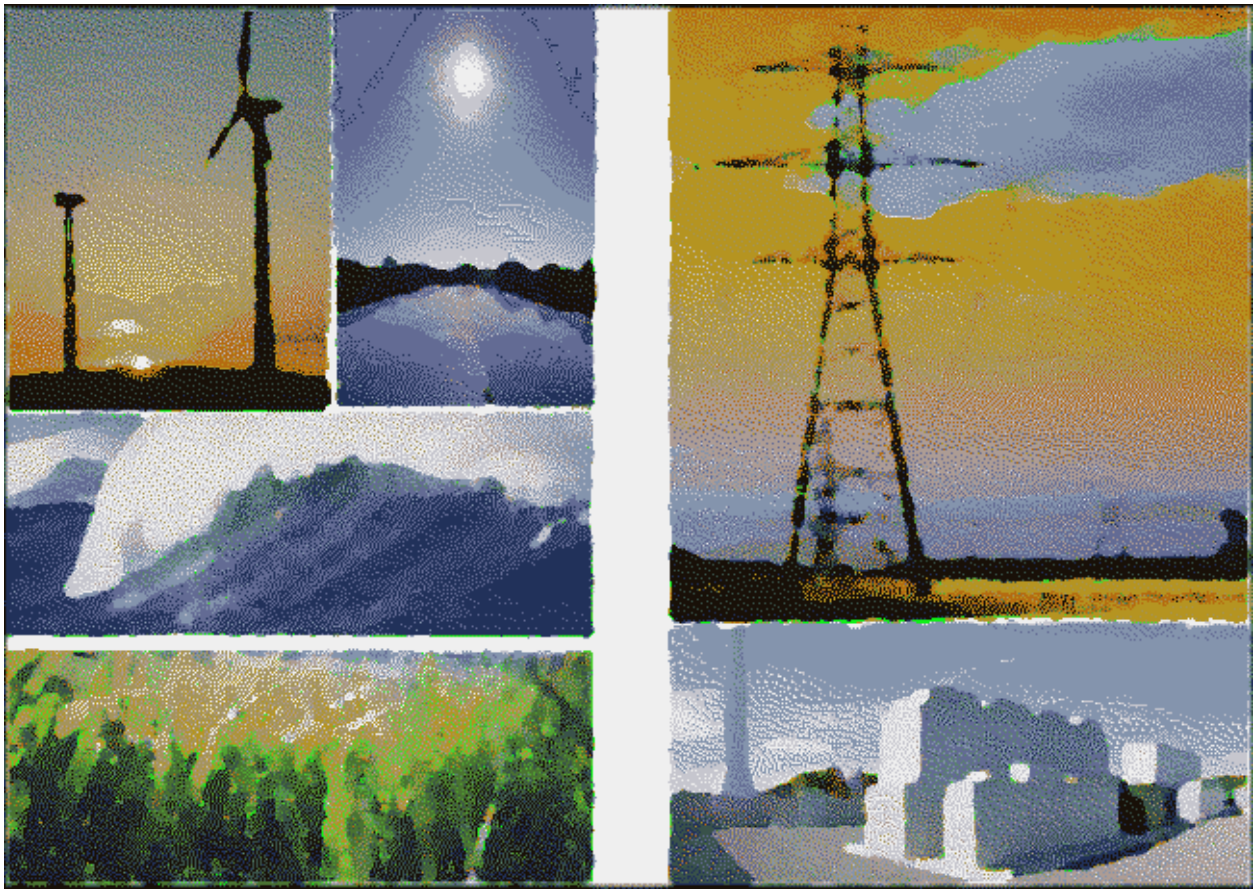
PROMAX™



SHORT-TERM ENERGY & TRANSMISSION MARKET SIMULATION SOFTWARE PACKAGE

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EXECUTIVE SUMMARY

ECCO International, Inc., ("ECCO") has developed ProMax™, a short-term, integrated energy and transmission market simulation software package that allows the accurate simulation of the Day-Ahead Market Clearing process performed by Independent System Operators or Transmission System Operators. ProMax™ performs a Day-Ahead Market Clearing simulation and produces energy market outcomes, such as schedules, market clearing prices congested paths and cost of congestion, taking into account bids from the market participants, the load forecast, forecast plant outages and forecast transmission outages.

A key objective of the ProMax™ software is to simulate the energy market Clearing and Dispatch processes performed by Independent System Operator and Transmission System Operators and produce an optimal schedule which minimizes production costs while respecting all resource constraints, such as start up costs, minimum up/down times, operating constraints, unit initial conditions, transmission constraints and ancillary service constraints.

ProMax™ utilizes the same modeling features as the Day-Ahead Market Clearing engines commonly used in ISOs/TSOs, with a full simultaneous multistep Unit Commitment MIP model which iterates with a full AC power flow, utilizing Power Transfer Distribution Factors (PTDFs), (or Generation Shift Factors) to enforce transmission constraints. Losses are fully modeled in the optimization using loss factors derived from the solved AC power flow solution as it iterates with the MIP UC. After the commitment solution is complete, a pricing run is performed to provide the dual variables to use in the LMP calculation, which includes the calculation of the energy, loss and congestion component for each bus, location, Load Aggregation Point (LAP), Trading Hub and APNode.

The ProMax™ model has been recently upgraded to include advanced features currently debated at the CAISO such as demand bids, convergence (i.e., virtual) bids and scarcity pricing of ancillary services.

The key ProMax™ output information is the hourly schedules and Locational Marginal Prices (LMPs), or zonal prices, Ancillary Services Marginal Prices (ASMPs), binding constraint sets and corresponding shadow prices.

ProMax™ has been successfully used by various Market Participants for various purposes. Typical ProMax™ applications include:

- Day-Ahead Market price forecasting (LMP/MCP), etc.
- Market simulation and what "if scenario" studies
- Validation of ISO market outcomes
- Transmission flow and congestion forecasting and analysis
- Loss factor forecasting
- Reliability studies, EUE/LOLP calculations, etc.
- Generator bid strategy evaluation
- Renewable Energy Resource modeling and analysis

Short-Term Energy & Transmission Market Simulation Software (ProMax™)

1. Introduction

ECCO International, Inc. has developed ProMax™ which is a generalized Security Constrained Unit Commitment package using state-of-the-art Mixed Integer Linear Programming (MILP) optimization technology. This program is a full multistep MIP Unit Commitment with minimum up/down times and start up costs, using an embedded AC power flow to calculate loss factors and provide linearized transmission constraints using shift factors. ProMax™ can be used for a multitude of applications such as price forecasting, market simulations, generation and transmission studies, etc. One of the key applications is short-term energy price forecasting. A brief description of this application is presented next.

2. Short-Term Market Clearing Price Forecasting

ProMax™ includes a module to forecast energy market clearing prices for the immediate short-term period using an accurate market clearing model which uses a forecast bid stack for all the units in the system to determine market clearing prices, taking into account the forecast system load and an explicit representation of the detailed transmission grid.

The input to the Price Forecasting module is the forecast unit and intertie bid stack for each trading interval in the day, the forecast TAC loads for the day and the transmission constraints including nomograms. The output is the locational market price forecast for each location and APNode for each trading interval. The energy, congestion and loss components are calculated for each location and APNode components that make up the total LMP.

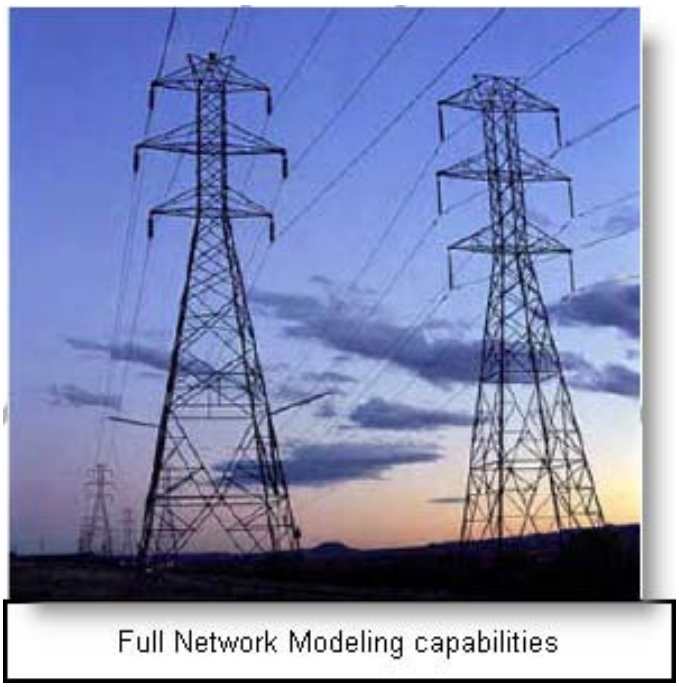
3. ProMax Model Overview

The optimization solver of ProMax™ utilizes the same Mixed Integer Programming (MIP) optimization technology as used by the ISOs to perform the Day-Ahead market clearing simulation. The classical MIP implementation utilizes cutting plane and Branch and Bound schemes. This method performs an implicit enumeration of all combinations of integer variables to locate the global optimal solution. In theory, the MIP is the only method that can make this

claim. It can, in fact, solve non-convex problems with multiple local minima. ProMax™ minimizes the operating cost as expressed by the bids and constraint penalty functions, while respecting all resource, system and transmission constraints.

ProMax™ is one of the most advanced amongst energy and transmission market simulation applications in the industry as it emulates very closely the modeling performed in the ISO Market Clearing engines including:

- Full unreduced network model, with a MIP UC (multi-interval) iterating with a fully coupled AC power flow
- Full representation of contingency constraints using shift factors and compensation methods to calculate the post-contingent state.
- Full representation of loss LMP's using the sensitivities from the solved AC power flow



Full Network Modeling capabilities

- Automatic Cascading of higher priority reserves to lower priority reserves.
- Convergence (i.e., Virtual) bidding
- Demand bids
- Scarcity pricing for Ancillary Services
- Distributed slack model either generation or load slack with user supplied factors.
- Proper representation of the LP pricing run with appropriate penalties for transmission, ancillary services, self-schedules, etc.
- Energy limited bids.

In the following sections we present the basic modeling capabilities of ProMax™.

3.1 Unit Constraints

ProMax™ models all resources in the same manner as modeled in the ISO Market Clearing applications.

The following constraints are explicitly represented in the ProMax™ software:

- Minimum up times,
- Ramp limits
- Minimum down times,

- The number of start-ups in a given period,

3.2 Transmission Constraints

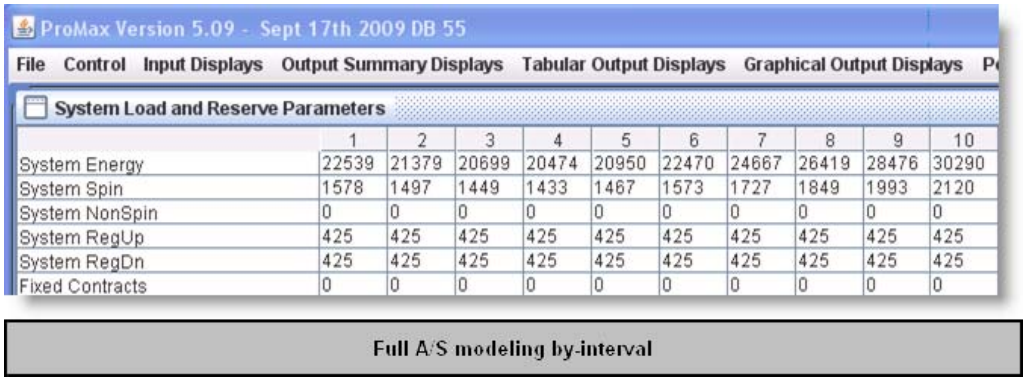
The status of the transmission system is a key element in effecting the operational outcome of the any ISO Day-Ahead Market (DAM). ProMax™ provides the added advantage of taking network constraints into account when forecasting for the study period.

3.3 Energy Limited Bid Constraints

Energy limited bid constraints can also be enforced by ProMax™. They can be represented as a constraint on the unit's or station's total MWH output for the study period.

3.4 Ancillary Services Constraints

Ancillary services constraints are also explicitly enforced on a system and zonal basis in the ProMax™ Price Forecasting module and in the ProMax™ Unit Commitment module. The following AS are modeled in ProMax™, Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserves. The reserve model includes cascading of the reserve from higher priority reserve bids to lower priority reserve (the Rational Buyer model), so that the procurement costs are minimized. ProMax™ produces Ancillary Services prices for every service and every resource in the system.



Full A/S modeling by-interval

3.5 Inter-tie Modeling

Interties are modeled with a set of intertie bids based on historical bids and forecast market price conditions. Historical bid behavior indicates that there is a significant must run component at the major scheduling points and these are modeled in the simulations with low bids. For each scheduling point a bid stack is constructed, with a low price must run component and then a graduated set of bids based on market prices in the area. ECCO International has invested considerable time and resources over a long period of time to develop the supporting database to ensure the best Inter-tie modeling.

3.6 Penalty Prices

The ProMax™ software provides the functionality to classify and prioritize constraints among themselves in order to control scheduling priorities. A common system of priority levels is supported for constraint priorities. The priority level for any control or constraint class is configurable. This capability is consistent with functionality that has been implemented at

various ISOs. The following constraint classes are supported and in the following priority order from high to low:

1) Power Balance Constraint;
2) Transmission constraints (separate levels for branch flows, interface flows/ nomograms, and contingency constraints) ;
3) Ancillary Services minimum regional requirements; and
4) Ancillary Services maximum regional requirements.

3.7 Market Power Mitigation

Market Power mitigation is modeled by performing consecutive runs of the market clearing process, the first with all constraints enabled, and the second run is performed with only competitive constraints included. If a unit was dispatched in the first run but not in the second run the bid price of this unit for the pricing run will be adjusted according to the CAISO tariff as part of the market power mitigation process.

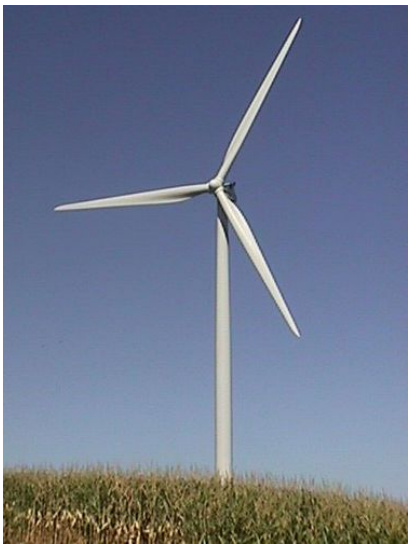
3.8 Convergence Bidding (CB) Modeling

This description outlines the potential for tests that may be conducted for evaluating the effects on the market prices and the convergence of the Power Flow in the Day-Ahead Market clearing (DAM) using ProMax™ simulations in the presence of convergence bidding (CB). One concern is that the introduction of CB, especially in substantial amounts, may reduce the chances of convergence of the power flow in the DAM clearing. The ProMax ™simulations are designed to test the stability and convergence of the Security Constrained Unit Commitment process (SCUC) and dispatch in DAM in the presence of CB as well as to assess the impact of CB on Locational Marginal Prices (LMPs.) ProMax™ has been configured to be able to test CB supply and demand bids in a LAP as well as nodal level.

Test 1			Test A: 20% – 15% – (difference 5%)		
UnitGens_ID	Iteration	Unit_ID	unitname	Date	HE 01
733	1001	734	DLAP_PGAE-APND-VDMD	VDMD Cleared	-1887.9
				VDMD Bids	-1887.9
732	1001	733	DLAP_PGAE-APND-VSUP	VSUP Cleared	0
				VSUP Bids	2517.2
735	1001	736	DLAP_SCE-APND-VDMD	VDMD Cleared	-1793.18
				VDMD Bids	-1793.18
734	1001	735	DLAP_SCE-APND-VSUP	VSUP Cleared	0
				VSUP Bids	2390.9
737	1001	738	DLAP_SDGE-APND-VDMD	VDMD Cleared	-319.2
				VDMD Bids	-319.2
736	1001	737	DLAP_SDGE-APND-VSUP	VSUP Cleared	0
				VSUP Bids	425.6

Convergence (Virtual) Bid Capability

3.9 Intermittent Resources Modeling



With the current Federal and State initiatives underway which are establishing requirements for minimum expected procurement of "green" supply, ECCO has included the capability of modeling intermittent producing resources in our ProMax™ software.

Intermittent resources are modeled, each with its own hourly profile, for all of the hours in the study period. These resources can be represented as fixed schedules that can vary from hour-to-hour or as energy limited resources over the course of the study period. These options allow for providing various level of flexibility in the study depending upon how these resources are operated within a particular region.

ECCO is also offering modeling of intermittent resources using a capacity factor. As in PJM, for example, for new wind units or those without a full three years of operating data, a wind category class average capacity factor can be applied. The wind category class average factor can be based on average performance of existing intermittent generators over pre-defined period. The wind class average capacity factor available to change based on local experience.

Typically the wind class average capacity factor has been defined as being between 10 to 13 % depending upon operating region

Further, ProMax™ has been configured to perform studies that are required to determine the cost of integration of Intermittent Resources, such as wind, into the grid as a function of the penetration level. These costs include the cost of Regulations and Reserves and the costs on intra-day Unit Commitment. Specifically, ProMax™ can be used to:

- Quantify the historical real-time load and wind variability, and their impact on regulation requirements and procurement costs. The impacts will be characterized by increasing levels of wind penetration.
- Quantify the historical load and wind forecasting errors, and their impacts on reserve requirements and procurement costs. The impacts will be characterized by increasing levels of wind penetration.
- Quantify the increased costs of Unit Commitment for intra-day operations as a function of the increased levels of wind penetration.

Finally, ProMax™ has been configured to perform reliability studies to evaluate the impact on the system reliability of increased levels of Intermittent Resources. Specifically, ProMax™ is configured to calculate various reliability indices, such as Expected Un-served Energy (EUE) and system Loss of Load Probability (LOLP) at various penetration levels of Intermittent Resources. Due to increased penetration of Intermittent Resources into the system, load curtailment may be required to ensure the balance of supply and demand during certain hours of

the day. Load curtailment is recommended in order to reduce the amount of spinning reserves required by the system. ProMax™ simulates the system under various conditions to calculate various reliability indices, such as EUE and LOLP.

DISCLAIMER

Product names, product specifications and software features are subject to change without notice. Use of the ProMax software is under license. Prices can be found in the pricing document that is delivered on request.

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