**EXHIBIT NO. ___(DEM-4)**
**DOCKET NO. UE-07___**
**PCA 5 COMPLIANCE**
**WITNESS: DAVID E. MILLS**

**BEFORE THE**
**WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

| | |
|---|---|
| **In the Matter of the Petition of**<br><br>**PUGET SOUND ENERGY, INC.**<br><br>**For Approval of its March 2007 Power Cost Adjustment Mechanism Report** | **Docket No. UE-_____** |

# THIRD EXHIBIT (NONCONFIDENTIAL) TO PREFILED DIRECT TESTIMONY OF DAVID E. MILLS ON BEHALF OF PUGET SOUND ENERGY, INC.

**March 30, 2007**

# Margin at Risk And Forward Hedging

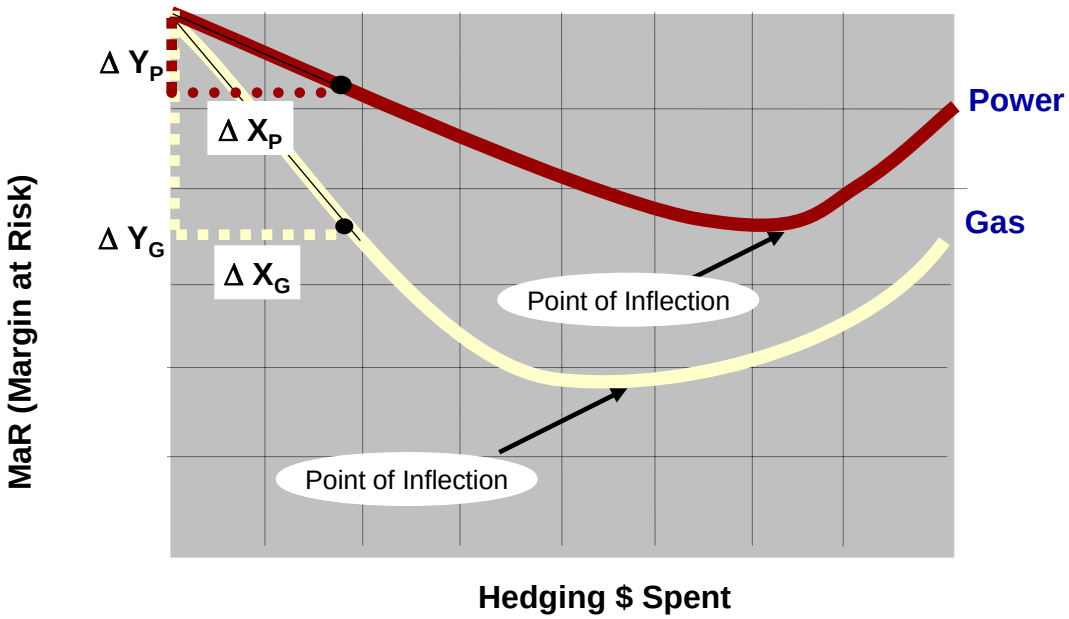
May 17, 2004

RMC Meeting

# Current Basis for Hedging Decisions

- Probabilistic Position
  - Volumetric forecast of load resource, given energy market volatility, resource outages and hydrological forecasts.
- Exposure Report
  - Captures portfolio exposure to spot market price fluctuations.
- Fundamental market views
- Marginal MaR Ratio
  - Measures risk reduction as a result of incremental hedging.
  - Ratio allows for comparative assessment of different commodity hedges.
    - Identifies best commodity and month for hedge transactions.
    - Useful tool to allocate credit.

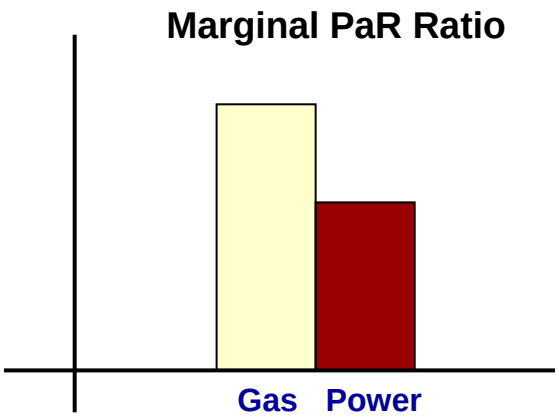
# MaR - Overview




*For illustration purposes only*

**Marginal MaR Ratio =** $\dfrac{\text{Change in MaR } (\Delta Y)}{\text{Hedging \$ Spent } (\Delta x)}$

Marginal MaR Ratio approximates the the amount of portfolio risk removed for each hedging dollar spent.



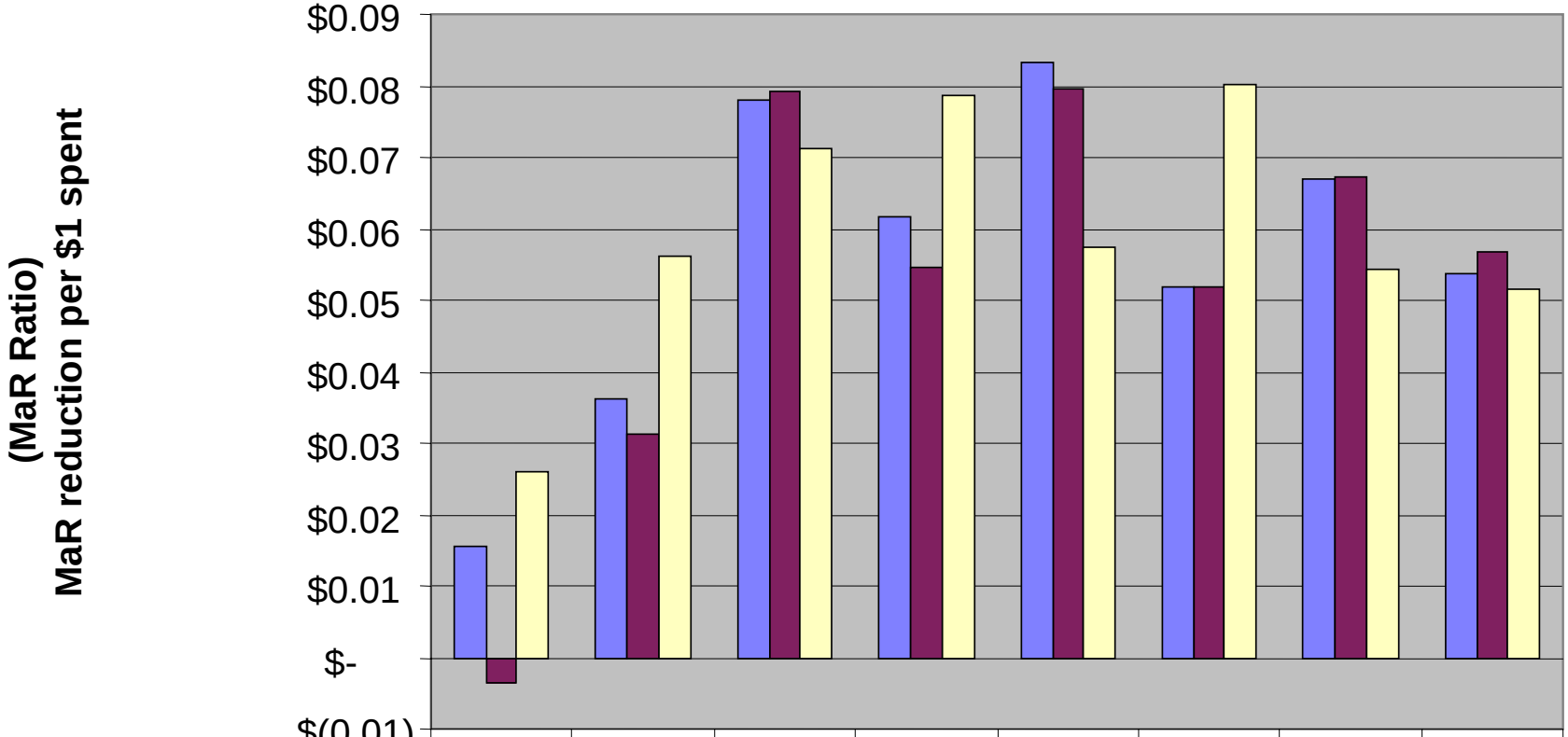
# MaR - Calculation

*For illustration purposes only*

| | Probabilistic | Scen 1- Worse Case | Scen 2 | Scen 3 | Scen 4 | Scen 5 |
|---|---|---|---|---|---|---|
| **Load** | **-194** | **-225** | **-220** | **-150** | **-180** | **-195** |
| Hydro (MWs) | 90 | 70 | 80 | 80 | 110 | 110 |
| Resources Sensitive to Heat Rates (MWs) | 42 | 50 | 50 | 40 | 40 | 30 |
| Other Resources & Fixed Price Contracts (MWs) | 30 | 30 | 30 | 30 | 30 | 30 |
| **Total Resourses** | **162** | **150** | **160** | **150** | **180** | **170** |
| Fixed Price Gas Hedges (MMBTu's) | 400 | 400 | 400 | 400 | 400 | 400 |
| **Power Spot Position (MWs)** | **-32** | **-75** | **-60** | **0** | **0** | **-25** |
| **Gas Spot Position (MMBTu's)** | **-20** | **-100** | **-100** | **0** | **0** | **100** |
| **Power Spot Exposure** | **-$2,470** | **-$6,375** | **-$5,100** | **$0** | **$0** | **-$875** |
| **Gas Spot Exposure** | **-$180** | **-$650** | **-$650** | **$0** | **$0** | **$400** |
| **Margin** | **$3,498** | **$530** | **$1,470** | **$3,380** | **$5,390** | **$6,720** |
| Power Price ($/MWhr) | $65.00 | $85.00 | $85.00 | $60.00 | $60.00 | $35.00 |
| Gas Price ($/MMBTu) | $5.80 | $6.50 | $6.50 | $6.00 | $6.00 | $4.00 |
| Heat Rate (MMBTu/MWhr) | 11.21 | 13.08 | 13.08 | 10.00 | 10.00 | 8.75 |

| | MaR | Marginal MaR Ratio |
|---|---|---|
| **Base Case** | **$2,968** | |
| **Purchase 25MW Power @ $65** | **$2,468** | **$0.31** |
| **Purchase 5,000 Dth/Day Gas @ $5.80** | **$2,560** | **$0.34** |

# Marginal MaR Ratio (Week Of 4/19/04)




| | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|
| Peak Power - 25MW Purch | $0.02 | $0.04 | $0.08 | $0.06 | $0.08 | $0.05 | $0.07 | $0.05 |
| Off Peak Power - 25MW Purch | $(0.00) | $0.03 | $0.08 | $0.05 | $0.08 | $0.05 | $0.07 | $0.06 |
| Gas (PSEE) - 5,000Dth/Day Purch | $0.03 | $0.06 | $0.07 | $0.08 | $0.06 | $0.08 | $0.05 | $0.05 |

# Future Enhancements

- Implement optimal total hedge quantities by month and commodity.
- Determine sensitivity in probabilistic position with respect to change in price/heat rate. (“gamma”)
  - Enables better understanding sensitivities of PSE’s asset heat rates vs. market heat rates.
  - Relationship is nonlinear.
- Incorporation of nonlinear hedges in Marginal MaR Ratio Analysis (Collars, HR call options etc.)
- Continued incorporation of fundamental views in generation and price modeling.
- Enhance optimal hedging strategies to minimize downside and maximize upside.

# Appendix

# Historical Hedging: Example 1

- Probabilistic June 2004 position as of 4/20/04

| | |
|---|---|
| Total Net Exposure | ($.22 million) |
| Gas Exposure | ($3.83 million) |
| Power Exposure (peak) | $2.3 million |
| Power Exposure (off-peak) | $1.32 million |

- Portfolio is long power and short gas
- MaR analysis indicates buying gas and selling power reduces downside risk.
- Fundamentally bearish market heat rates. Monetize relatively high heat rates
- Hedging transaction: Sell 75 aMWs flat and purchase 15,000 MMBtus/day.

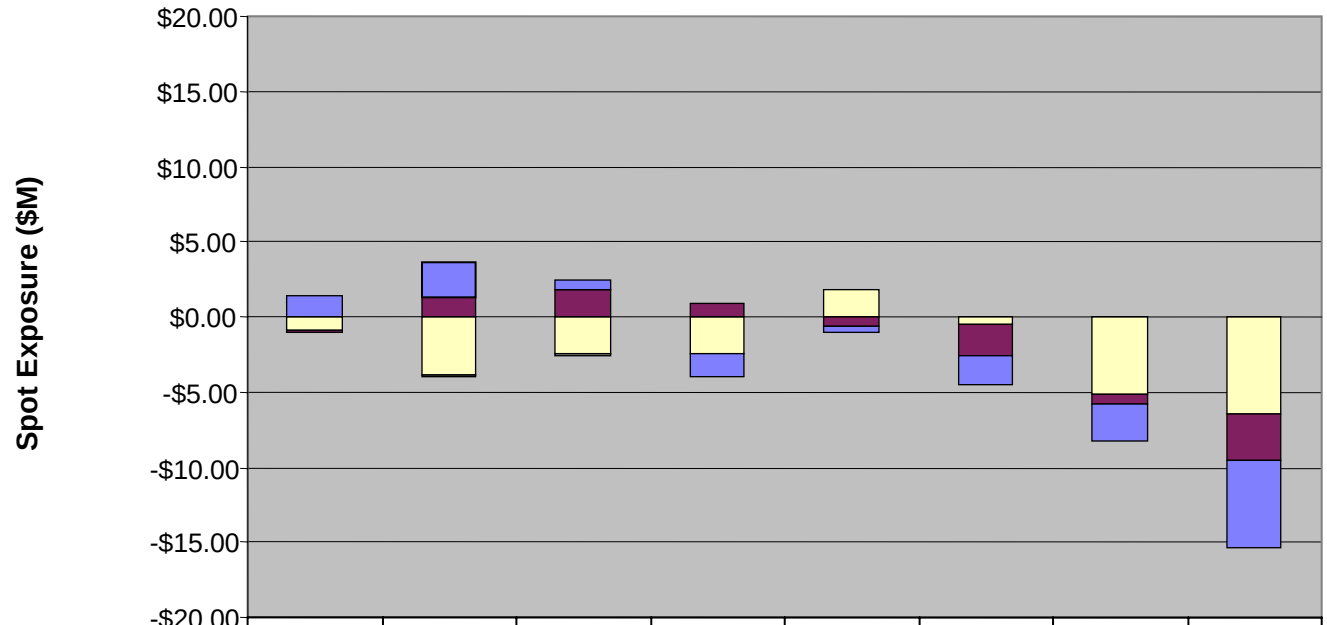
# Historical Hedging: Example 2

- Probabilistic August 2004 position as of 4/20/04

| | |
|---|---|
| Total Net Exposure | ($2.98 million) |
| Gas Exposure | ($2.39 million) |
| Power Exposure (peak) | ($1.56 million) |
| Power Exposure (off-peak) | $0.96 million |

- Portfolio is short on peak power and gas; long off peak power.
- MaR analysis indicates buying gas reduces downside.
- Hedging transaction:  Purchase 10,000 MMBtus/day.

# Spot Exposure & Probabilistic Position (4/19/04)



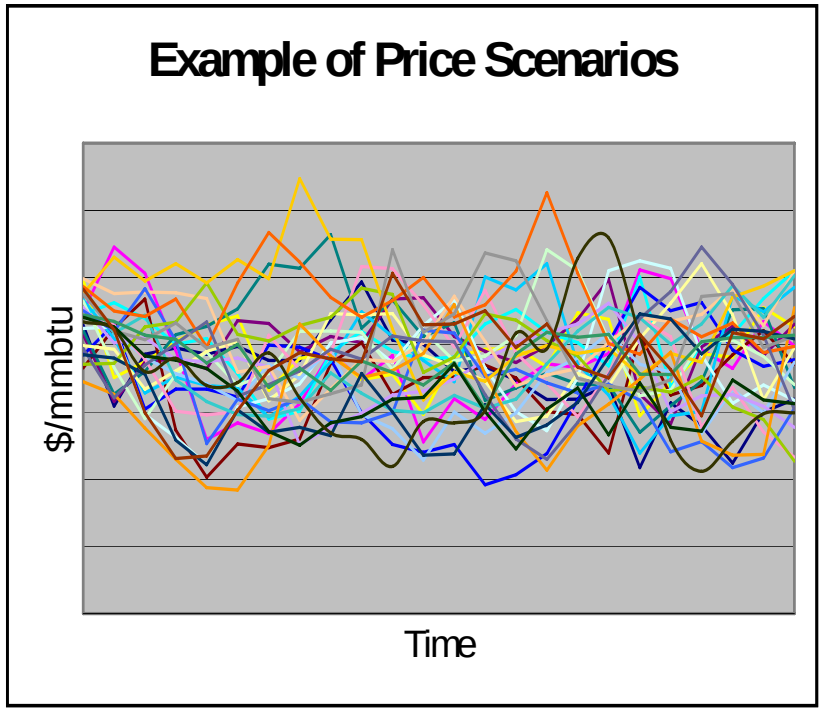

| | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|
| Total Net Exposure | $0.38 | -$0.22 | -$0.04 | -$2.98 | $0.81 | -$4.57 | -$8.25 | -$15.35 |
| Peak Power | $1.47 | $2.30 | $0.63 | -$1.56 | -$0.36 | -$1.96 | -$2.42 | -$5.74 |
| Off Peak Power | -$0.16 | $1.32 | $1.82 | $0.96 | -$0.67 | -$2.12 | -$0.68 | -$3.20 |
| Gas | -$0.93 | -$3.83 | -$2.49 | -$2.39 | $1.83 | -$0.49 | -$5.15 | -$6.41 |

**Forecasted Spot Purchases or (Sales)**

| | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|
| **Peak Power** | -80 | -90 | -25 | 70 | 35 | 145 | 168 | 281 |
| **Off Peak Power** | -14 | -117 | -140 | -76 | 71 | 184 | 70 | 215 |
| **Gas** | 8,103 | 30,481 | 19,287 | 17,818 | -9,562 | 5,802 | 34,880 | 40,617 |

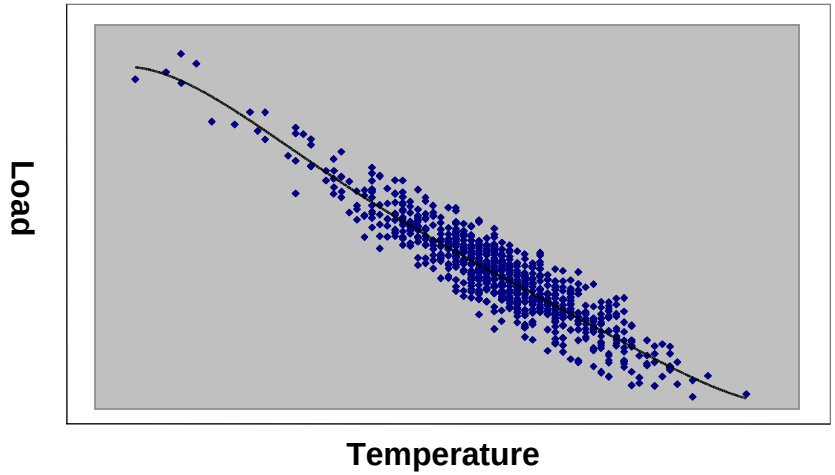
# Developing Key Inputs
## Price Modeling

- Scenarios of prices are modeled to represent possible futures spot outcomes.
  - Econometric regression equations are used to assess correlations between supply and demand factors.
  - To produce price scenarios, these equations are solved using fundamental forecasts (e.g. GDP) and stochastic variables (e.g.weather).



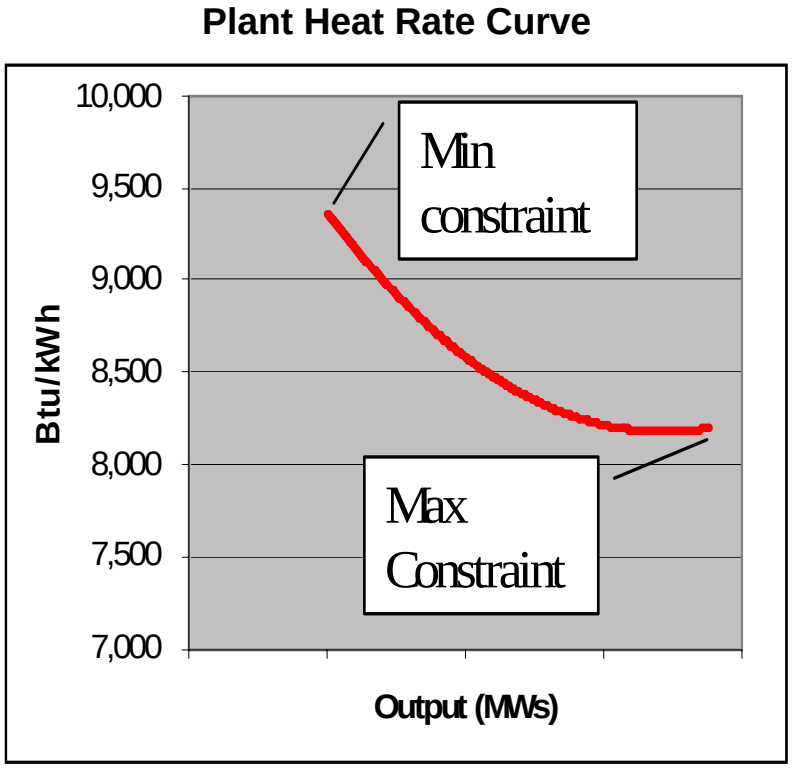
# Developing Key Inputs
## Load Modeling

- Another large risk is load uncertainty due to weather
  - relationship between load and temperature is derived
  - historical temperature variations are used in conjunction with load and temperature relationship to develop load scenarios



# Developing Key Inputs
## Thermal Modeling

- Modeling physical characteristics of thermal units
  - operational constraints
  - efficiency
  - outage characteristics
  - NUG contract complexity
- Gas-Power price correlation
  - not always linear



# Developing Key Inputs
## Hydro Modeling

- Over one-third of PSE capacity is hydro based
  - Scenarios of hydro production are modeled to represent possible futures outcomes.
  - Uncertainty in hydro production represents a huge volumetric uncertainty
  - Correlation between price and hydro