Transmission Reliability Peer Review

Transmission Bottlenecks

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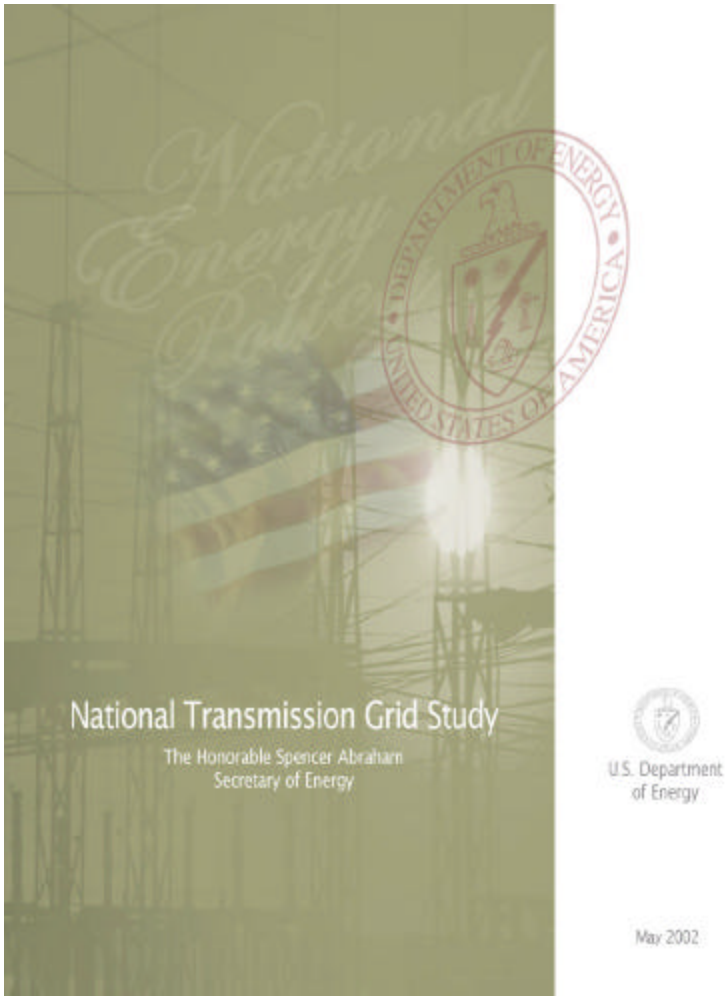
DOE National Transmission Grid Study



"DOE believes that identifying and eliminating major transmission bottlenecks is vital to our national interest. National-interest transmission bottlenecks create congestion that significantly decreases reliability, restricts competition, enhances opportunities for suppliers to exploit their market power unfairly, increase prices to consumers, and increases infrastructure vulnerabilities."

http://www.ntgs.doe.gov

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Project Objectives/Accomplishments

Conduct scoping and planning studies to support DOE implementation of NTGS recommendations on national-interest transmission bottlenecks

CERTS has prepared 4 reports (listed below), 1 memo, and is studying MISO:

- Survey of current transmission bottlenecks, as reported by ISOs – J. Dyer, EPG
- Review of commercially available transmission bottleneck analysis techniques/models – P. Sigari, KEMA
- Assessment of tools under development by national labs that might be available to support bottleneck assessment – S. Thomas, et. al, Sandia
- Review of recent reports of congestion costs – B. Lesieutre/J. Eto, LBNL

ISO Survey of Transmission Bottlenecks

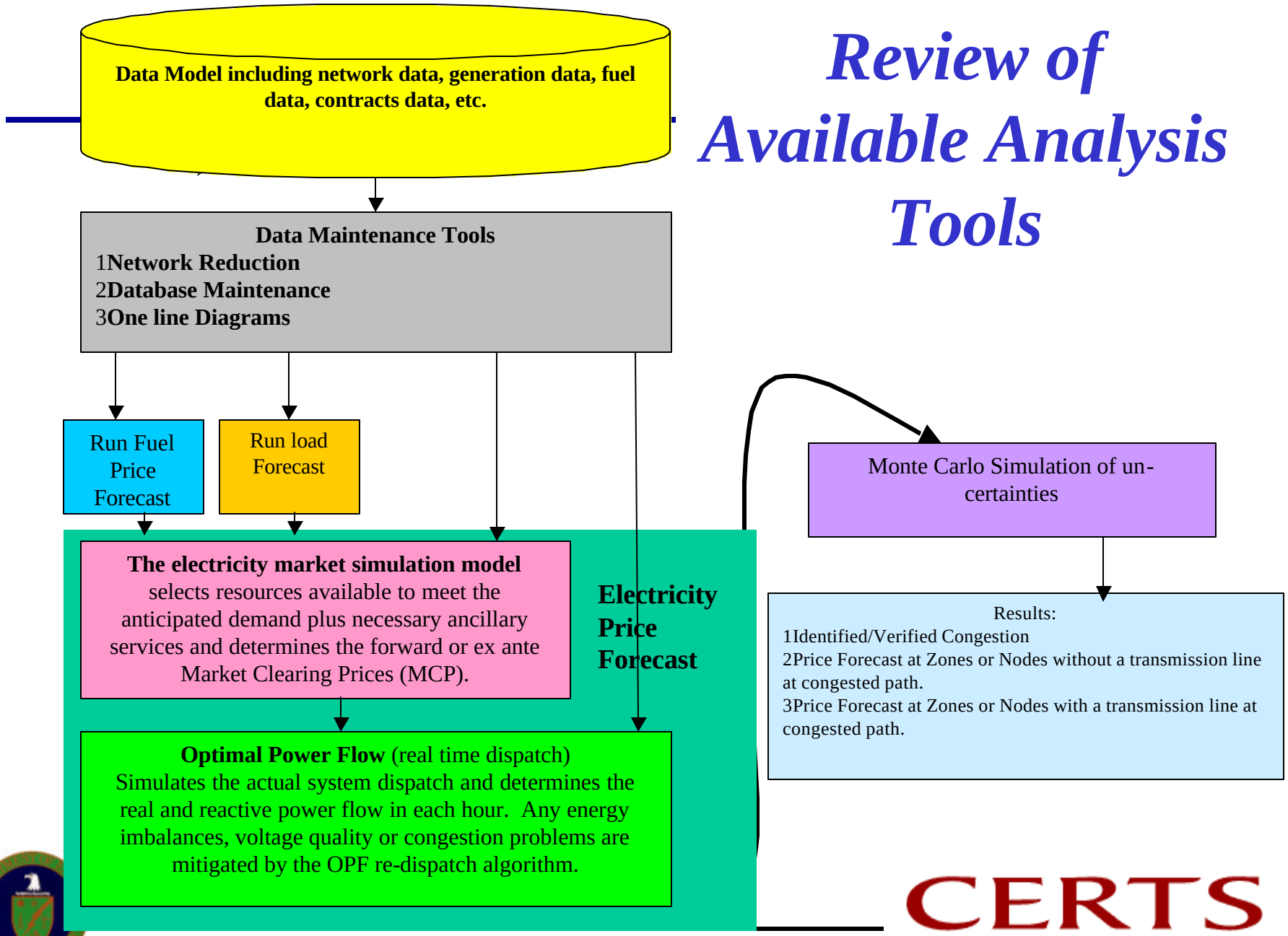
	Jeopardizes National Security	Widespread Grid Reliability Problems	Risk of Significant Consumer Cost	Unacceptable Number of TLR Events	Unacceptably High Price Differentials	High Likelihood That Market Power Will Be Exercised
CAISO		San Diego Area and the San Francisco Peninsula	Path 15		Path 15 and Path 26	Path 15 and Path 26
ERCOT			South to North Texas and South Texas to Houston			
MISO				Lack of EHV Infrastructure	Lack of EHV Infrastructure	Lack of EHV Infrastructure
NYISO			Central East, Leeds-PV and NYC/L.I. Cable Interface			Central East , Leeds-PV and NYC/L.I. Cable Interface
ISO-NE		SW Conn.-Norwalk, NE Mass/Boston Area and NW Vermont			Maine, SE Mass. & R.I. (Locked in Gen)	SW Conn.-Norwalk and NE Mass/Boston Areas
PJM			NW Penn., West of Wash.DC, Delmarva Peninsula, West and East 500kV Interface			NW Penn., West of Wash.DC, Delmarva Peninsula, West and East 500kV Interface

Survey completed March 2003, thus data for MISO can be viewed as incomplete since MISO was very new when surveyed. If surveyed today MISO data would be more extensive.

ISO Survey of Transmission Bottlenecks

Priority	ISO	Comment
1	NYISO	Congestion costs over a three year period are averaging in excess of $900 million per year.
2	ISO-NE	Load is at risk now
3	CAISO	California has two significant load pockets that are forecasted to be in violation of reliability criteria and a path that has inhibited transactions between the northern and southern portions of the state.
4	PJM	PJM's congestion costs continue a four year trend of almost doubling each year, but the majority of 2002 increase is a result of adding PJM West to its market.
5	MISO	At this time, the true congestion costs are unknown. The region will have difficulty operating an efficient market with the limited EVH infrastructure.
6	ERCOT	ERCOT will need to expand its transfer capability to accommodate new generation and achieve market efficiency.

Review of Available Analysis Tools



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Review of Available Analysis Tools

Product	National Regional State	Electrical Network	Market Simulation
TRACE	**N, R, S**	**Y**	**N**
GridView	**N, R, S**	**Y**	**Y**
AURORA	**R**	**N**	**Y**
TRACE	**N, R, S**	**Y**	**N**
CAR	**-**	**-**	**-**
MAPS	**N, R, S**	**Y**	**N**
PROSYM	**N, R, S**	**Y** (w/PowerWorld)	**Y**
UPLAN	**N, R, S**	**Y**	**Y**
SCOPE	**N, R, S**	**Y**	**N**
PSS/E, MUST	**N, R, S**	**Y**	**N**
PROMOD VI	**N, R, S**	**Y**	**Y**

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Survey of National Laboratory Models

- **Electricity Market Complex Adaptive System – Argonne**
- **Generation and Transmission MAXimazation – Argonne**
- **Transmission Entities with Learning Capabilities and Online Self-Healing – Argonne**
- **Power Market Simulator – LANL/NISAC**
- **Power System Analyzer – LANL/NISAC**
- **Positive Sequence Load Flow and Positive Sequence Dynamic Simulation by GE; and PSS/E from PTI – PNNL**
- **BUZZARD – Sandia**

Review of Congestion Costs

Table 4. Summary of Congestion Costs Reported by ISOs, DOE, and FERC			
	Period	Congestion Costs	Congestion Cost-Calculation Method(s)
PJM [1]	1999	$53 M	Congestion Revenues
PJM [1]	2000	132 M	
PJM [1]	2001	271 M	
PJM [2]	2002	430 M	
ISO-NE [3]	5/99-4/00	$99 M	Uplift Charges[i]
ISO-NE [3]	5/00-4/01	120 M	
ISO-NE [4]	2003	50 – 300 M	System Redispatch Payments
CAISO [5]	2000	$391 M	Congestion Revenues
CAISO [5]	2001	107 M	
CAISO [6]	2002	42 M	
CAISO [7,8]	2005	-7.47 – 306 M	System Redispatch Payments+ Congestion Revenues
NYISO [9]	2000	$1,240 M	System Redispatch Payments (est) + Congestion Revenues
NYISO [9]	2001	570 M	
NYISO [10]	2000	517 M	Congestion Revenues
NYISO [10]	2001	310 M	
NYISO [11]	2002	525 M	
FERC [12]	6/00-8/00	$891 M	System Redispatch Payments (partial) + Congestion Revenues
DOE [13]		$157 M – 457 M	System Redispatch Payments + Congestion Revenues

[i] ISO New England's congestion cost calculation method was modified in March 2003.

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Review of Congestion Costs

Information about the operation of congestion revenue rights markets is needed to assess the impacts of congestion revenue charges on consumers.

Information on generators' offers is needed to assess system redispatch payments.

Many studies presume that generator offers reflect competitive market conditions.

Customer costs may rise as a result of reducing congestion.

Minimizing consumer costs may not increase aggregate social wealth.

There is no standardized conceptual framework for studies of congestion costs

Next Steps

- **Support OETD planning and implementation of NTGS recommendations – public process on criteria for and federal role in addressing bottlenecks**

- **Complete MISO market pre-assessment**
  - **improve data/verify findings with MISO;**
  - **identify potential bottlenecks/opportunities for exercise of market power**

- **Work with EIA to improve quality of transmission data**

- **Plan workshop on advanced modeling/simulation needs**

- **Support DOE efforts to assist regional planning entities**

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Congestion Cost Backup Slides

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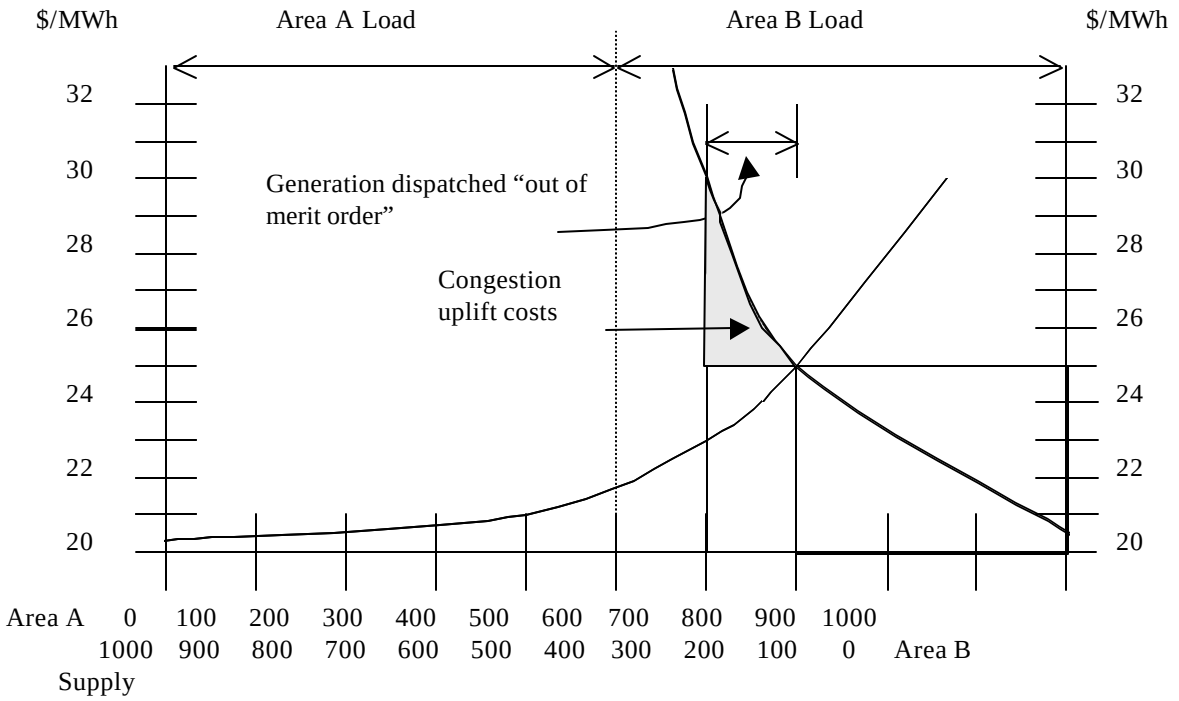
Congestion Costs – Uplift Charges



Congestion costs = dispatch payments out of merit order

Congestion costs are equal to the increased dispatch payments by the market to generators out of merit order. The dispatch payments are calculated using a uniform market clearing price for most generation. However, generators dispatched out of merit order because of congestion are paid at their offer prices. The uplift charge is shared equally among the consumers.

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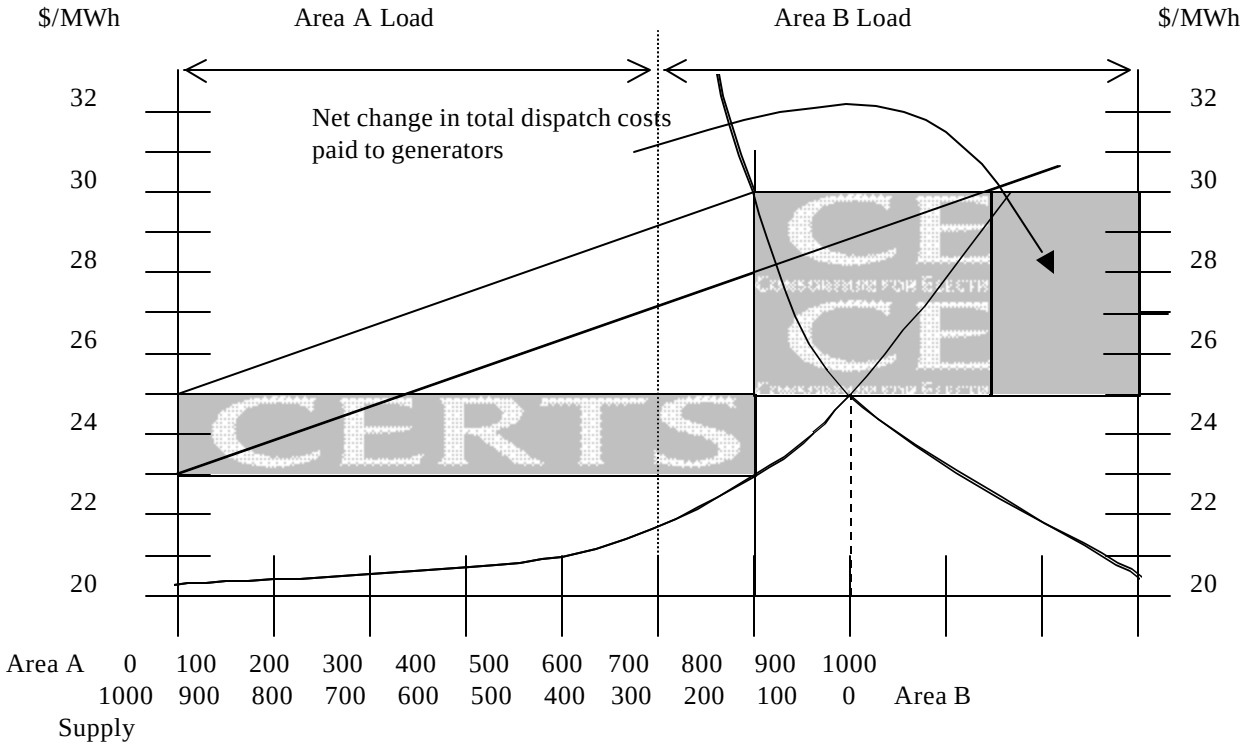
Congestion Costs – System Redispatch Payments



Congestion costs = change in dispatch costs

Congestion costs are equal to the difference in dispatch payments by the market to generators in the congested case relative to costs for the uncongested case. The dispatch payments are calculated using LMPs.

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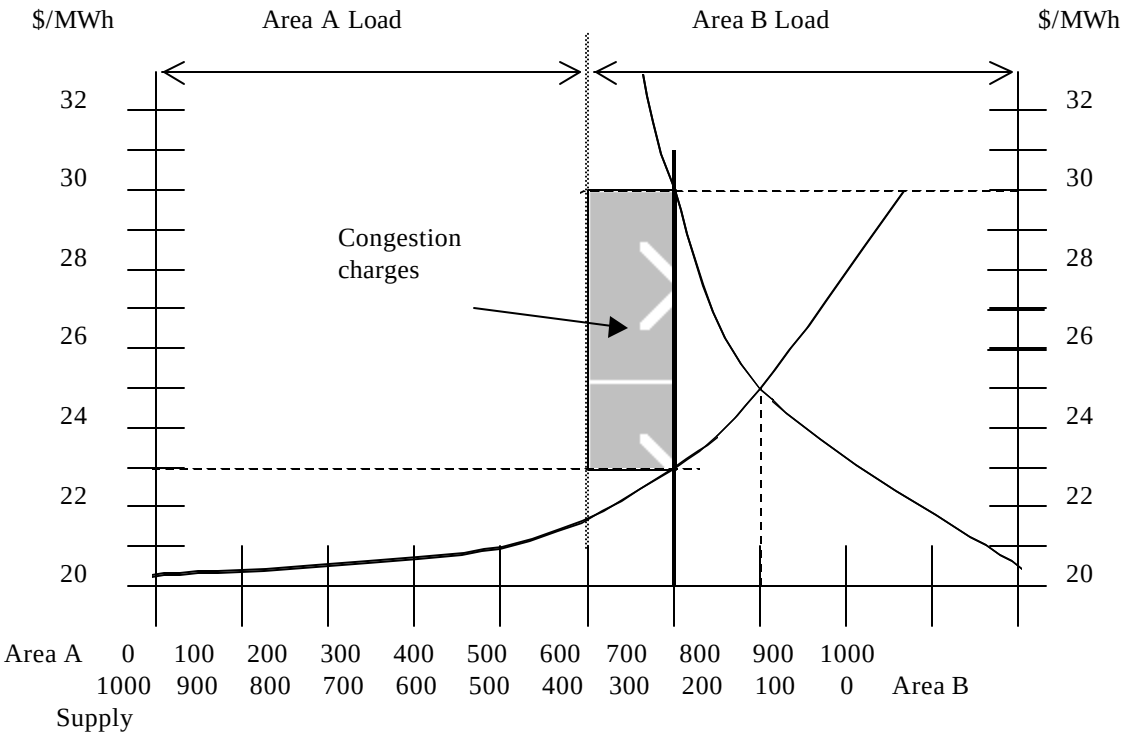
Congestion Costs – Congestion Revenues



Congestion costs = congestion charges

In a market that uses LMPs, congestion revenues are the valuation of transmission of energy across a congested interface. Neglecting losses, these revenues equal the product of the energy flow and the price. Congestion revenues are also equal to the difference between what consumers pay for energy and what generators are paid for supply

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