results, HVDC + 2720MW CTs vs. Base

Convention is:	BASECASE minus HVDC Case			
SYSTEM	Δ Production Cost Savings	Δ Net Generation Revenue	Δ Load LMP Cost	Δ Adjusted Production Cost Savings
MISO	$84M	$89M	$163M	$87M
PJM*	($52M)	($52M)	$61M	$23M
IESO	$27M	$80M	$76M	($7M)
OTHER*	($23M)	$50M	$65M	$2M
MICH	$116M	$92M	$138M	$68M
Non-MICH MISO	($31M)	($3M)	$25M	$19M
TOTAL	$37M	$167M	$365M	$105M
	Positive - cost reduction, good for load customers	Positive - a reduction less market power	Positive - cost reduction, good for load customers	Positive - cost reduction, good for load customers

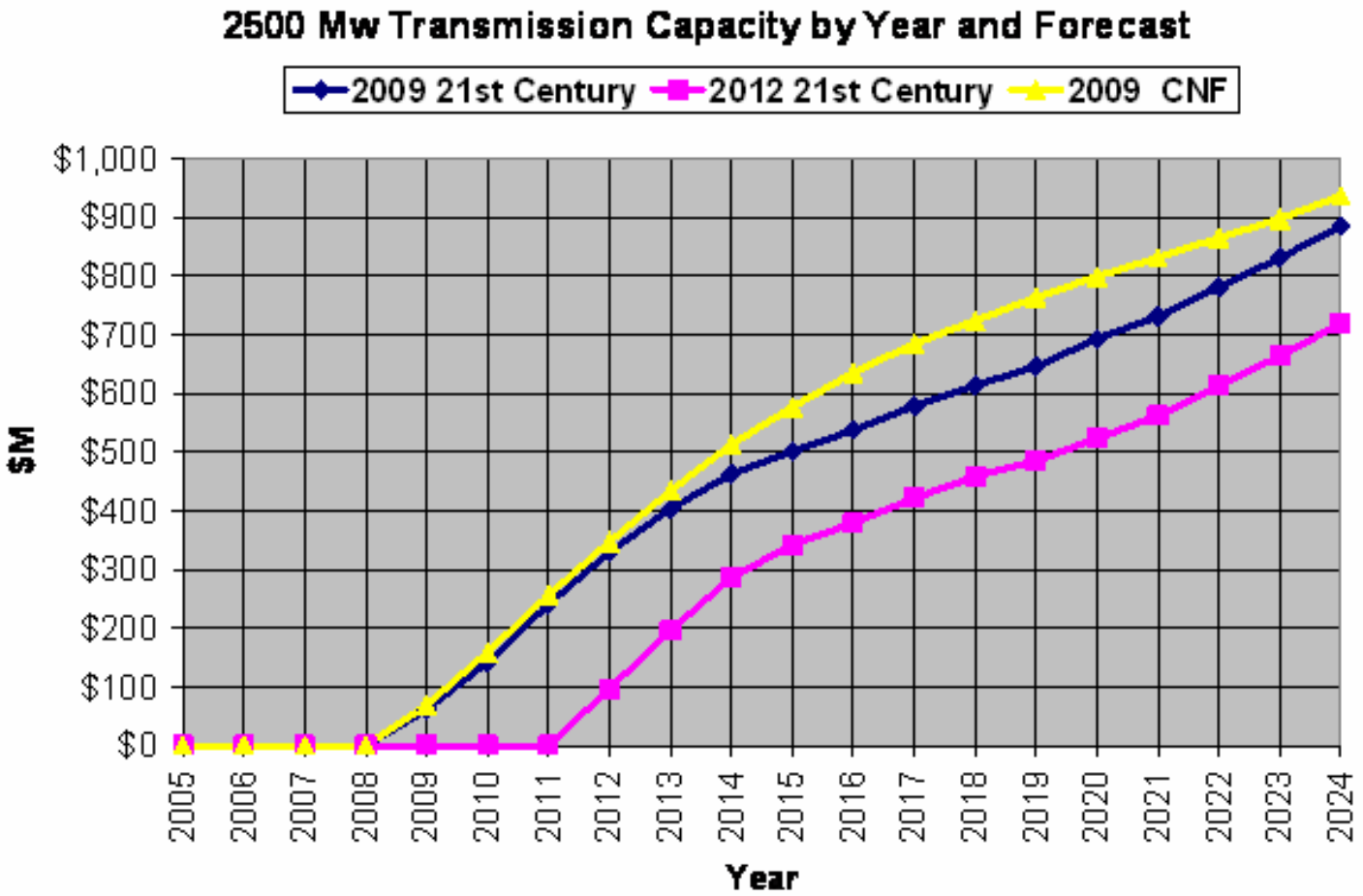
Strategist Runs

- Used CNF generation list and fuel assumptions
- Used PROMOD 2011 case to establish the transaction base price from a 2500 Mw transmission line
- Ran both a CNF and a CEP forecast
- CEP forecast results are presented with an indication of the differences
- Generation capital deferment is the major long term factor
- Short term production cost is dominate


Load Forecast Chart
CNF Load
CEP. Load
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
MW
1980 Mw
6485 Mw
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Year

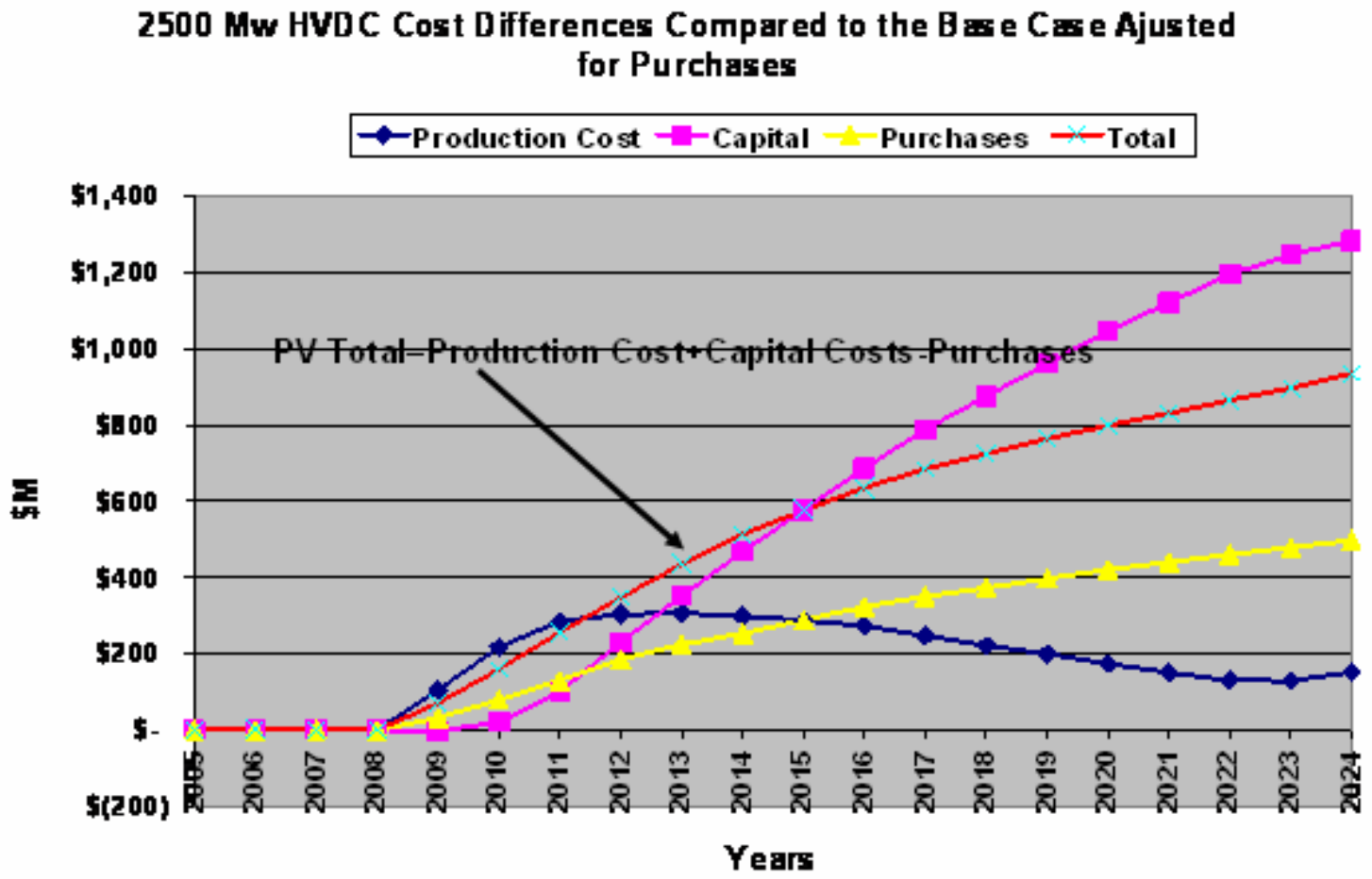
Need in 2009

- The CNF Forecast need for transmission capacity or equivalent generation was
  - 2450 Mw
- The CEP Forecast need for transmission capacity or equivalent generation is
  - 1500 Mw
- There is a need in 2009 for either transmission or generation for LOLP considerations and Transmission Service.

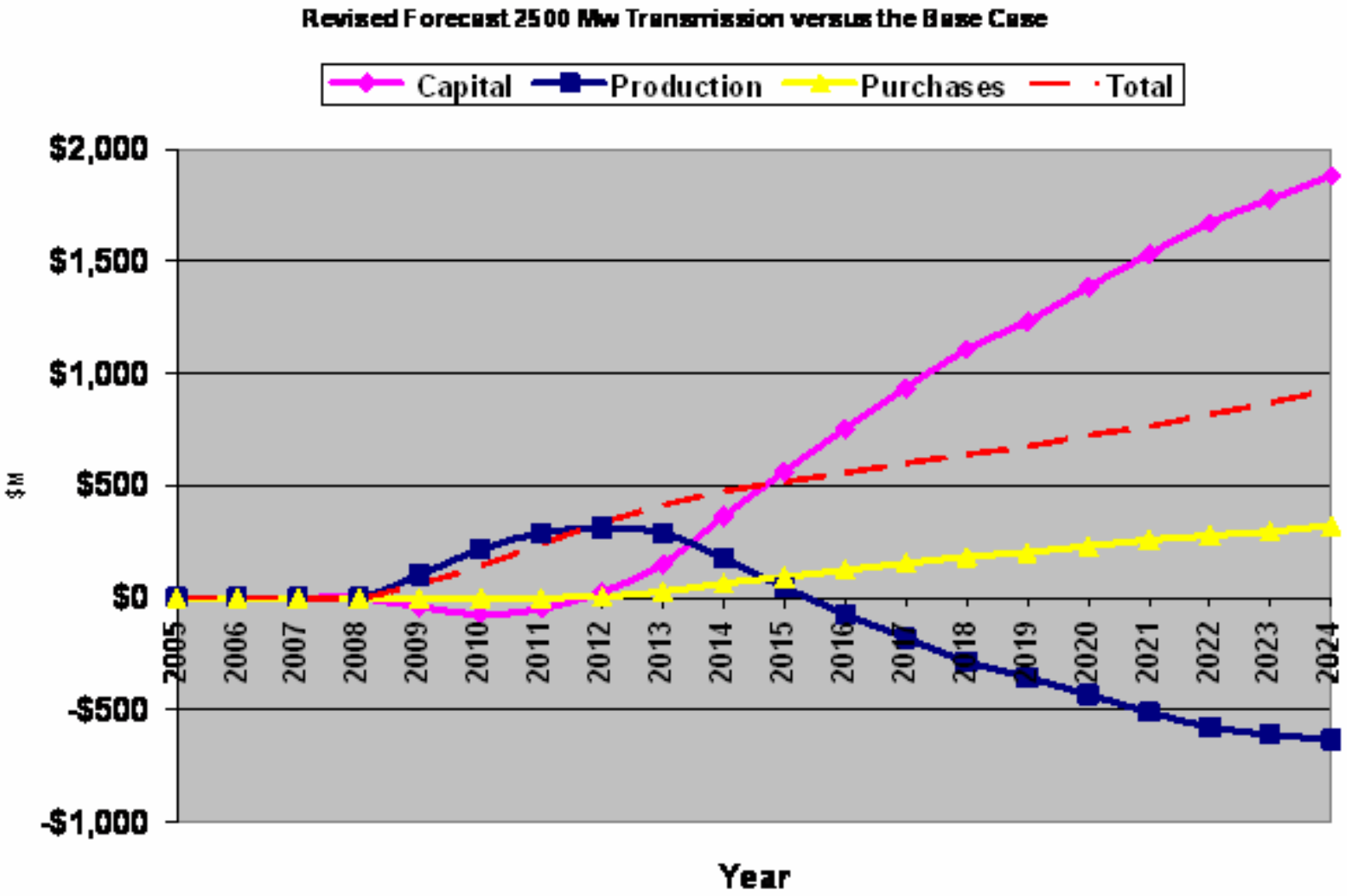


Delay reduces benefits $80M/yr to 2012

CNF Forecast



CEP Forecast



6% Reduced benefit due to CEP versus CNF forecast

Base Case with CEP Forecast

9) Base Case with Load Adjustments and no generation forced in										
	CAPACITY	CTLO	CTSE	CTUP	CCLO	CCSE	CCUP	BCLO	BCSE	BCUP
YEAR	MW	160	160	160	500	500	500	500	500	500
2005	0	0	0	0	0	0	0	0		
2006	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0
2010	160	0	1	0	0	0	0	0	0	0
2011	500	0	0	0	0	0	0	0	1	0
2012	500	0	0	0	0	0	0	0	1	0
2013	500	0	0	0	0	0	0	0	1	0
2014	1,000	0	0	0	0	0	0	1	1	0
2015	500	0	0	0	0	0	0	0	1	0
2016	500	0	0	0	0	0	0	1	0	0
2017	500	0	0	0	0	0	0	0	1	0
2018	500	0	0	0	0	0	0	0	1	0
2019	500	0	0	0	0	0	0	0	1	0
2020	1,082	0	0	0	0	0	0	1	1	0
2021	500	0	0	0	0	0	0	1	0	0
2022	1,000	0	0	0	0	0	0	1	1	0
2023	660	1	0	0	0	0	0	0	1	0
2024	820	1	1	0	0	0	0	0	1	0
Total	9,222	2	2	0	0	0	0	5	12	0

Base- 2009 Transmission

	Base - 2009 HVDC in service									
	CAPACITY	CTLO	CTSE	CTUP	CCLO	CCSE	CCUP	BCLO	BCSE	BCUP
YEAR	MW	160	160	160	500	500	500	500	500	500
2005	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0
2010	160	0	1	0	0	0	0	0	0	0
2011	500	0	0	0	0	0	0	0	1	0
2012	500	0	0	0	0	0	0	0	1	0
2013	500	0	0	0	0	0	0	0	1	0
2014	1,000	0	0	0	0	0	0	1	1	0
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	-1	1	0
2019	-500	0	0	0	0	0	0	-1	0	0
2020	500	0	0	0	0	0	0	1	0	0
2021	0	0	0	0	0	0	0	1	-1	0
2022	0	0	0	0	0	0	0	0	0	0
2023	-340	1	0	0	0	0	0	-1	0	0
2024	320	1	1	0	0	0	0	0	0	0
Total	2,640	2	2	0	0	0	0	0	4	0

2009 Transmission with CEP Forecast

YEAR	CAPACITY MW	CTLO 160	CTSE 160	CTUP 160	CCLO 500	CCSE 500	CCUP 500	BCLO 500	BCSE 500	BCUP 500	DCLN 2500
2005	0	0	0	0	0	0	0	0	0		
2006	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0
2009	2500	0	0	0	0	0	0	0	0	0	1
2010	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0
2015	500	0	0	0	0	0	0	0	1	0	0
2016	500	0	0	0	0	0	0	1	0	0	0
2017	500	0	0	0	0	0	0	0	1	0	0
2018	500	0	0	0	0	0	0	1	0	0	0
2019	1000	0	0	0	0	0	0	1	1	0	0
2020	582.35	0	0	0	0	0	0	0	1	0	0
2021	500	0	0	0	0	0	0	0	1	0	0
2022	1000	0	0	0	0	0	0	1	1	0	0
2023	1000	0	0	0	0	0	0	1	1	0	0
2024	500	0	0	0	0	0	0	0	1	0	0
Total	9082.35	0	0	0	0	0	0	5	8	0	1

BASE CASE CNF Forecast											
	New Capacity	CTLO	CTSE	CTUP	CCLO	CCSE	CCUP	BCLO	BCSE	BCUP	DCLN
YEAR	MW	160	160	160	500	500	500	500	500	500	2000
2005	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0
2007	320	0	**2**	0	0	0	0	0	0	0	0
2008	660	**1**	0	0	0	**1**	0	0	0	0	0
2009	820	**2**	0	0	0	**1**	0	0	0	0	0
2010	980	**1**	**2**	0	0	**1**	0	0	0	0	0
2011	1000	0	0	0	0	0	0	**1**	1	0	0
2012	1000	0	0	0	0	0	0	**1**	1	0	0
2013	1000	0	0	0	0	0	0	**1**	1	0	0
2014	1000	0	0	0	0	0	0	**1**	1	0	0
2015	500	0	0	0	0	0	0	0	1	0	0
2016	1160	**1**	0	0	0	0	0	1	1	0	0
2017	1000	0	0	0	0	0	0	1	1	0	0
2018	660	**1**	0	0	0	0	0	1	0	0	0
2019	1160	**1**	0	0	0	0	0	1	1	0	0
2020	1242.3	**1**	0	0	0	0	0	1	1	0	0
2021	820	**1**	**1**	0	0	0	0	1	0	0	0
2022	1160	0	**1**	0	0	0	0	1	1	0	0
2023	1320	**1**	**1**	0	**1**	**1**	0	0	0	0	0
2024	1160	**1**	0	0	0	**1**	0	1	0	0	0
Mw	16962.3	1760	1120	0	500	2500	0	6000	5000	0	0

PROMOD Study
Discussion Overview

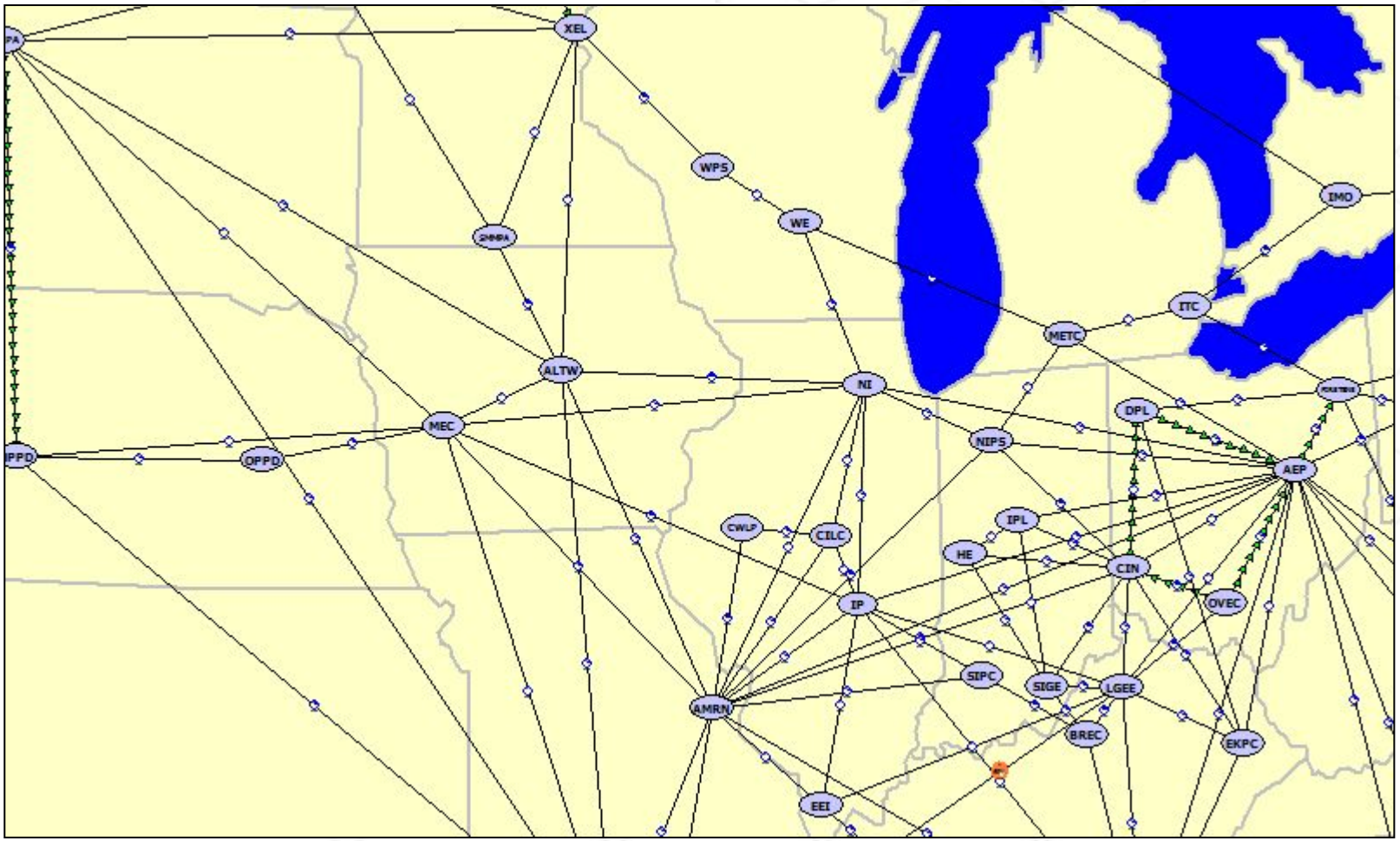
Study Methodology

- **Transmission expansion studies**
  - **765kVAC line from AEP-Cook to ITC-Blackfoot**
  - **500kVDC line from AEP-Cook to ITC-Blackfoot**
- **Capacity expansion studies**
  - **2720MW CTs installed @ ITC-Blackfoot**
  - **500kvDC line and 2720MW CTs @ ITC-Blackfoot**

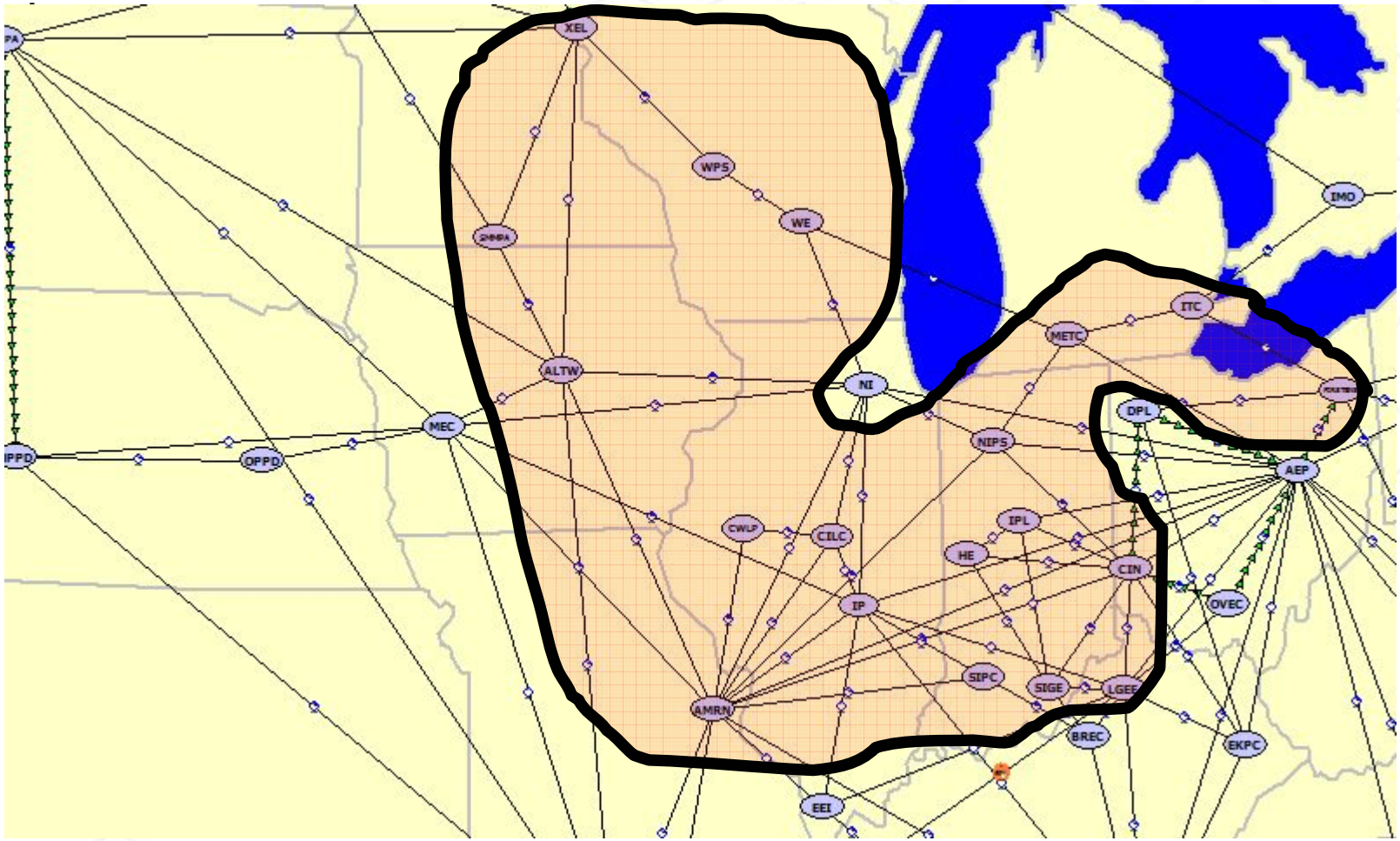
Study Methodology

- Perform preliminary studies maximizing import into study area to determine limits
- Cross reference these limits with work done by MISO & Stakeholder planning groups
- Modify security constrained data using new ACCC transfer study results, required interfaces, etc.
- Identify economically unresolved constraints & their impact (duration, shadow costs)

Study Footprint - Geography



Study Footprint – MISO Footprint



Study Base Case

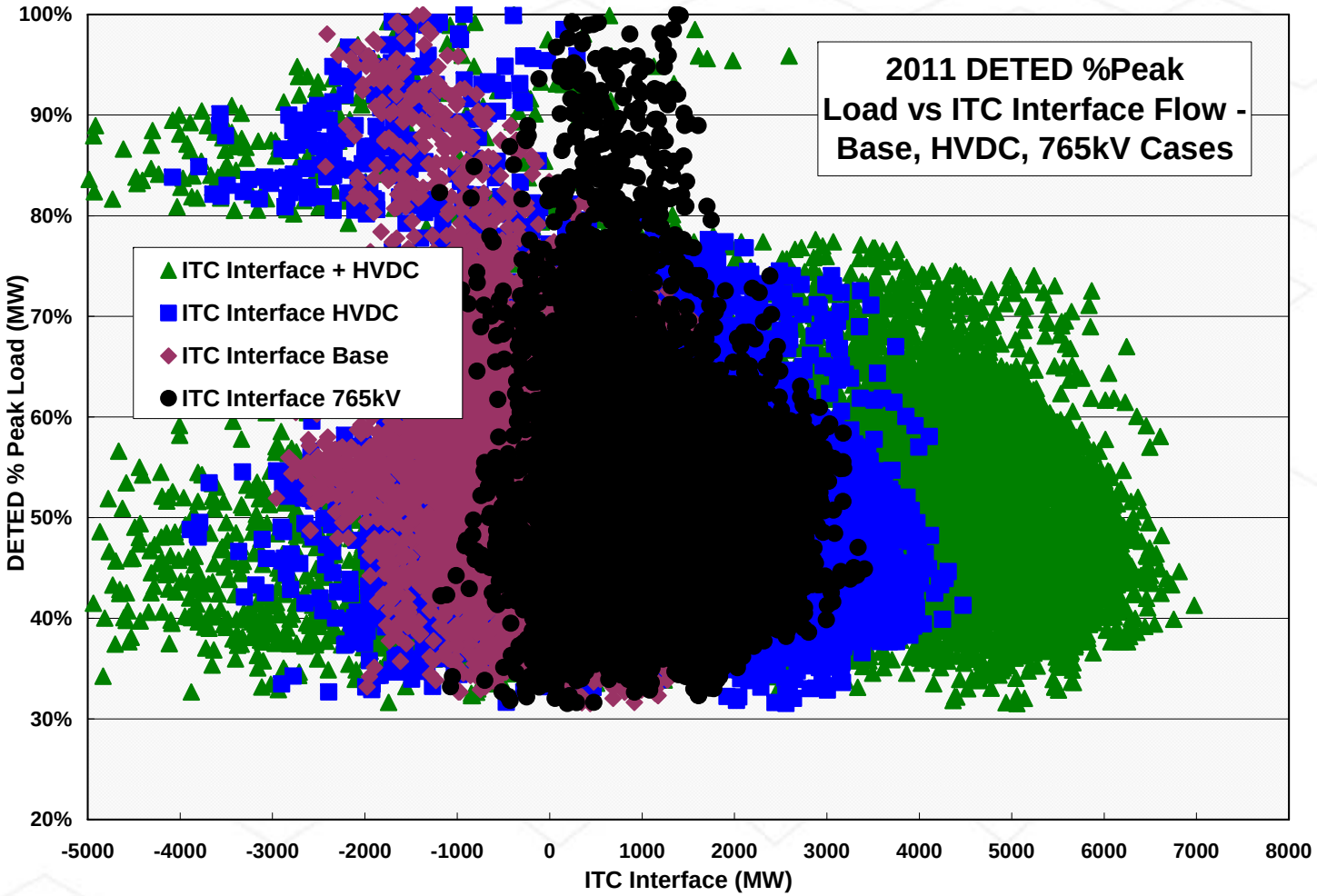
- MISO MTEP06 2011 CASE 01242006
- Michigan CNF Resource Planning Study load forecast
- Stakeholder developed list of constraints

Basecase Production Cost 2011

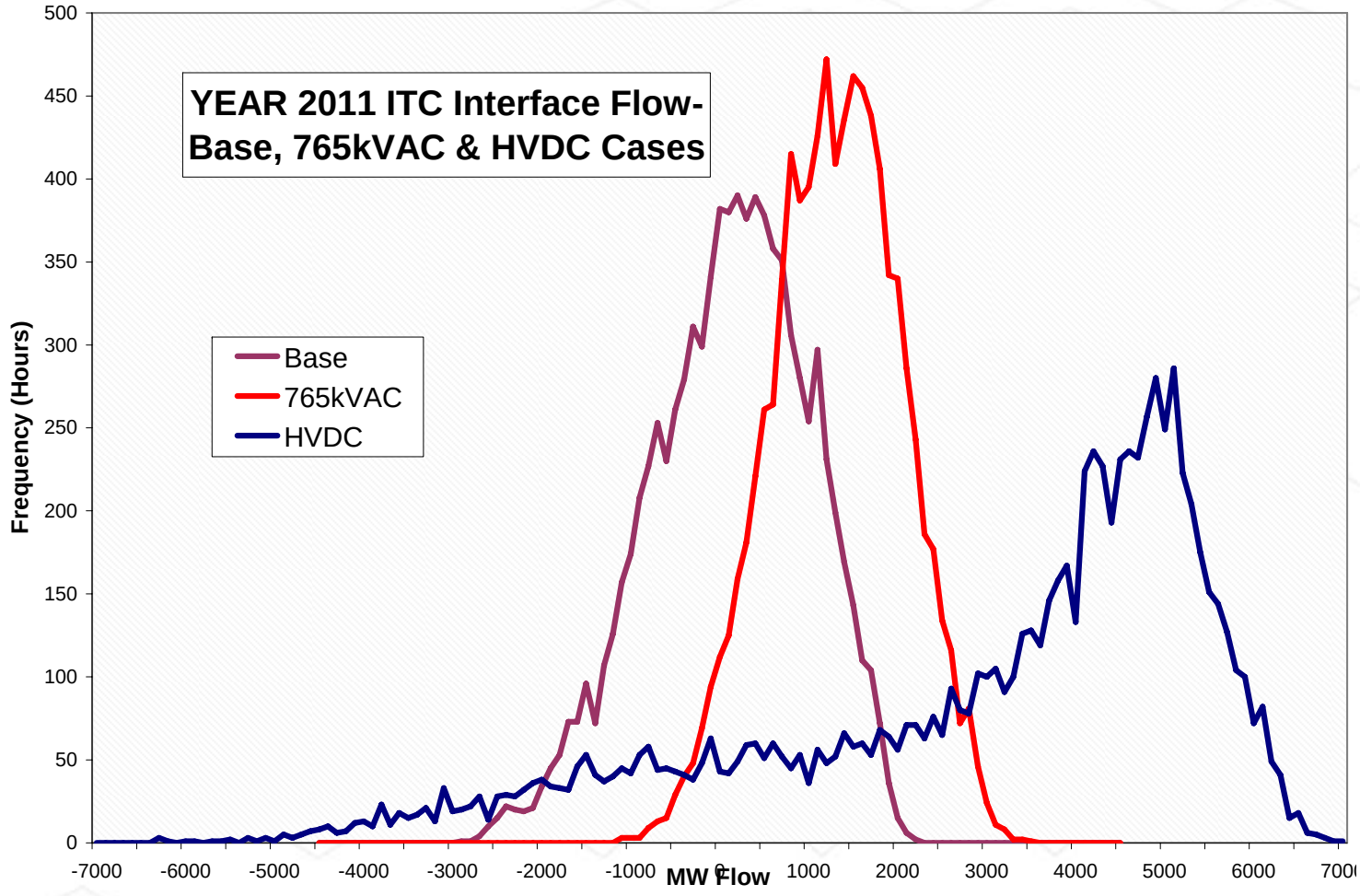
REGION	Basecase Prod Cost
PJM*	$ 16,990,484,247
IESO	$ 2,469,145,297
MISO	$ 14,774,654,397
MICH	$ 3,198,226,557
OTHER*	$ 32,644,599,851
non MICH MISO	$ 11,576,427,840

*PJM includes Exelon and AEP. OTHER refers to companies outside of the MISO-IESO-PJM footprint, namely companies in the South/Southeast regions

2011 ITC Interface Flow vs. DETED Load Factor



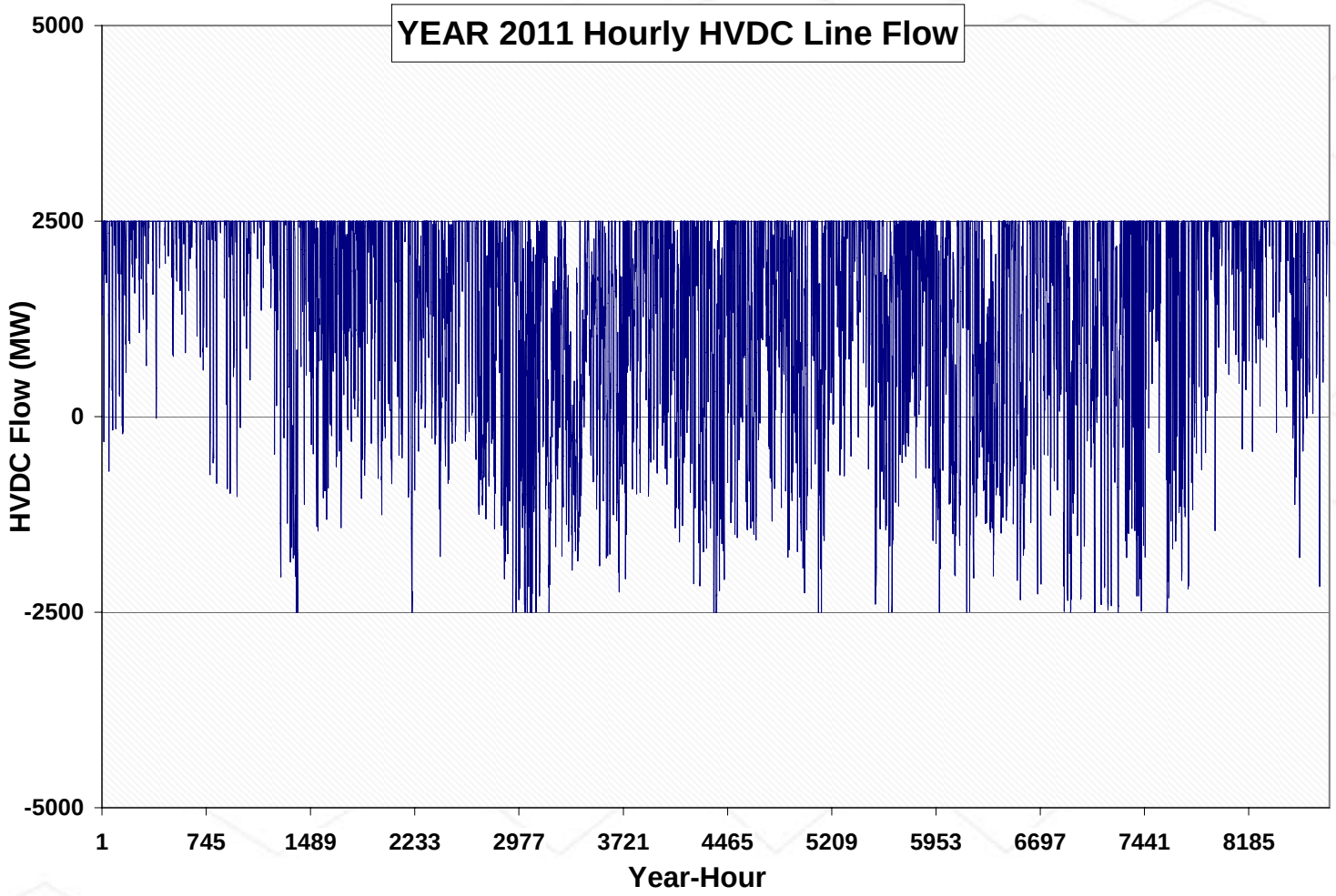
ITC Interface Flows–Base, 765kV & HVDC



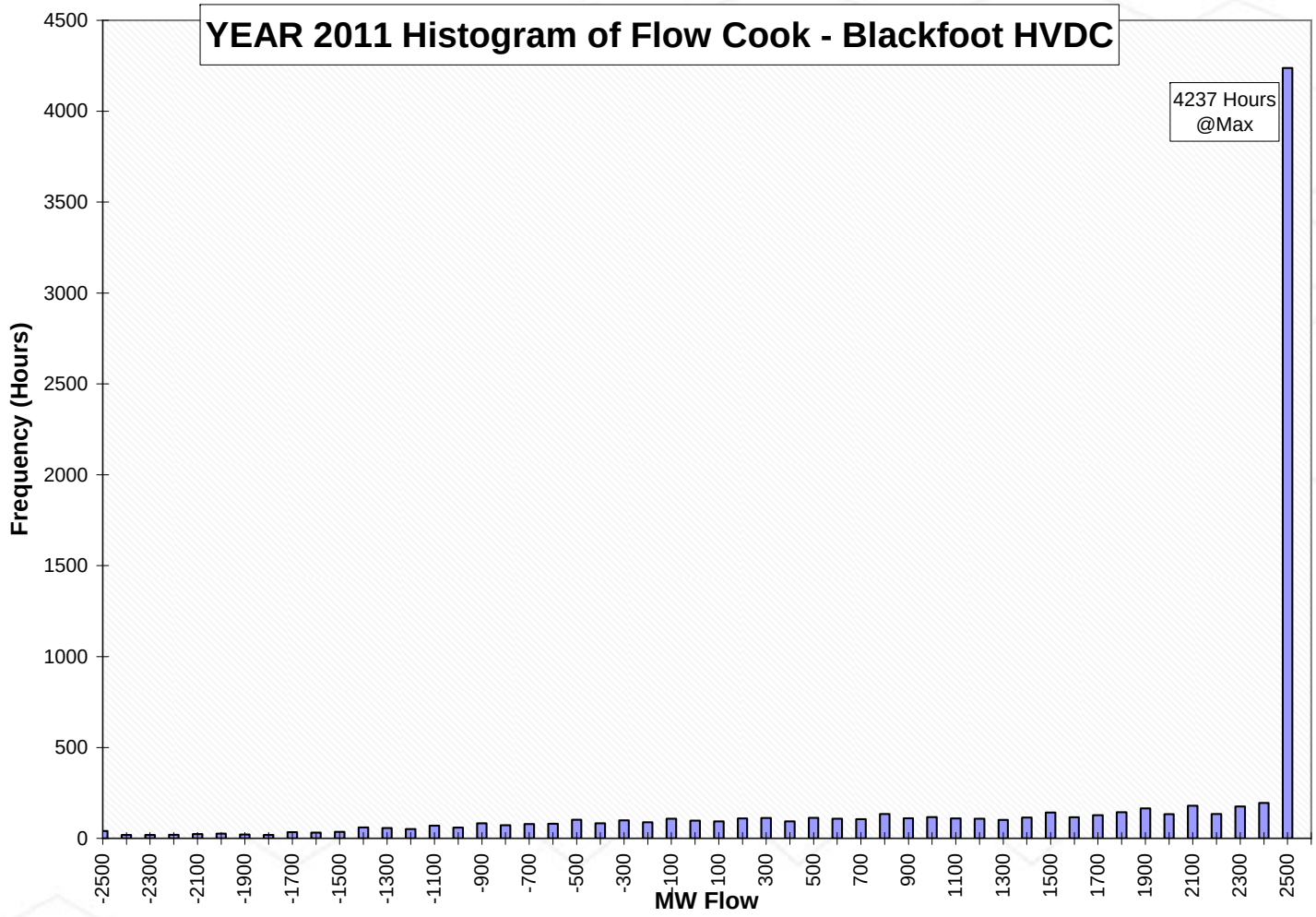
Hourly ITC Interface Flow

- **HVDC case encompasses full range of operation of the base and 765kV cases**
  - **Illustrates the "dispatchable" nature of the HVDC line's operation**
- **765kVAC facilitates a less volatile interface flow**
  - **Illustrates the network supporting characteristics of the AC line's operation**

HVDC Line Flow Hourly



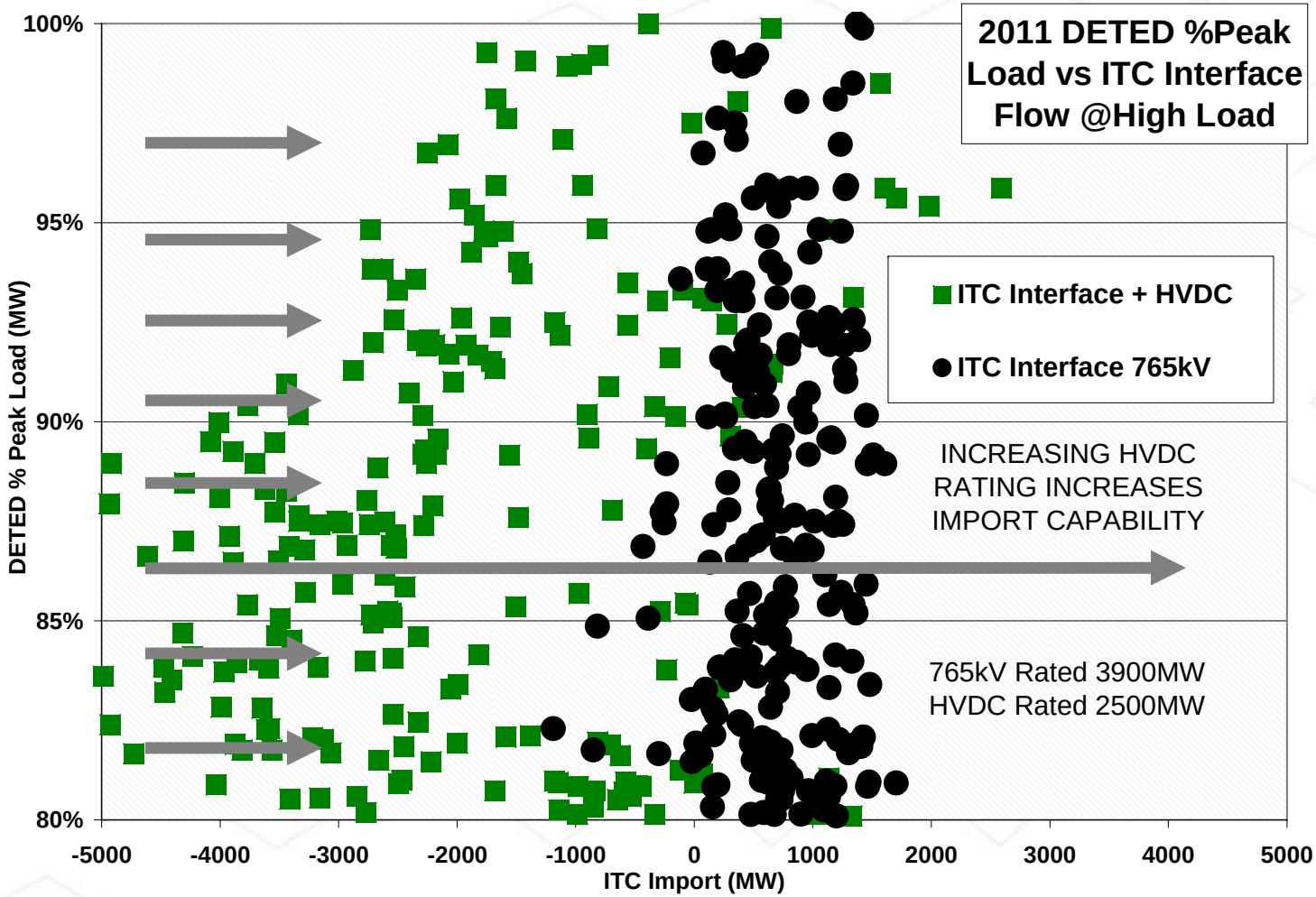
HVDC Line Flow Histogram



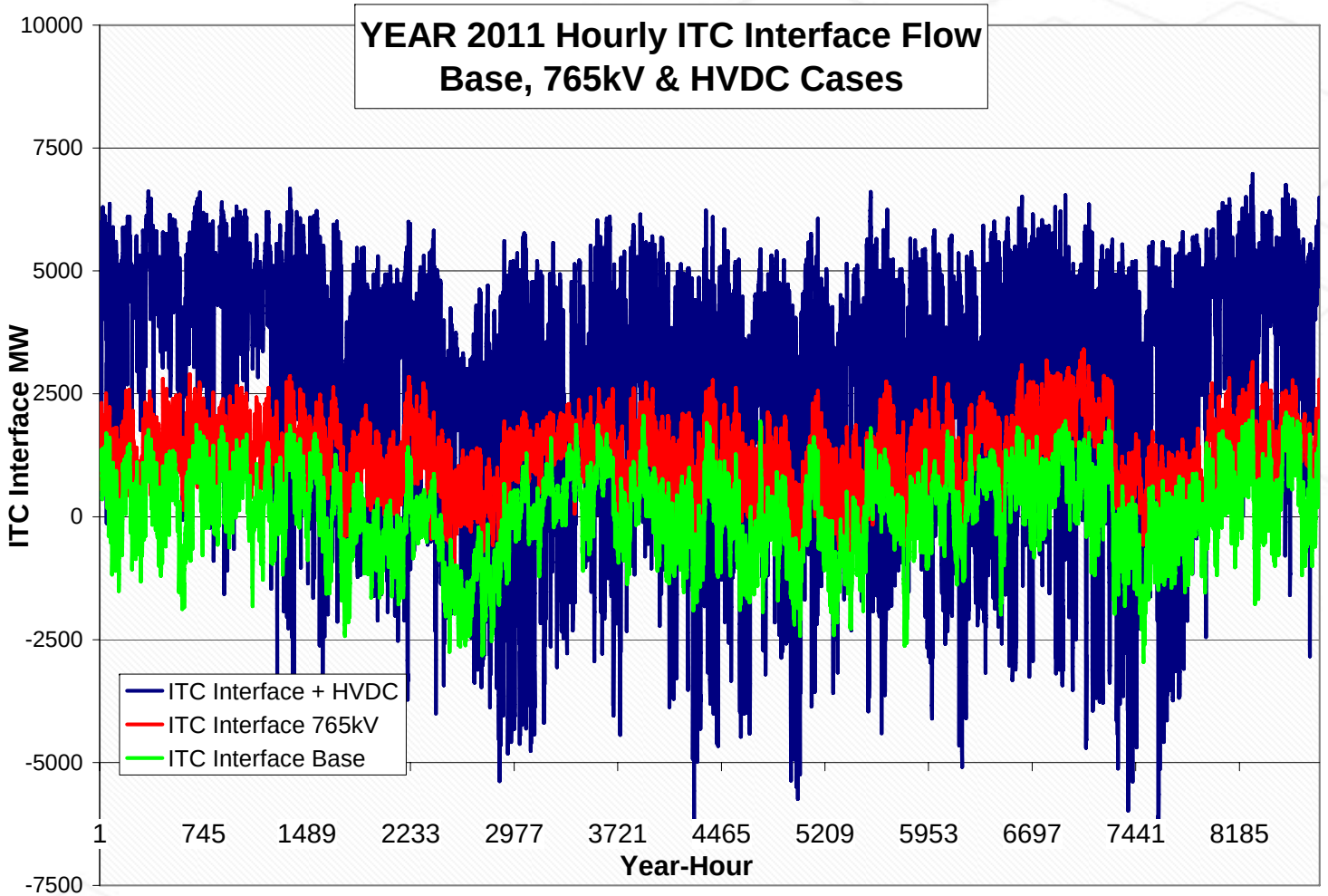
ITC Interface Flow

- **HVDC line is limited to 2,500 MW**
  - **Line is at max (into ITC) for >50% of the 2011 hours**
  - **MI needs would support a 4000MW HVDC line**
- **765kVAC is rated @ 3975MVA**
  - **Line facilitates greater interface flow @ high load due to this ~1500MVA difference**
- **Recommend future analysis @ higher rated HVDC line**

2011 ITC Interface vs. DETED Load >80%LF



Hourly ITC Interface Flow



DETED-AEP Hourly LMP Diff vs. ITC Interface Flow