Ventyx Energy

PROMOD IV and PowerBase Overview

August 19, 2008

Gary Moland – Vice President – Advisors
Rick Hunt – Lead Consultant – Advisors
Brenton Meese – Regional Sales Executive
PowerBase™ Suite

**MarketPower®**
Long Term Energy and Capacity Market Price Forecasting,
with Automatic Capacity Expansion

**PROMOD IV®**
Detailed Generation and Transmission Simulation with LMP Forecasting

**Strategist®**
Integrated Resource Planning Optimization

**PowerBase**
Common Database, Consistent User Interface, Scenario & Risk Analysis

**MarketVision™**
Data Subscription with generation and transmission data for NA markets
PowerBase

- Comprehensive Energy Market Data Repository
  - Generating Units
  - Fuels
  - Demands
  - Transmission

- Robust Data Management Capabilities
  - Scenario/Case structure with drag and drop functionality
  - Data Inheritance by Category

- Built-In Reporting and Visualization Features
  - Report Agent - Input data reporting
  - Map Agent – geographic data visualization tool
Generation Inputs

Costs & Characteristics

- Operating Capacity with monthly deration profiles and Percent Firm
- Fully Loaded Average Heat Rates with monthly detailed input/output curves for up to 6 segments
- Fixed & Variable O&M
- Scheduled Maintenance Dates and unscheduled maintenance requirements
- Forced outage rates with mean time to repair for PROMOD IV
- Energy Bid Options (% of cost plus adder)
- Location, GADS, Operator, CoGen, Alternate Name & ID, Custom Values
- Operating Reserve Type and Contribution Level, with Spinning Reserve Bid
- Minimum runtime and downtime
- Startup fuel and requirements, plus adder
- Ramp Up and Ramp Down rates
Fuel & Emissions

• Fuel
  ▪ Fuel costs - total cost or broken out between commodity, basis, and delivery costs.
  ▪ A generic fuel category may be specified: the appropriate area forecast will be used based on the generator area.
  ▪ Multiple fuels may be burned, fuel switching may be economic or set to fixed input percentages
  ▪ Average Heat Content used to report consumption in PROMOD IV

• Emissions
  ▪ Emissions costs are determined by applying allowance prices to the generator release rates.
  ▪ Release rates may be generator-specific, or defined for a particular fuel with a generator reduction amount.
Demand

- Multiple demand groups for aggregating load classes

- Annual peak & energy forecasts are applied to an hourly load shape and adjusted to produce demand shapes over time.
Nodal Transmission Data for PROMOD IV LMP

- **Topology**
  - Buses and Branches (including transformers and DC ties) may be directly input, or imported from PSS/E or PSLF
  - Generator and Load Area bus mapping is input in PowerBase
  - Flowgates and contingencies are directly input

- **Pools**
  - Equivalent to ISO’s and large markets
  - Interchange between pools subject to tariffs or hurdle rates
  - Each pool has its own reference bus specification and assumption for marginal loss calculations included in LMP.

- **LMP Reporting**
  - Individual buses may be selected for LMP calculation and reporting
  - Custom hubs may be developed with specified buses based on generator-weighted, load-weighted, straight average, or custom weighting
Drag and drop individual data “cases” to easily create separate scenarios
Publish & Subscribe cases to easily share information with others in a workgroup
Import large quantities of data from comma-delimited files or Access databases
Manage & Report Data by Category

Set default data assumptions by user-defined categories
Click any level in the category tree to filter down to a subset of items
Produce input summary reports
Easily assign Annual Profiles and Escalation rates by category
NewEnergy Report Agent

Quickly select, filter, and arrange inputs and results as desired.

Use the NewEnergy Pivot Cube to filter and arrange data “on the fly”, and produce graphs with the click of a button.

Send data directly to Microsoft Excel worksheets, Microsoft Access database tables, or Web pages.
NewEnergy Map Agent

Dynamically display Generator, Area, and Transmission data on a map

Use color-coded value ranges, generate contour maps, and animate values over time.
PROMOD IV Analysis Modes

- **Nodal Transmission (LMP)**: Security-constrained unit commitment and dispatch with DC powerflow constraints, marginal losses, and LMP calculations

- **Zonal Transmission**: “Pipeline” transmission constraints between areas

- **MarketWise**: Dispatch a single generator or an entire portfolio against input hourly market prices
PROMOD IV Summary

PROMOD IV® Transmission Analysis Module is a detailed nodal market simulation tool

Application Highlights:
- Locational Marginal Price (LMP) forecasting
- Financial Transmission Right (FTR) valuation
- Asset/Portfolio valuations
- Economic benefit of new transmission
- Transmission congestion analysis
- ISO participation cost/benefit analysis
- Assess Impact of changes in market design
- Analysis of system transmission losses
Market-Based Nodal LMP Forecasting

- Powerflow case – Input to PROMOD
- Generation Shift Factors – DC Load Flow Solution
- Congestion management through re-dispatch
- Security Constraint Dispatch
- Phase Angle Regulators, DC Ties
- Bus-level marginal price calculations
- Nodal impact on unit commitment
- Co-optimized Ancillary Services
- Detailed modeling of Wind Generation
Security-Constrained Dispatch

Line Flows for Binding Contingency Event - July 2008

- Monitored Line Flow
- Outaged Line Flow
- Contingency Flow
- Emergency Line Rating

Flow (MW)

Hour

Ventyx
LMP Decomposition

PROMOD IV calculates the following components of LMP:

\[ \text{Bus } LMP_i = \text{SMP}_r + \text{MCC}_i + \text{MLC}_i \]

Where \( \text{SMP}_r \) = system marginal price at the Reference Bus \( r \)

\( \text{MCC}_i \) represents the marginal cost of congestion as bus \( i \)

\( \text{MLC}_i \) represents the marginal losses at bus \( i \)

Marginal congestion costs can be broken down to show the contribution from each binding transmission limit.
### LMP Diagnostic Analysis - LMP Decomposition

**JUL.24, 2007 TUESDAY HOUR: 1**

<table>
<thead>
<tr>
<th>Reference Bus: JUNIATA</th>
<th>9</th>
<th>2</th>
<th>5</th>
<th>6</th>
<th>9</th>
<th>15</th>
<th>19</th>
<th>266</th>
<th>302</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference LMP:</strong></td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
<td>23.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>From Bus</th>
<th>To Bus</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALDWICK</td>
<td>5027</td>
<td>HILLS SH</td>
</tr>
<tr>
<td>INTERFACE 'Con Ed. 1000MW Whe</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>INTERFACE 'Con Ed. 1000MW Whe</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>NF-M SHF</td>
<td>5014</td>
<td>MARLTONW</td>
</tr>
<tr>
<td>BAYWAY</td>
<td>4958</td>
<td>LIN SHF</td>
</tr>
<tr>
<td>NF-S SHF</td>
<td>5015</td>
<td>SLVR LK</td>
</tr>
<tr>
<td>INTERFACE 'DPL PENINSULAR'</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>BRANCHBG</td>
<td>2</td>
<td>BRANCHBG</td>
</tr>
<tr>
<td>BRANCHBG</td>
<td>4962</td>
<td>FLAGTOWN</td>
</tr>
<tr>
<td>JACKSNRD</td>
<td>5061</td>
<td>HINCH.AV</td>
</tr>
<tr>
<td><strong>Pool Constraints:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Losses:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total LMP:</strong></td>
<td>21.93</td>
<td>21.69</td>
</tr>
</tbody>
</table>

**Notes:**
- The LMP Diagnostic Analysis provides a detailed breakdown of margin price changes at different buses.
- Key events include power transfers and constraints affecting the margin price at each location.
- The Losses section shows any discrepancies in the total LMP calculations, ensuring accuracy in the analysis.
Transmission Utilization & Congestion Analysis

Hourly Line Flows on Pleasant Valley Line For 1 Week period

- Actual Flow
- MAX Flow

Hours

Ventyx