DAYZER

Day-Ahead Market Analyzer

DAYZER is a user-friendly detailed market analysis tool which facilitates the understanding of the complex operation of electricity markets with little training and effort.

<u>Key Features</u> Open Architecture Powerful Algorithms Intuitive Data Visualization

Who should use DAYZER?

Analysts: DAYZER is a powerful tool that can forecast Day-Ahead hourly LMPs (Zonal or Nodal), Shadow Prices and Congestion Costs under "what if" scenarios.

Market Monitors: DAYZER is useful tool that can be used to analyze bidding behavior and different market equilibria (marginal costs, Nash, etc...)

DayZer v5.0	b123: NEF	POOL 11	-15-2009	(Winter)		
ile Edit View :	5imulation Ir	nputs Too	ols Reports	Help		
Run Sin	329 Uni	its	Hour 1	+		Λ
Generation Units	Load Zones	Transmiss	sion Constraint:	s Substat	ons	
Generation Unit	Zone	Туре	Capacity	Bid	Cost 🗸	
A. L. Pierce	South	NGT	99.00	35.51	0.00	
AELLIVERMURE	Maine∠ Now Ha	STr	34.62 295.00	17.20 22.96	0.00	
AES LONDON	New Ha	NCC	395.00	23.11	0.00	
AES THAMES	Rest of	STc200	182.00	43.09	99766.65	
ALTRESCO (pit	West C	CC	173.00	30.99	0.00	♪ { ∸
AMOSKEAG	New Ha	Hydro	17.50	0.10	46198.91	
ANP BELLING	South E	NCC	267.00	24.90	0.00	
ANP BLACKST	South E	NCC	251.00	25.11	0.00	- I / / I - I
ANP-BELLING	South E	NCC	271.00	25.01	0.00	
ASCUTNEY GT	Vermont	GT	14.20	224.34	0.00	_ \ \ (−) \
AYERS ISLAND	New Ha	Hydro	9.08	0.10	23995.91	
AZIOUUHUS H Aggregate Upito	maine∠ West C	NGT	5.81 250.00	0.10 300.29	14760.16	
BAR HARBOR	Maine Z	GT	8.60	302.43	0.00	
BARMILLS	Maine Z	Hydro	4.00	0.10	8668.08	
BEAR SWAMP	West C	PS	562.00	0.10	0.00	The second is the second in the second is th
BELDENS	Vermont	Hydro	4.58	0.10	12113.20	
BELLOWS FAL	New Ha Weet C	NCC	48.54	25.59	128240	
BERLIN 1 GT	Vermont	GT	47.65	215.12	0.00	
BETHLEHEM	New Ha	STr	15.70	24.42	0.00	
BIO ENERGY	New Ha	STr	1.00	11.47	0.00	
BULTUN FALLS	Vermont	Hydro	7.80	0.10	20619.31	
BOOT MILLS	West C	Hudro	20.00	0.10	52858.83	
BRANFORD 10	South	GT	21.28	199.30	0.00	
BRAYTON DIE	South E	GT	7.55	172.16	0.00	
BRAYTON PT 1	South E	STc+	252.00	35.94	0.00	
BRAYTON PT 2	South E	SIC+	249.00 £22.00	35.19 25.14	0.00	
BRAYTON PT 4	South E	STo+	445.00	42.56	0.00	
BRIDGEPORT	South	CC	530.00	25.50	0.00	
BRIDGEPORT	South	STo200	147.00	151.02	0.00	
BRIDGEPORT	South	STc+	370.00	39.43	0.00	
BRIDGEPORT	South Norwalk	STr	14.70 58.70	216.00	0.00	
BRIDGEWATER	New Ha	STr	15.55	24.45	0.00	NEW ENGLAND
BRISTOL REF	Rest of	STr	12.74	21.01	0.00	
BRUNSWICK	Maine Z	Hydro	20.20	0.10	43629.25	THROUGH 2015
BUCKSPURT	Maine∠ Sauth	NUU	183.00	19.94	0.00	ISO NEW ENCLUDE.
BUBUNGTON	Vermont	GT	0.40 22.96	248.16	20240.40	
CABOT/TURN	Rest of	Hydro	62.19	0.10	209134	
CANAL 1	South E	STo+	564.00	118.92	474620	
CANAL 2	South E	STo+	562.00	39.51	0.00	
LAPE 514	Maine /	121	17.29	188.21	1110	
System, Unit, Line, and						
oad Zor	ie cha	racte	ristics			Mini-GIS Engine showing
hown in tabular format. system components and LMPs						

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DAYZER

Day-Ahead Market Analyzer

DAYZER Sample Screen shots

1. System Supply/Demand Curve

3. Line Flows and Congestion Costs

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2. System Load and Unit Commitment 4. Transmission Rights Evaluation Tool



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DAYZER FEATURES

Cambridge Energy Solutions is pleased to present its Day-Ahead Locational Market Clearing Prices Analyzer (DAYZER) for analyzing the locational market clearing prices and transmission congestion costs in US electricity markets.

• **Simulates** operation of the electricity markets, ISO dispatch procedures and calculations made by the ISOs in solving for the security-constrained, least-cost unit commitment and dispatch in the day-ahead markets.

- Forecasts the day-ahead and hourly locational market-clearing prices and congestion costs.
- Updates using the most recently available data on fuel prices, demand forecast, unit & transmission line outages, emission permits costs.
- Incorporates all the security, reliability, economic and engineering constraints on generation units and transmission system components.
- **Customizable** to emulate specific operation of any regional market and the dispatch or operating procedures adopted and used by the ISOs, with its unique ability to capture the particularities of each regional market.

DAYZER is currently available for the NYISO, NEPOOL, PJM RTO, MISO, ERCOT, WECC, CAISO and ONTARIO markets.

DAYZER has the following features:

- > Easy to use and user friendly, with scripting interface to automate long-term as well as short-term simulations.
- > Accurate security-constrained unit commitment and dispatch algorithms that mimic those used by the ISOs in the Day-ahead market.

> Accurate data inputs and assumptions (up-to-date database on thousands of items). Uses NAPD for information on generation and transmission system.

- > Accurate modeling of each market with its own particularities (second contingency constraints, locational reserve markets, etc.)
- > Captures marginal transmission losses in dispatch and prices in markets where implemented.
- > Graphical user interface plus transparent Access database and reporting output.
- > Captures hourly transmission outages, transmission contingencies, planned and known transmission upgrades.
- > Models accurately phase angle regulators and loop flows.
- > Allows users to analyze various scenarios and quantify the impact of various key variables/assumptions.
- > Validated against actual market prices (samples as shown in following graphs).

In addition to DAYZER as a core, DAYZER long-term uses the following modules:

- a. Long-term load forecast (based on historical load shape and forecasted peak demand)
- b. Fuel prices from NYMEX (Fuel Oil and Natural Gas)
- c. Random Outage using Bernoulli probability model
- d. Maintenance schedule (optimized based on reserves)
- e. Imports/exports

The simulation results shown in the graphs reveal good comparison to actual day-ahead market clearing prices published by the ISOs, given the following:

- 1. Error in zonal load forecast (uses load forecast rather than actual day-ahead bids for NYPP and assumes no virtual bidding for all markets)
- 2. Error in generation unit outages (assumes uniform de-rating of generation units)
- 3. Error in bid estimation (assumes marginal cost bidding)

The pattern shown in the graphs is consistent over longer periods.



Hourly Average LMPs (by month)



CAISO Aug 2010 LMP Comparison



(Comparisons with Day-Ahead Market - Pacific Gas & Electric Zone)



CAISO Aug 2010 LMP Comparison

(Comparisons with Day-Ahead Market – Southern CA Edison Zone)





ISO

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WECC Dec 2009 LMP Comparison

(Comparisons with Day-Ahead Market – Pacific Gas & Electric Zone)







NEPOOL Jan 2010 LMP Comparison

(Comparisons with Day-Ahead Market – Nepool Hub)



NEPOOL July 2010 LMP Comparison



— DAYZER

— NE-ISO



NYPP Aug 2010 LMP Comparison

(Comparisons with Day-Ahead Market – NYC – Aug '10)

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NY-ISO



NYPP Aug 2010 LMP Comparison (Comparisons with Day-Ahead Market – NYCapital – Aug '10)





Avg. LMP (\$/MWh)

Avg. LMP (\$/MWh)

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PJM-ISO

PJM-ISO



Avg. LMP (\$/MWh)

Avg. LMP (\$/MWh)

PJMRTO Aug 2010 LMP Comparison

(Comparisons with Day-Ahead Market – PJM Eastern Hub)



- DAYZER

- PJM-ISO





30 20 10

Avg. LMP (\$/MWh)

Avg. LMP (\$/MWh)



MISO LMP Graphs

(Michigan Hub – Sep '09 to Aug '10) (Using Standard CES Assumptions)



Daily Average LMPs



Midwest-ISO





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Midwest-ISO

MISO Aug 2010 LMP Comparison

(Comparisons with Day-Ahead Market - Aug 2010)





Real-Time-Market





DAYZER VISUALIZER

Sample NEPOOL Transmission Map view



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DAYZER VISUALIZER

Sample PJMRTO hourly LMP heat-map views showing comparison with Day Ahead LMPs



DAYZER VISUALIZER



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Dayzer Bidding Strategies at a glance...

- **Marginal Cost**: Generators bid their marginal cost as fuel cost + variable operating & maintenance cost + environmental emission cost.
- **Fixed Bid Adders**: A fixed set of bid adders (\$/MWh) for the selected unit(s) can be applied using this bidding strategy. This strategy could be used to simulate the PUSH bidding approach in New England Market.
- **Strategic bidding**: Dayzer uses historical market clearing prices at liquid trading hubs to adjust the supply curve such that the marginal generation units maintain their merit order but their bids come closer to historical market clearing prices.
- **Next Unit in Merit Order**: The bid of the next unit in the merit order is used instead of the marginal cost of that unit. This strategy represents a zero risk to generator owners in bidding their output into the day-ahead market.
- **Next Owner in Merit Order**: The bid of the generation unit owned by the next owner in the merit order is used instead of the marginal cost for all units owned by a single owner, maintaining the merit order of these units. This strategy represents a zero risk to generator owners in bidding their output into the day-ahead market.
- **Block Bid Adders**: Allows the user to design bidding strategies by unit type, by adjusting the block bids of generation unit. The bid adders are based on percentages of marginal cost of each block.
- **Scarcity Bid Adders**: Allows the user to increase the bids for those units whose capacity in the merit order or price is above a user set level.
- **Unit Block Bids**: Allows the user to modify bid block capacities and bids for each individual unit.
- **Highest Fuel Price**: When determining bids for units capable of using multiple fuel types, Dayzer will use the fuel with the highest cost.
- **Lowest Fuel Price**: When determining bids for units capable of using multiple fuel types, Dayzer will use the fuel with the lowest cost.

A brief on DAYZER Operations:

- DAYZER uses Security Constrained Unit Commitment and Dispatch procedures as well as MIP in its Algorithms.
- MIP stands for mixed-integer program. It is the minimization or maximization of a linear function subject to linear and Integer constraints.
- The User can perform various comparitive studies based upon different inputs, model loop-flows, run simulations with different Bidding strategies, create Day-to-Day running Batch processes, as well as create MS Excel / PDF Reports for the same.