

# Transmission Penalty Factors

MIC

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Joe Bowring

Devendra Canchi

John Hyatt



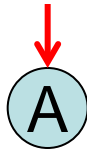
Monitoring Analytics

# Transmission Constraint Penalty Factors

- **In the PJM dispatch model, transmission constraints are violated under some conditions and flow exceeds the specified line limit**
- **Violated transmission constraints have defined penalty factors**
- **LMPs are affected by the penalty factors**
- **LMPs reflect the local scarcity**

# A Simple Two Bus Example

Gen A  
Offer: \$25 per MWh  
Eco Max: 200 MW



Limit: 150 MW

Gen B  
Offer: \$50 per MWh  
Eco Max: 100 MW

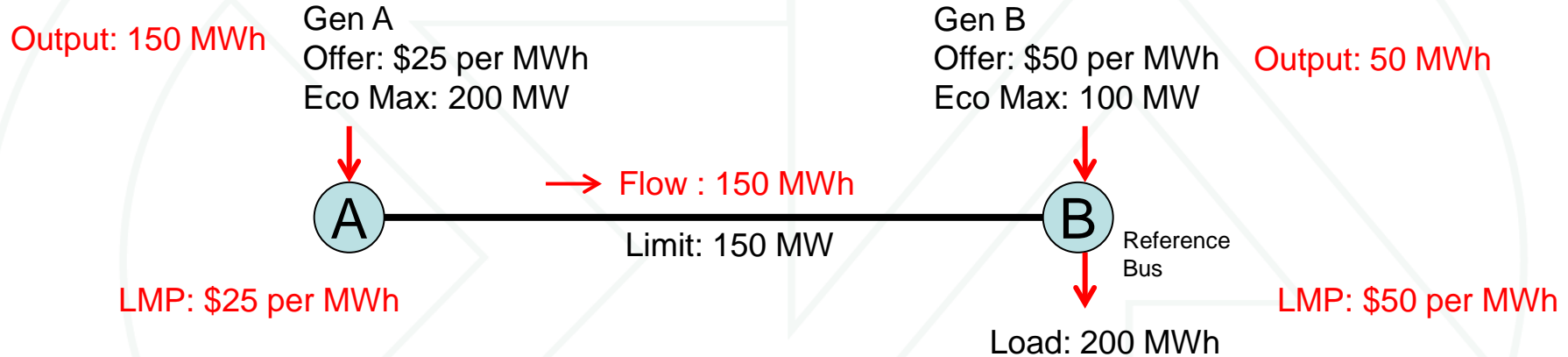


Reference  
Bus

Load: 200 MWh

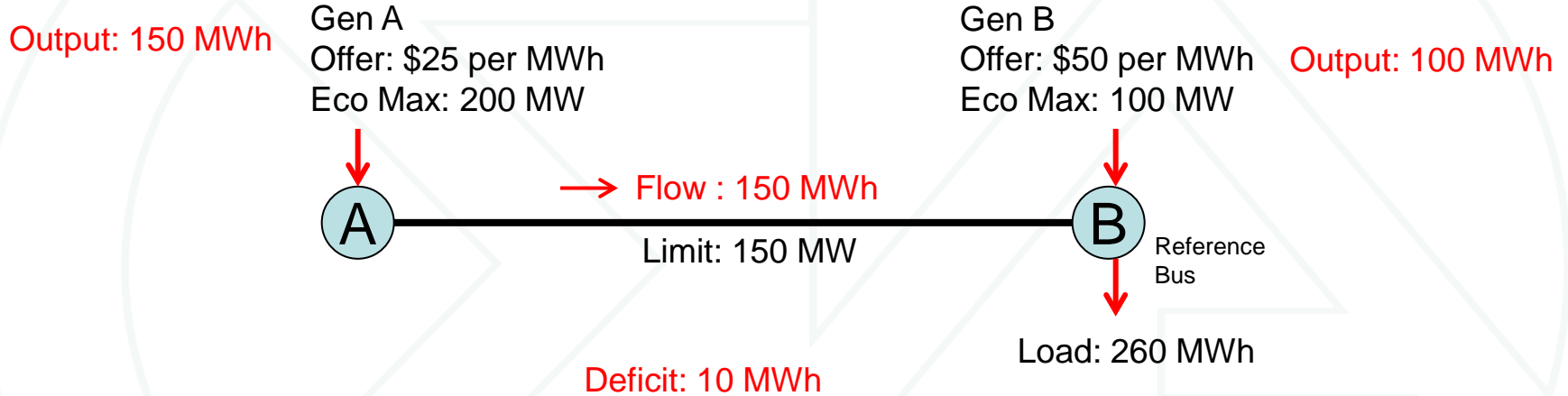


# A Simple Two Bus Example



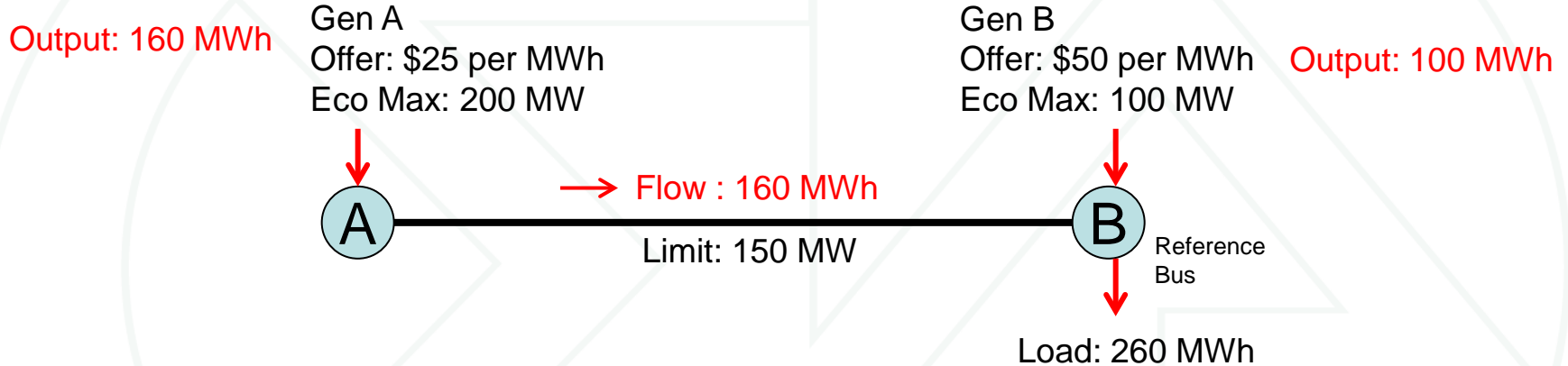
**Shadow price is -\$ 25 per MWh.**  
**Shadow price represents the cost savings associated with increasing the transmission line limit by 1 MW**

# A Simple Two Bus Example



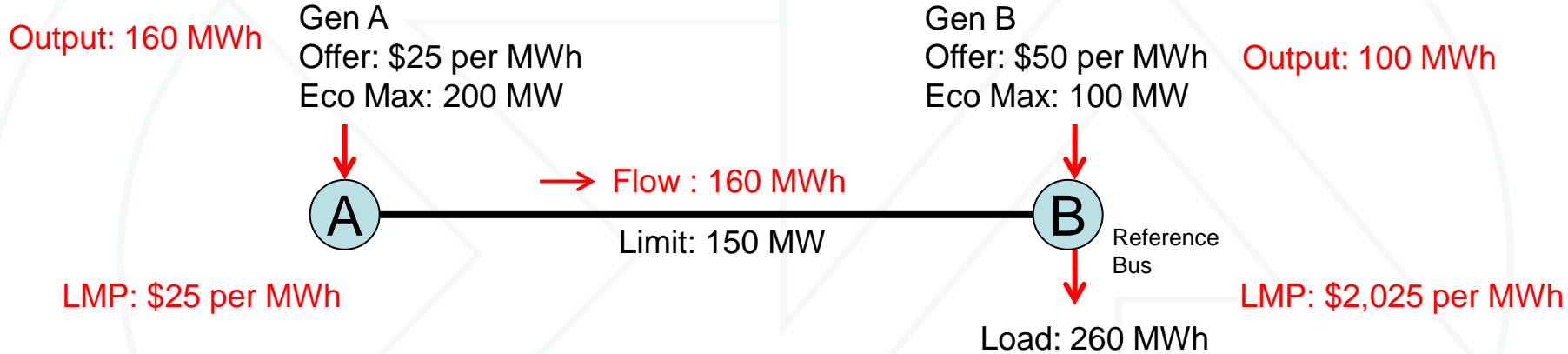
**The limit on the transmission line prevents extra generation to reach the load**

# A Simple Two Bus Example



**Transmission constraint is violated**  
**Every violation incurs a cost called transmission penalty factor**  
**PJM currently values violations typically at \$2,000 per MWh**

# A Simple Two Bus Example



**Shadow price: -\$2,000 per MWh**

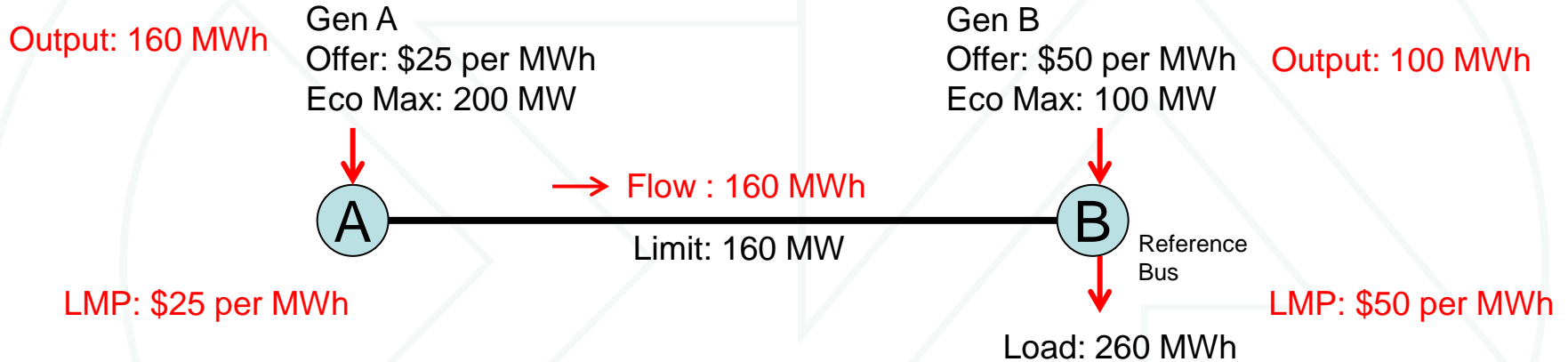
**Shadow price = Cost of Violation (Transmission Penalty Factor)**

# Constraint Relaxation Logic

- **The shadow price of a violated constraint should equal the transmission penalty factor**
- **PJM uses a method called “constraint relaxation logic” to affect shadow prices of violated transmission constraints**
- **The logic typically results in reducing the shadow prices to be slightly below the defined constraint violation penalty factor**
- **LMP is not related to marginal unit offers**



# A Simple Two Bus Example



**Constraint Relaxation logic increases the line limit such that the constraint is not violated**  
**Shadow price: -\$50 per MWh**

# Historical Data

	2013			2014			2015		
	Number of Constraints	Percent	Average Shadow price	Number of Constraints	Percent	Average Shadow price	Number of Constraints	Percent	Average Shadow price
PJM Internal Binding Transmission Constraints	60,538	49%	(\$172.93)	131,348	62%	(\$172.52)	140,545	66%	(\$159.27)
PJM Internal Violated Transmission Constraints	17,948	15%	(\$531.84)	32,398	15%	(\$640.62)	20,255	10%	(\$957.49)
Market to Market Transmission Constraints	45,210	37%	(\$299.24)	48,418	23%	(\$445.51)	51,680	24%	(\$281.89)
All Transmission Constraints	123,696	100%	(\$271.17)	212,164	100%	(\$306.30)	212,480	100%	(\$265.19)

	2016			2017 (Jan-Sep)		
	Number of Constraints	Percent	Average Shadow price	Number of Constraints	Percent	Average Shadow price
PJM Internal Binding Transmission Constraints	130,855	64%	(\$120.13)	62,893	60%	(\$112.11)
PJM Internal Violated Transmission Constraints	19,536	10%	(\$643.04)	7,071	7%	(\$605.87)
Market to Market Transmission Constraints	54,848	27%	(\$264.34)	34,239	33%	(\$347.48)
All Transmission Constraints	205,239	100%	(\$208.44)	104,203	100%	(\$222.95)

**Monitoring Analytics, LLC**

**2621 Van Buren Avenue**

**Suite 160**

**Eagleville, PA**

**19403**

**(610) 271-8050**

**MA@monitoringanalytics.com**

**www.MonitoringAnalytics.com**

