Storage Optimization Software (SOS^{tm})
By WTM Energy Software, LLC
(Offering the Latest and Best Natural Gas Storage Model^{sm})

USER'S GUIDE
(For Version 3.000 – March 31st, 2015)

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What Does the Model Consider as "Valuable" in Storage Leases?

As the user peruses this guide, it is worth noting what the WTM storage model considers as valuable in natural gas storage leases. This knowledge will help the user interpret the model results and recommendations much more clearly.

Purely and simply, the value in trading natural gas storage derives from being able to buy physical at low prices, store it, and sell it at high prices in expectation. This is regardless of the strategy employed to capture such value (eg, cash trading, rolling intrinsic, or basket of spreads). But maximum value is had in expectation by optimally trading at same-day and next-day gas prices ("cash prices") each day and delta hedging accordingly to reduce risk. Cash prices possess very profitable trends – the most well-known trend is the winter/summer spread – and high volatility. Having access to a storage facility means that a trader can inject/buy on a given day when cash prices go too low and withdrawal/sell when prices go abnormally high. This ability to trade physical gas each day so as to exploit these trends is the optionality in storage.

Much optionality exists in storage, and that optionality is even greater when traders have the ability to either buy or sell gas from storage at any given time (by being partially filled). Further, if various gas storage inventory levels are associated with higher maximum daily injection/withdrawal quantities (MDIQs and MDWQs, respectively), then these levels become especially valuable! The trick for any storage trader is to (1) recognize the high-optionality inventory levels at any given time, (2) optimally trade toward those levels, (3) remain at those levels only for the term in which they are valuable, and (4) recognize and trade toward the next set of levels after that term. A lot of this so called follow-on optionality exists in storage leases, which makes the option value in storage very complex and not well-behaved relative to other American-type options.

The Storage Optimization Software (SOS^{tm}) from WTM Energy Software, LLC, gives values based on optimal trading/hedging, identifies the valuable inventory levels, recommends optimal trades each day for getting to those inventories, gives guideline near-optimal delta hedges each day for protecting total value (intrinsic plus extrinsic), gives cash-to-prompt trading thresholds each day for buying and selling physical optimally, and possesses the ability to track performance to see if you are realizing value through time commensurate with what you expected.

In addition to these results, SOS also has a VaR (Value-at-Risk) Calculator that allows traders to ascertain how well total storage value is protected for any set of desired hedges, including their current set. VaR minimizing hedges protect *extrinsic value*, not just intrinsic value! Thus, if traders prefer to use different hedges than the SOS guideline hedges, they can use the VaR Calculator to ascertain how effective those hedges are. Relating storage hedges to extrinsic value protection is new and is just another valuable and unique feature of SOS.

Overview of Worksheets Used to Run the Model

WTM's Storage Optimization Software (SOS^{tm}) is run via an Excel workbook using four main worksheets and one parameter sheet. Other sheets exist that support and save model results after the model is run, and we discuss those as well. **Note that copies of this workbook can be made for each storage lease**, thus relieving traders from changing volume/ratchet inputs as different leases are valued. An overview of all sheets is now given.

The 4 Main Worksheets:

Three of the four main sheets require the user to input a few values concerning the storage lease on each sheet. Lease dates are entered on the first, market data on the second (prices, basis, volatilities, and discount rates), and operational constraints on the third (capacity in MMBtus, ratchets, charges, requirements and ad valorem taxes). After such input, the user clicks a button to run the storage model. The model may take several minutes to run, depending upon the storage lease term and winter/summer spreads in prices and volatilities, but upon completion the output will appear on the fourth main worksheet, "4-Output." The specific outputs shown for a full model valuation are

- (1) – Total dollar storage value for the amount of gas inventory currently stored
- (2) – Dollar storage value per unit of capacity in MMBtus of the lease
- (3) – Recommended physical trade for the current day and cash-to-prompt spread
- (4) – Guideline forward contract (delta) hedge volumes for the current inventory
- (5) – One-day-95% VaR of the delta-hedged storage value for the current inventory
- (6) – Maximum intrinsic values and corresponding intrinsic hedges
- (7) – Threshold cash-to-prompt spreads for profit-maximizing injection/withdrawal
- (8) – A table of storage values, recommended physical trades, deltas, and VaRs for the whole range of inventory levels

These are discussed further below in detail. All these results help in four main ways: (a) Valuations help in bidding and daily performance tracking; (b) recommended physical trades tell you if injecting or withdrawing at today's cash price is profit-maximizing; (c) cash-to-prompt thresholds tell you what the cash-to-prompt spreads on the day must move to in order for injection or withdrawal to be profit-maximizing; (d) guideline delta hedges indicate how much capacity is optimal to hedge on the day and whether to focus on longer-term or shorter-term contracts in doing so.

This worksheet also allows you to save results to the performance tracking database. This is discussed below when performance tracking is discussed.

The 1 Parameter Worksheet:

The one parameter sheet allows for five pieces of input: the short-term mean-reversion speed, the long-term mean-reversion speed, the long- to short-term volatility ratio, the capacity constraint on the net-delta, and a switch to calculate full results, intrinsic only results, or cash-to-prompt threshold only results. This net-delta parameter is a percentage of tolerance relative to the lease's maximum capacity, and it is a bound on net buy/sell hedge exposure that calculated guideline hedges are allowed to be mismatched. For example, both a value of 10% for this parameter and a value of 1 million MMBtus for the lease's capacity mean that the current inventory plus calculated guideline injection delta-hedge volumes must be within 100,000 MMBtus of the calculated withdrawal delta-hedge volumes.

The two mean-reversion speeds and long- to short-term volatility ratio are referenced in both the Journal of Energy Markets paper and our white-paper as *a*, *b* and *k* respectively. The former paper is referenced on our website with links to the journal while the latter paper is on our website and may be downloaded and printed.

The model has default estimated values for these parameters but allows for input of them since different parameters may apply for different storage locations. If the user wishes to override the default values, then the user must estimate these parameters outside the model and input them on the parameter worksheet. Within the model, these parameters are considered constants during valuations.

Note that the default values are *a* = 9.0, *b* = 0.1 and *k* = 1.5. These values were estimated using data on different storage years, cycle-rates, and gas hubs around North America, and these values were quite robust over time and locations.

This sheet also allows for inputting a Results Choice Indicator, which allows one to select which set of results is to be run: "F" for full valuation results, "I" for intrinsic only valuation results, and "T" for cash-to-prompt threshold only results. The last two results can run much faster than the full set of results.

Other worksheets that give the ability to efficiently and quickly tailor delta hedges so as to minimize storage value VaR and to track performance through time as value is being realized are utilized only after the model is run and are discussed now.

The VaR Calculator Worksheet:

This worksheet supports the trader in dynamic hedging and is utilized after the model runs that day. It allows for the trader to perform what-if scenarios for hedging total storage value, both intrinsic and extrinsic! Since delta hedging storage value allows for multiple sets of hedges that hedge overall with the same effectiveness, one can use this worksheet to find a set of hedges that minimizes the deviation from your current set of hedges. Specifically, the trader can enter the current hedges as a set of proposed hedges into the VaR Calculator, click a button, and the VaR of the storage value hedged with those proposed hedges appears. The

VaR of the storage value hedged with guideline hedges is also shown for comparison. If the two VaRs are close, then the trader can be confident that the set of proposed hedges will protect total storage value well, even if guideline deltas are quite different.

WARNING: The VaR Calculator computes VaRs from the last full valuation, not from partial valuation runs for either intrinsic values only or trading thresholds only. So if the last full valuation was not recent, then VaR Calculator results will be stale. Thus, running the model on a full valuation (as selected from the Results Choice Indicator on sheet "Parameters") before using the VaR Calculator is recommended.

The Performance-Tracker Worksheet:

This sheet allows the user to track performance on a storage lease through time. It answers the question of whether or not you are realizing cash flows through injections, withdrawals and hedges at a rate commensurate with how the forecast storage value was estimated at the beginning of tracking.

Five click buttons, a chart, and the chart's data appear on this worksheet. The click buttons allow you to either recalculate the chart and its data or to save, delete, import or update raw trade data for physical, for hedges, and for any miscellaneous cash flows. (A save/update click button also appears on the output worksheet, 4-Ouput) Results should be saved every trading day after the model is run and trading is finished.

When updating the performance data each day, you'll click the "Save/Track Results" button to either enter or update trades. This button, along with the button "Reset/Recalc Chart," will be the two buttons most frequently used and used most every trading day. The other buttons are used quite infrequently: "Import Data" is used when you are in the middle of a performance tracking effort on a lease, WTM issues an updated workbook version, and you must import existing data from the old workbook to the new one so that the new one can pick up on tracking where the old workbook left off; "Delete Data" is used when performance tracking is to start anew on either a new lease or a new storage year on the same lease; "Update Initial Data" is used to either examine or update starting hedge and inventory positions for a lease being tracked.

If all goes well through time with your trading, then the tracking chart should show a fairly flat line through time (ie, the updated value is fairly constant through time) that is close to your value at the beginning of tracking.

The tracker is also designed for you to quickly go back to previous days and actualize physical trading volumes, hedges, and miscellaneous cash flows. **All these can be called up, modified, and re-saved for previous days, and no re-running of storage valuations must be performed. The performance tracker already possesses the data needed to make adjustments on performance going forward from when the trades were modified.**

The sheet contains data and results that allow (1) for various other worksheets in the workbook to operate, (2) for performance tracking results to be calculated, and (3) for easier support from WTM if the model should somehow fail. This sheet should not be deleted or modified in any way!

We now discuss the individual worksheets in detail.

The Worksheets in Detail

The storage model runs on the input of the four following worksheets: The sheets are named "1-StartHere," "2-PriceInputData," "3-VolumeInputData," and "Parameters." Not much input is entered on each sheet, but once the data is properly input, the user may click the button "Get Results" on sheet "4-Output" to run the storage model and get results.

The one calculator sheet, one performance tracking sheet, and one reference sheet are explained further below.

Worksheet "1-StartHere"

Upon opening the workbook (under "Enable Macros"), the cursor will be placed immediately on the sheet labeled "1-StartHere." Only three dates are to be entered on this sheet: the beginning storage lease date, the ending storage lease date, and the date for which the valuation is run, which is usually the current date (all in mm/dd/yyyy format).

Two click-buttons appear on the sheet. The "Reset Sheet" button is used to clear the sheet and reload various cells with proper labeling and formatting for data entry. The dates are to be entered in the light-blue highlighted cells.

When all three dates are entered, the user clicks the other button, "Update and Continue." The input dates are immediately checked for correctness, other sheets are updated based on the entered dates, any subsequent date-dependent input will get assessed against these dates for errors, and the next worksheet ("Parameters") is shown. However, if an error exists with the dates, then an error message appears that tells the user about the problem. A screen shot of this sheet is shown below.

Note lastly that if you attempt to move from this sheet without clicking the Update and Continue button, the model will ask if you wish to do so before moving away from this sheet.

Worksheet "2-PriceInputData"

This second worksheet is for input of market data: forward prices, physical premiums, monthly contract volatilities, and discount rates. On this sheet, four click buttons and a check box are present.

The button labeled "Import ICE Data" is used to load all prices, basis, and volatility values from row 12 downward (the values in cells B4 and B5 are always entered manually). If you have a full ICE license, then you are entitled to receive a nightly download of three workbooks from ICE that have all the price, basis, and volatility data from the close of the day before. The model can read that data and import it properly to the model. You'll have to know the ICE code for your desired location first: You'll be prompted for it during the import. The model attempts to read the most recent ICE downloads within the last week. If none exist, or if the import fails, then the data must be entered manually.

The button labeled "Reset Sheet" is used to clear the sheet and reload various cells with proper labeling and formatting for data entry. All input is entered in the light-blue highlighted cells, and the forward contract months (e.g. Apr-2015) and option expirations (e.g. mm/dd/yyyy format) that can be input are filled into the sheet automatically into their respective columns.

The button labeled "Reset Expiries Only" is just like the "Reset Sheet" button with one major exception: All prices, rates, and volatilities that were on the sheet previously will not be erased; only contract month expiries, option expirations, and which of them is required input are updated. Such a feature reduces redundant price/rate/volatility input.

Clicking the button labeled "Update and Continue" immediately causes all data to be checked for correctness and the next worksheet ("3-VolumeInputData") is shown if all data are validated. If, on the other hand, a problem exists with the data, then an error message appears that tells the user about the problem.

The check box causes more cash-to-prompt input cells to appear in the range C4:H4. If you desire to forecast a shape for short-term cash-to-prompt spreads and have the model optimize around that, too, then click the check box and enter the forecast. Otherwise, the model will only optimize around the current cash- and BalMo-to-prompt spreads. If you choose to optimize around a forecast and you are less than a week from the month-end, then the model will optimize around the forecast and disregard the BalMo-to-prompt spread.

The data entered on this worksheet consist of 3 groups: (1) – cash- and BalMo-to-prompt spreads (ie, cash price or BalMo price minus the prompt price, not vice-versa), prompt-onward forward prices, basis, and physical premium data, (2) - volatility data, and (3) - discount rate data. A partial screen shot of this worksheet is now given.

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| WTM | Price, Rate and Volatility Input | | | | | | | | | | | | | Energy Software, LLC. |

The screenshot shows a spreadsheet titled **Price, Rate and Volatility Input** with the following content:

(Do Not add or delete rows or columns) ☑ Shape First Week of Cash Prices?

	Next-Day	ND+1	ND+2	ND+3	ND+4	ND+5	ND+6
Cash-to-Prompt Spread	0.020	0.030	0.035	0.020	0.010	0.000	-0.010
BalMo-to-Prompt Spread	0.010						

Current Spot Price (nd or sd) 2.920 <---Location's Cash Price
Mar-2015 2.910 <---Location's BalMo Price

Volatilities:

Discount Rate %
(Fill from top in ascending maturity order)

Buttons: Import ICE Data | Update and Continue | Reset Expiries Only | Reset Sheet

Forward Prices: Delivery Month	NYMEX	XAA Basis	Physical Premium	Location's All-in Price	Expiration (mm/dd/yyyy)	Implied Vol%		Maturity (mm/dd/yyyy)	Rate %
Apr-2015	2.900	0.000	0.000	2.900	03/26/2015	42.25		07/01/2017	3.000
May-2015	2.890	0.000	0.000	2.890	04/27/2015	41.05			
Jun-2015	2.900	0.000	0.000	2.900	05/26/2015	40.33			
Jul-2015	2.930	0.000	0.000	2.930	06/25/2015	39.20			
Aug-2015	2.930	0.000	0.000	2.930	07/28/2015	37.65			
Sep-2015	2.910	0.000	0.000	2.910	08/26/2015	37.60			
Oct-2015	2.930	0.000	0.000	2.930	09/25/2015	36.48			

Cash- and BalMo-to-Prompt Spreads, Prompt Forwards, Basis and Physical Premium Data:

The current cash- and BalMo-to-prompt spreads per MMBtu are entered into the light-blue highlighted cells marked accordingly. This includes any cash-to-prompt shaping in the near term (cells C4:H4). The next-day and BalMo spreads are required input and must be a number that makes sense (eg, not so negative that the all-in cash price becomes zero or less). The cash-to-prompt shaping is optional, depending on whether or not the shaping check box is selected, but any shaping must yield cash prices that make sense. All these numbers come from the traders around 8am as the cash market trades.

Forward price data is entered into three columns just below, and the cells are shaded in light-blue. The first of the columns, column B, is of forward price data: specifically, NYMEX prices per MMBtu. Only numbers strictly greater than zero must be entered.

The second and third columns, C and D, are for location basis and physical premium per MMBtu, respectively. Both must be entered, even if zero, next to every entered NYMEX price, and these numbers can be positive or negative. However, any NYMEX price, its basis, and its physical premium must sum (the sum is the physical price) to be strictly greater than zero. Note that this sum is shown in column E next to each month's data, and again in cells B7 and B8 (and B9 if NYMEX settle has passed for the month but month-end is not yet reached).

Volatility Data:

One column of data (shaded in light-blue) is available for input: the percentage volatility on monthly delivery contracts. The required option expirations, just to the left, should be automatically filled on the sheet and correspond to NYMEX expirations. If the expirations are not filled, then click either the button "Reset Expiries Only" or "Reset Sheet," and the expirations will be shown in their correct placement.

For each option expiration, a single percentage volatility is entered (i.e., 50% is entered as 50.0). This volatility is merely the implied volatility of the contract corresponding to the option expiration. For example, if the prices are for a location very near Henry Hub, then the NYMEX implied volatilities will do. For a location far from Henry Hub, scaling the NYMEX implied volatilities will do. You may estimate the location scalars yourself or check with WTM on a simple estimation procedure to do so.

Interest Rate Data:

A set of two columns on the right of the worksheet, highlighted in light-blue, are used to input this data. Zero-coupon instruments on either LIBOR or Treasury strips can be used, but the company's WACC is more conservative. The data are entered starting from top to bottom and in ascending expiration order (no empty rows in the midst of the data should appear).

The first column is the maturity in mm/dd/yyyy format: Maturities must be greater than the current date and span greater than the lease end-date (given on sheet 1-StartHere). The second column is for the yield to that maturity, which must be entered as a percentage strictly greater than zero (i.e., enter 10% as 10.0) or equal to zero if no discounting of expected cash flows is desired.

ICE Data Import Cells:

You may notice data in columns O and P on this sheet. These columns allow for importing NYMEX volatilities from ICE and scaling them to volatilities on monthly contracts at your storage hub. Cell P10 is the scalar. Scaling the NYMEX implied volatilities is simple, you may estimate these scalars yourself, or you can check with WTM on a simple estimation procedure to do so. If ICE data is not imported, then all price, basis, physical premium, and rate information must be entered manually.

Worksheet "3-VolumeInputData"

This third worksheet is for input of operational data: maximum capacity, current inventory, fuel charges (both injection and withdrawal), commodity charges (both injection and withdrawal), ratchets, minimum/maximum requirements, and ad-valorem taxes. On this sheet, two click buttons are present.

The button labeled "Reset Sheet" is used to clear the sheet and reload various cells with proper labeling and formatting for data entry. All input is entered in the light-blue highlighted cells.

Clicking the button labeled "Update and Continue" immediately causes all data to be checked for correctness and the next worksheet ("4-Output") is shown if all data are validated. If, on the other hand, a problem exists with the data, then an error message appears that tells the user about the problem.

The data entered on this worksheet consist of 5 groups: (1) – inventory data such as Capacity in MMBtus, Current MMBtu Inventory, (2) – transaction costs, (3) – ratchet information, (4) – minimum/maximum requirement data, and (5) – ad-valorem taxes. A partial screen shot of this worksheet is now given.

WTM   **Volume Fees and Constraints**

Capacity in MMBtus	1,000,000
Current MMBtu Inventory	100,000

(Do Not add or delete rows or columns)

[Update and Continue]   [Reset Sheet]

	JAN		FEB		MAR		APR	
	Inj Charge	Wth Charge	Inj Charge	Wth Charge	Inj Charge	Wth Charge	Inj Charge	Wth Charge
Fuel Charge (Percent)--------------------------------->	1.500	0.000	1.000	0.500	1.500	0.000	1.500	0.000
Commodity Charge $/MMBtu---------------------->	0.010	0.010	0.000	0.000	0.010	0.010	0.010	0.010

Ratchets:
(Enter rates in MMBtus/day)

Ratchet MMBtus	JAN		FEB		MAR		APR	
	Inj Rate	Wth Rate	Inj Rate	Wth Rate	Inj Rate	Wth Rate	Inj Rate	Wth Rate
0	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
500,000	8,300	12,000	8,300	12,000	8,300	12,000	8,300	12,000

Levels must be in ascending order starting from 0. Must start from the top and work down! (No Gaps!)

Min/Max Requirements:

(Enter Dates as mm/dd/yyyy) Having no values is acceptable. Must start from the top and work down! (No Gaps!)

MMBtus	Begin Date	End Date	Min or Max?
100,000	08/01/2015	08/15/2015	Min

Taxes per MMBtu (Enter dates in ascending order with no gaps):

Date	% Tax	$ Tax
12/31/2015	1.500	

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Inventory Data:

The "Capacity in MMBtus" is the maximum capacity of the storage lease and must be a number strictly greater than zero. The "Current MMBtu Inventory" is the amount of MMBtus currently in storage and must be a number greater than or equal to zero, but less than or equal to the maximum capacity.

Fuel and Commodity Charges:

Two fuel charges per calendar month must be entered: one for injection and one for withdrawal. These are to be entered as percentages greater than or equal to zero (i.e., 1.5% is entered as 1.50) and less than or equal to 50%. These fuel charges are applied in the same way that fuel charges are applied in gas transportation: The percentage is applied to a grossed-up volume such that the delivered volume is left remaining after applying the charge.

Two commodity charges per calendar month must be entered: one for injection and one for withdrawal. These are to be entered as numbers greater than or equal to zero, less than or equal to $0.50, and are in dollars per MMBtu.

If bid/ask spreads or transportation costs to/from the storage facility are involved, one may adjust these fuel and commodity charges accordingly (bid/ask spreads are just like extra commodity charges; transport may add both extra fuel and commodity charges).

Ratchet Information:

The ratchet information consists of 25 columns highlighted in light-blue. The first column, "Ratchet MMBtus," is the starting volume of the ratchet in MMBtus, not percent. The second and third columns, respectively, are for the MDIQs and MDWQs for each January of the lease term for that starting volume. Both the MDIQs and MDWQs are entered in MMBtus, and they apply to volumes greater than or equal to the starting volume but strictly less than the next ratchet starting volume, and only for each January of the lease term. The fourth and fifth columns, respectively, are the MDIQs and MDWQs for each February of the lease term, etc. The last two columns, respectively, are the MDIQs and MDWQs for each December of the lease term.

The ratchet starting volumes must be entered in strictly ascending order, starting from zero, having no gaps in the data, and the model considers the MDQs of the last ratchet to be in force from that ratchet volume up to the lease Capacity in MMBtus. Except for the first starting volume, which is always zero, all volumes must be strictly greater than zero if they exist. The MDIQs and MDWQs must be numbers greater than or equal to zero. Only data entered in the light-blue cells are considered by the model.

The ratchet data presented to the storage trader are usually not given in a way that can be directly input on this worksheet. The proper way to create the ratchet lines to be filled on the worksheet is as follows:

1. Start from the 0 inventory line (Row 13) and enter its MDIQs and MDWQs, respectively, for each calendar month
2. Going from 0 inventory, determine the next inventory level for which either an MDIQ or an MDWQ changes due to a ratchet or month; enter that level value, the MDIQs, and the MDWQs on the next line of the ratchet section, respectively. If either the MDIQ or the MDWQ changed at that inventory level or month, but not both, then the value for the one that didn't change is still entered on the line, and its value is equal to its value on the previous line
3. Continue performing step 2 until you reach the final inventory level for which the MDIQs and MDWQs no longer change up to the Capacity in MMBtus (therefore, the volume level of the last line in the ratchet section is a number strictly less than the Capacity in MMBtus).

For example, if a ratchet schedule is presented as follows . . .
- 0 inventory up to 499,999 the MDIQ is 10,000
- 500,000 and over the MDIQ is 8,000
- the MDWQ is always 15,000
- no injection in January is permitted

then two lines are input on the ratchet schedule as follows:

		Jan		Feb …	
	Start Volume	Inj	Wth	Inj	Wth
1.	0	0	15,000	10,000	15,000 …
2.	500,000	0	15,000	8,000	15,000 …

Minimum/Maximum Requirements Data:

Minimum requirements are lease constraints where the leaser must maintain a certain minimum inventory over a certain period. Maximum requirements are the mirror image of that. Sometimes leases will possess these constraints directly; other times you may wish to employ them yourself, as in cases where you have retail customers and want to ensure that you always have a minimum inventory to handle customer swings during critical times.

Four columns of data, highlighted in light-blue, are entered. The first column is the minimum/maximum requirement volume in MMBtus, while the second and third columns are the beginning and ending dates for which the requirement applies. The fourth column is a selection that denotes the requirement is either a minimum requirement or maximum requirement.

The requirement volumes are entered in MMBtus and must be numbers greater than or equal to zero. The dates are entered in mm/dd/yyyy format, the beginning and ending dates may be the same, and those dates can be any date in the remaining lease term, including the current date or the end-date of the lease.

Note that no data whatsoever has to be entered in the minimum requirements section for the model to run. Also note that the requirements must start from the top and work down with no gaps in the data (but do not have to be in any date order). Lastly, only data entered in the light-blue cells are considered by the model.

Ad-Valorem Data:

Three columns of data, highlighted in light-blue, are entered. The first column is the date the tax is figured on any working gas inventory at that time, the second is the percentage tax (i.e., 1% is entered as 1.0) applied to the value of that inventory at that time, the third is the dollar tax per MMBtu of inventory. The model allows for both types of taxes to be entered at once. The value of inventory at any time in the model for tax purposes is the inventory MMBtu volume times the gas-daily price that day.

Worksheet "Parameters"

This sheet holds five pieces of input: the short-term mean-reversion speed, the long-term mean-reversion speed, the long- to short-term volatility ratio, the capacity constraint on the net-delta, and an indicator for selecting what set of outputs are to be figured.

The button labeled "Reset Sheet" is used to clear the sheet and reload various cells with proper labeling and formatting for data entry. All input is entered in the light-blue highlighted cells. Clicking the button labeled "Update and Continue" immediately causes all data to be checked for correctness and the next worksheet ("2-PriceInputData") is shown if all data are validated. If, on the other hand, a problem exists with the data, then an error message appears that tells the user about the problem.

The fourth parameter listed at the top is a percentage of tolerance, relative to the lease's Capacity in MMBtus, of how far off the calculated guideline delta hedges are allowed to be from fully hedged. For example, both a value of 10.0 (meaning 10%) for this parameter and a value of 1 million MMBtus for the lease's Capacity in MMBtus mean that the current inventory plus calculated injection delta hedges must be within 100,000 MMBtus of the calculated withdrawal delta hedges (but the total capacity hedged may be under the maximum capacity by more than 100,000 units, i.e., the parameter does not constrain this from happening). Thus, the guideline delta hedges are calculated under the constraint implied by this parameter, and a greater percentage (ie, a looser constraint on calculating guideline hedges) usually implies a more effective set of guideline hedges.

The two mean-reversion speeds are referenced in the white-paper as a and b, respectively, while the long- to short-term volatility ratio is referenced as k in the paper. Note that the white-paper can be downloaded and printed from the web site, and a link to our paper in Journal of Energy Markets is also shown on our website. These three inputs are needed to run the model, but their values will probably change only very infrequently.[1] Estimated values for a are typically in the 9.0 or over range, while estimated values for b are typically around 0.1 and k around 1.50. In the SOS model, a can be thought of as representing short-term weather effects on cash prices, while b can be thought of as representing longer-term supply/demand effects. For example, a spike in weather affects the cash price for several days, but that effect usually diminishes quickly; however, a new set of commercial customers coming on-line would cause movements in whole strips of forward prices due to these firms securing long-term supplies of natural gas.

The value of k can be thought of as a ratio of how large, on average, volatility from commercial effects is to volatility of short-term weather effects. A ratio of 1.5 means that the former effect contributes 1.5 to 1.0 in the overall volatility.

The typical estimated values for both a and b are greatly different from the mean reversion speeds estimated from a one-factor model: The one-factor speeds are typically estimated to

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[1] - The quantitative analysts should be in charge of estimating these inputs.

be 1.5 to 2.0 and can be thought of as an average of the short-term and long-term mean-reversion speeds.

The SOS model allows for input of estimated mean-reversion speeds and of *k* since different parameters may apply for different storage locations. The user must estimate these values outside the model, but within the model, they are considered constants during valuations.

When one clicks the button "Reset Sheet," the sheet is cleared, cells are reformatted and reloaded with proper labeling for data entry, and default mean-reversion speeds and *k* are filled in. The default values are *a* = 9.0, *b* = 0.1 and *k* = 1.50. These default values were estimated using data on different storage years, cycle-rates, and gas hubs around North America, so one may use these values if one cannot estimate them for the time being. A screen shot of this sheet is below.

WTM **Parameters**

(The short-term speed is referenced as 'a' in the white-paper; the long-term speed is referenced as 'b')

Short-Term Mean-Reversion Speed:	9
Long-Term Mean-Reversion Speed:	0.1
Long- to Short-Term Volatility Ratio:	1.5

Update and Continue   Reset Sheet

| Enter the capacity constraint on net-delta: | 0 |
(Enter as a percent between 0 and 100)

| Results Choice Indicator? | F |
('F' for full, 'I' for intrinsic only, 'T' for thresholds only)

Note that both *a*, *b* and *k* have upper and lower bounds within the model. If input values violated the bounds during a model run, then the bound value is used within the model, and the input value will be overwritten with the bound value after the model finishes. Bounds facilitate stable calibration, but one should not find the bounds very constraining.

This sheet also allows for inputting a Results Choice Indicator, which allows one to select which set of results is to be run: "F" for full valuation results, "I" for intrinsic only valuation results, and "T" for cash-to-prompt threshold only results. The last two results can run much faster than the full set of results. Thus, one would use "I" to get maximum intrinsic values and intrinsic hedges only, which takes only a couple of seconds to run, and one would use "T" for daily trading if only cash-to-prompt thresholds are needed, which takes usually just a few minutes to run.

The model usually takes only 8 minutes or less per year of storage lease to run a full valuation. But we note that run-times can be extreme for a full valuation if the maximum minus the minimum forward prices among those prices spanning the lease term is over 100% of the minimum forward price. For example, a cash price on a three-year lease is $2.00 and the third-year winter prices are in the $4.00 range. In really bad cases, the model may take

20 minutes per year of storage lease to run for a full valuation (60 minutes on a three-year lease). An intrinsic only run would still take a mere couple of seconds, but the cash-to-prompt thresholds only run will take just a few minutes. So if a full valuation is not needed in such a case, then a partial valuation may return desired results much faster.

Worksheet "4-Output"

WE RECOMMEND THAT YOU SAVE THE WORKBOOK PRIOR TO EACH VALUATION; doing so will cause all of your input to be saved if Excel should end abnormally during a valuation, which is extremely rare but does happen.

Running the Model:

On this worksheet three click buttons are present. The button labeled "Reset Sheet" is used to clear the sheet and reload various cells with proper labeling and formatting.

Clicking the button "Save/Track Results" causes that day's results to be entered into the performance tracking database. Input screens also appear that allow for the input of both physical and hedge trades on the current or any given previous day. See the section on performance tracking for more.

Clicking the button labeled "Get Results" immediately causes all the input entered on all before-mentioned worksheets to be checked for correctness. If a problem exists with the input, then an error message appears that tells the user about the problem. If not, then the model runs for a few minutes and then produces the output. On most of today's PCs, the model takes about 8 minutes per year of storage lease to run. Longer run-times can occur and are discussed in the section on Worksheet "Parameters." The specific outputs shown for a full model valuation are

(1) – Total dollar storage value for the amount of gas inventory currently stored
(2) – Dollar storage value per unit of capacity in MMBtus of the lease
(3) – Recommended physical trade for the current day and cash-to-prompt spread
(4) – Guideline forward contract (delta) hedge volumes for the current inventory
(5) – One-day-95% VaR of the delta-hedged storage value for the current inventory
(6) – Maximum intrinsic values and corresponding hedges
(7) – Threshold cash-to-prompt spreads for profit-maximizing injection/withdrawal
(8) – A table of storage values, recommended physical trades, deltas, and VaRs for the whole range of inventory levels

A partial screen shot of the output is given below.

Storage Values, Trading Thresholds, and Deltas

(Press button 'Get Results' to run the model)

Get Results	Reset Sheet	Save/Track Results

RESULTS for Current Date: 03/10/2015

Current MMBtu Inventory (levels in red indicate storage cannot be depleted by lease end)	Storage Value	Value per MMBtu of Capacity	Recommended Trade	Delta for MAR 2015 Contract
100,000	697,378	0.697	Inject	112,000
Optimal Intrinsic Value with Hedges for Inventory = 100,000	414,513	0.415		0
Optimal Intrinsic Value with Hedges for Inventory = 0	121,760	0.122		0
Threshold Cash-to-Prompt Spread to buy/inject ($/MMBtu):		0.048		
Threshold Cash-to-Prompt Spread to withdraw/sell ($/MMBtu):		0.115		

Results for Various Inventory Levels

MMBtus Inventoried (levels in red indicate storage cannot be depleted by lease end)	Storage Value	Value per MMBtu of Capacity	Recommended Trade	Delta for MAR 2015 Contract.
0	395,920	0.396	Inject	144,000
2,000	401,992	0.402	Inject	143,333
4,000	408,090	0.408	Inject	142,667
6,000	414,164	0.414	Inject	142,000
8,000	420,263	0.420	Inject	141,333
10,000	426,192	0.426	Inject	140,667
12,000	432,258	0.432	Inject	140,000

Only a partial screen shot of the full valuation is shown here, where some of the results in (1) through (4) and (6) and (7) are shown, and part of the results table in (8) is shown just below that. The rest of the results table's storage values, guideline hedging deltas, and VaRs are not shown due to limited space here. The yellow-shaded results are pertinent results for the current inventory only.

The threshold cash-to-prompt spreads give the spread to the prompt price that the cash price must beat in order to inject or withdrawal optimally that day. **The spread is given as the cash price minus the prompt price**, so, eg, cash prices greater than prompt prices would be shown as positive spreads. Note that this spread could be *positive* for injections (usually for very low inventories) or *negative* for withdrawals (usually for very high inventories).

The results table is output from the model that gives the trader an idea of which inventory levels possess the most optionality for cash-price plays (eg, storing or withdrawing gas only very short term). Specifically, the inventories where the recommended physical trade is zero are typically the levels possessing the most optionality. These levels typically coincide with the highest VaRs.[2] Also, if the trader subsequently injects or withdrawals on the current day, then the trader should consult the results table for the guideline hedging deltas associated with the new inventory.

In order to speed run-times, one may select only parts of the above output to be generated rather than the full set of results. Specifically, intrinsic values only or trading thresholds only can be run. This is discussed more in the section on the sheet "Parameters."

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[2] - The VaR in this model measures the dispersion of storage values from the (linear) forward contract guideline hedges; thus, the VaR is a measure of non-linearity (gamma) in storage values, which can only occur from optionality in the model.

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Interpreting Odd-Looking Output:

At certain times, especially when the storage lease end-date is near, the model's recommended physical trades can look odd. Specifically, the results table on the sheet "4-Output" can show several pockets of inventory levels for which the recommended trade is zero. Below is an example of such output.

Results for Various Inventory Levels

MMBtus Inventoried (levels in red indicate storage cannot be depleted by lease end)	Storage Value	Value per MMBtus of Capacity	Recommended Trade (MMBtus)
0	11,192	0.011	5,000
5,000	40,614	0.041	0
10,000	69,973	0.070	0
15,000	99,183	0.099	0
20,000	128,298	0.128	0
25,000	157,280	0.157	0
30,000	186,240	0.186	-5,000
35,000	215,141	0.215	-5,000
40,000	243,912	0.244	-5,000
45,000	272,620	0.273	-5,000
50,000	301,216	0.301	-5,000
55,000	330,025	0.330	5,000
60,000	359,447	0.359	0
65,000	388,407	0.388	-5,000
70,000	417,367	0.417	-10,000
75,000	446,369	0.446	0
80,000	475,329	0.475	-5,000
85,000	504,289	0.504	-10,000
90,000	533,249	0.533	-15,000
95,000	561,847	0.562	-5,000

Notice the output says that we should trade to one of three inventory regions, depending upon our current inventory: the region of 5,000 to 25,000, 60,000, and 75,000. First, note that a ratchet exists at 60,000 in which the maximum daily withdrawal quantity dramatically increases (mathematically, ratchets are the cause of several such pockets occurring). Also note that 20 days are left in the storage lease in this example.

At first glance, the output looks wrong, especially for inventories of 60,000 and greater. The output is correct; here is the intuition. Recall that storage value occurs from trading on profitable trends in cash prices, and that having some gas in storage allows one the added optionality of profiting from both up and down trends. Since the lease end-date is only 20 days away, a high-optionality inventory region from 5,000 to 25,000 makes sense: One can take advantage of both up and down trends in cash prices without the threat of leaving gas in storage by the lease end-date. Further, attempting to inject to 60,000 so as to take advantage of the higher withdrawal rate does not make sense if it will take several consecutive days of injection to do so.

However, if your current inventory is 55,000, then injecting one more day allows one to profit from higher withdrawal rates on subsequent days. And if one is at 65,000, then withdrawing only 5,000 allows one to still profit from higher withdrawal rates on subsequent days. This reasoning explains why an inventory of 60,000 has added value.

Lastly, the inventory of 75,000 becomes significant since the higher withdrawal rate just happens to be 15,000/day: At 75,000, one may withdrawal at 15,000/day for two days, as opposed to just one day for inventories below 75,000 but greater than or equal to 60,000. Thus, being at 75,000 has added value over being at, say, 60,000.

This reasoning explains a lot of the "saw-tooth" pattern seen in recommended trades across inventories. But at higher inventories in this example, the saw-tooth pattern is not present since one must keep withdrawing, rather than choosing particular days to withdrawal, so as to not leave gas in storage by the lease end-date.

Worksheet "VaRCalculator"

This worksheet is utilized after the storage model runs and results display on sheet "4-Output." This sheet's main purpose is to aid the user in assessing how hedges not proposed by the model protect total storage value, both intrinsic and extrinsic value, for the current inventory. Storage traders typically lay hedges on to lock-in intrinsic value; however, those hedges may not do an adequate job of protecting extrinsic value (which is protected by hedges that reduce daily VaR. And since delta hedging total storage value provides for several effective but disparate sets of hedges, this sheet allows traders a way of assessing the effectiveness of proposed hedges. Usually traders attempt to find an effective set of hedges that deviates minimally from their current set of hedges.

Assessing hedge effectiveness is done as follows. On this sheet, the user inputs a held-over inventory and a proposed set of hedges, clicks a button, and the VaR of the whole position (storage value hedged with the proposed hedges) is displayed in a yellow-highlighted cell. Next to that in another yellow-highlighted cell is the VaR using guideline deltas from sheet 4-Output. This result is displayed as reference for the user to know how VaR may be minimized. Thus, if the two VaRs are close in value, then the trader may be confident that the proposed hedges protect storage value.

Also on this sheet, two click buttons are present. The button labeled "Reset Sheet" is used to clear the sheet and reload various cells with proper labeling and formatting for data entry. All input is entered in the light-blue highlighted cells. This button should be clicked anytime the user is unsure of where inputs should go.

Clicking the button labeled "Get VaR" immediately causes all data entered on this worksheet to be validated. If a problem exists, then an error message appears that tells the user about the problem. If not, then the two before-mentioned VaRs appear in yellow-highlighted cells.

The input labeled "Held-Over Inventory" allows the user to input the amount of stored gas (in MMBtus) to be held over from the current day to the next (how well the hedges protect extrinsic is dependent upon held-over inventory). Thus, the model does not assume that the user will follow the recommended physical trade that day. The "Held-Over Inventory" must be greater than or equal to zero and less than or equal to the maximum lease capacity.

Just below the "Held-Over Inventory" is a range of cells to input the proposed set of hedges: in MMBtus; longs are positive numbers, shorts are negative. The expirations of the forward contracts used in hedging are displayed just to the left of the input. The expirations' range starts from the month associated with the current date and goes through the month associated with the storage end-date. If less than two months remain in the storage lease, the model will display two contracts, so the user can always use at least two contracts to hedge. A screen shot of this worksheet is shown below.

WTM   VaR Calculator for Proposed Hedges

Enter the gas inventory that is to be held over through tomorrow,
and enter the proposed hedges. After all data are entered, click
the button 'Get VaR.'

Get VaR	Reset Sheet

Held-Over Inventory (MMBtus):   100,000

Hedging Contract:	Proposed MMBtus for Hedging:	VaR of Your Proposed Hedges	VaR of Near-Optimal Hedges
Jan-2015	0	19,654	7,564
Feb-2015	200,000		
Mar-2015	200,000		
Apr-2015	0		
May-2015	0		
Jun-2015	0		
Jul-2015	0		
Aug-2015	0		
Sep-2015	0		
Oct-2015	0		
Nov-2015	-300,000		
Dec-2015	-200,000		
Jan-2016	0		
Feb-2016	0		
Mar-2016	0		

Note that one can see the VaR of the un-hedged storage lease (at the held-over inventory) by entering zeros for all the contract hedges. Doing this gives the user an idea of how much total risk needs to be hedged.

WARNING: The VaR Calculator computes VaRs from the last full valuation, not from partial valuation runs for either intrinsic values only or cash-to-prompt thresholds only. So if the last full valuation was not recent, then VaR Calculator results will be stale. Thus, running the model on a full valuation (as selected from the Results Choice Indicator on worksheet "Parameters") before using the VaR Calculator is recommended.

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Worksheet "Performance-Tracker"

This worksheet allows you to see how well you are realizing cash flows from injections, withdrawals and hedges through time. Specifically, if you realize cash flow for the lease at the rate the model projected at the start of tracking, then your interim performance per MMBtu will be close to the storage value projected at the start of tracking.

On this worksheet a chart and its data below it are shown as well as five click buttons. The data for the chart shows cash flows and remaining storage value, day by day, from the start of tracking. As cash flow is realized, it plus the remaining storage value, discounted, should be close to the storage value at the start of tracking. Thus, when correct hedging is employed and the real world behaves like the model's world, the interim storage value should remain close to constant over time (forming a flat line on the chart). This would indicate that all storage value, including extrinsic value, has essentially been turned into something having the risk of only a AAA bond.
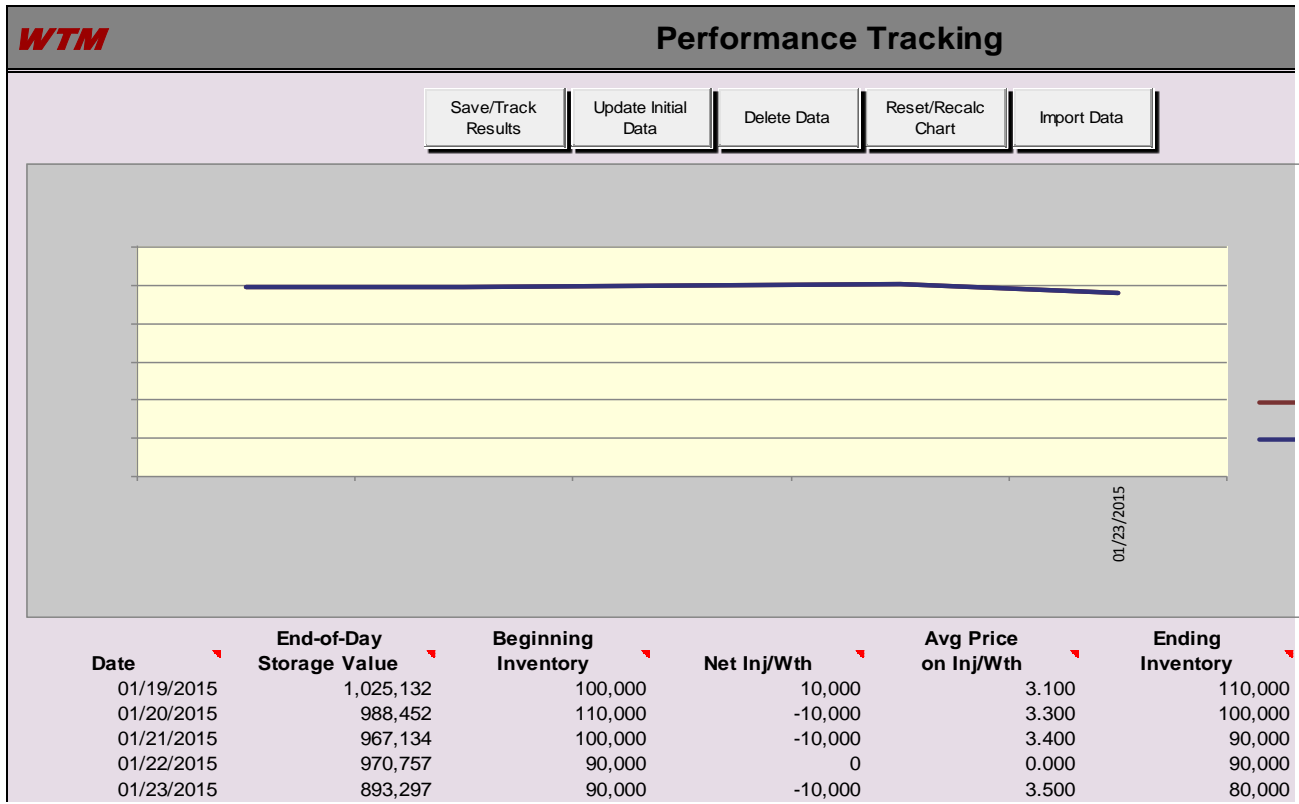
In general, the performance tracking each day will involve clicking the "Save / Track Results" button, saving the day's trades, and clicking the "Reset/Recalc Chart" button to add the performance that day to the chart. The other buttons – "Update Initial Data," "Delete Data," and "Import Data" – will be used infrequently and rarely.

IMPORTANT NOTE: As trade volumes actualize after their first entry into the performance tracking database – thus requiring you to modify previous days' trades through the button "Save / Track Results" – it is important to note that you do not have to rerun the model for the updated inventories and hedge volumes for those previous days. The Performance Tracker makes all necessary adjustments automatically from that modification date onward!

IMPORTANT NOTE: When the prompt-month hedge is allowed to go to settlement, you should enter an offsetting hedge trade into the performance tracking database that day that closes the prompt-month position at the settlement price.

The five click buttons are described as follows.

The button "Reset/Recalc Chart" uses the raw performance tracking data to calculate the chart data shown just below the chart. The old chart data is completely destroyed and recreated so as to include any updated data for previous days. After this data is generated, the chart is re-created, as well. A partial sample of the performance tracking worksheet including both the chart and chart data is shown below:

WTM				Performance Tracking				
		Save/Track Results	Update Initial Data	Delete Data	Reset/Recalc Chart	Import Data		

Date	End-of-Day Storage Value	Beginning Inventory	Net Inj/Wth	Avg Price on Inj/Wth	Ending Inventory
01/19/2015	1,025,132	100,000	10,000	3.100	110,000
01/20/2015	988,452	110,000	-10,000	3.300	100,000
01/21/2015	967,134	100,000	-10,000	3.400	90,000
01/22/2015	970,757	90,000	0	0.000	90,000
01/23/2015	893,297	90,000	-10,000	3.500	80,000

The button "Import Data" is used to import the performance tracking data from another workbook into the workbook on which this button is clicked. This button is meant to be used as WTM issues a new workbook release of SOS and data must be imported into it. Importing allows for the new workbook to track from where the old workbook left off.

When the "Import Data" button is clicked, an input box confirming your desire displays, and if you continue, then a standard file-open box appears for you to browse SOS Excel workbooks from any subfolder. You merely select the SOS workbook to import from, and the model imports automatically.

The button "Delete Data" allows for either a date range or the whole range of raw performance data to be erased. You would erase all data when you are either setting up the workbook for a new lease or when you decide to start tracking performance from a new starting day, as with the starting of a new storage year on a multi-year lease. The following screen appears when the button is clicked:
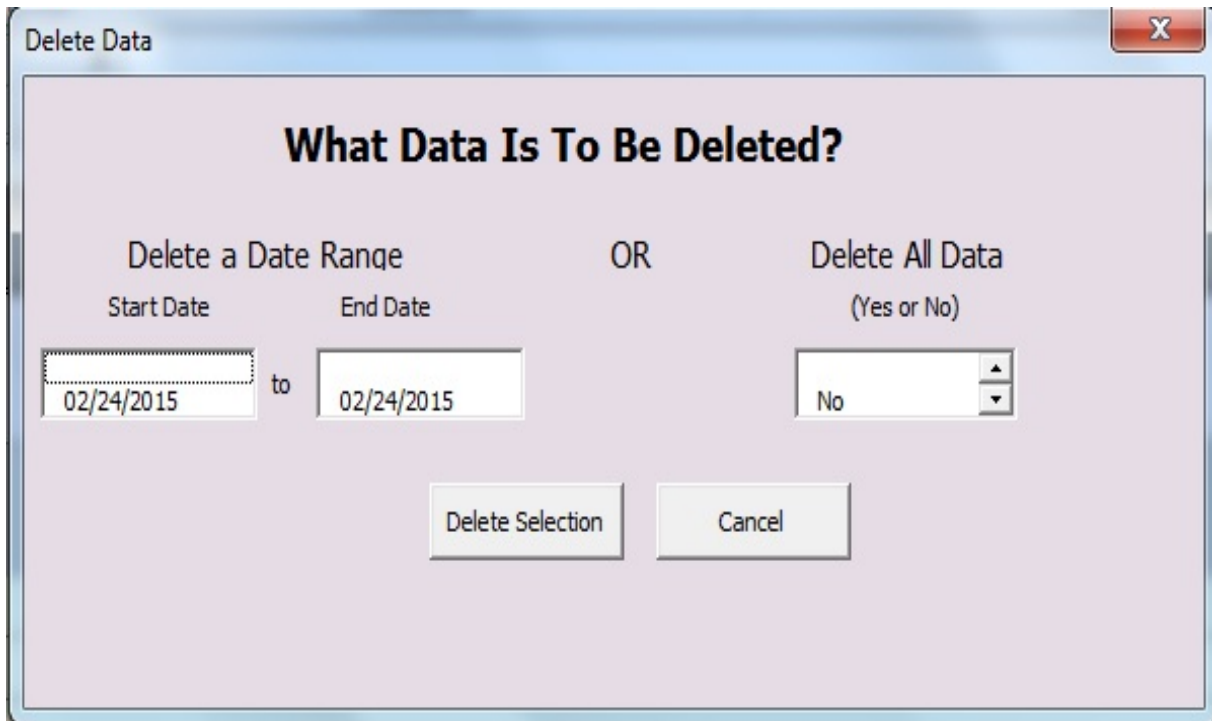
One may either select a date range to delete from the left-hand side or select all data to delete from the right-hand side. Both options cannot be simultaneously chosen, and if a date range is chosen, then it must make sense: Both a start date and end date must be chosen; the start date must be less than or equal to the end date. Once the selection is made, you then click the "Delete Selection" button, a confirmation box appears as a warning, and the deletion is performed if you continue on.

The button "Update Initial Data" allows you to see or modify the initial inventory and hedge volumes for the start of tracking. Since storage value and hedge performance depend on these beginning values, they must be input at the start of tracking. You may also modify initial discount rates here that will be used to discount any future, realized cash flows on any given day back to the start of tracking. Discounting is needed since the storage value at the start of tracking is a present value at that time.

Use this feature especially when you need to examine or update initial data. The following screen appears when the button is clicked:

Input The Initial Values as of 02/24/2015

Initial Hedge Volumes		Initial Discount Rates		Initial Inventory
Contract	Monthly Volume	Month	Rate (Perecent)	MMBtus
				10,000
Feb-2015	0	Feb-2015	3.00	
Mar-2015	0	Mar-2015	3.00	**Lease Capacity**
Apr-2015	0	Apr-2015	3.00	MMBtus
May-2015	0	May-2015	3.00	1,000,000
Jun-2015	0	Jun-2015	3.00	
Jul-2015	0	Jul-2015	3.02	**Lease End Date**
Aug-2015	0	Aug-2015	3.05	(MM/DD/YYYY)
Sep-2015	0	Sep-2015	3.07	07/31/2021
Oct-2015	0	Oct-2015	3.10	
Nov-2015	0	Nov-2015	3.12	
Hedge Page 1		Rate Page 1		

[Previous Hedges] [More Hedges]   [Previous Rates] [More Rates]

[Save All]   [Cancel]

The initial hedge volumes in MMBtus are input on the left-hand side next to the corresponding contract. Only 10 contract months at a time are shown. Use the buttons "Previous Hedges" and "More Hedges" to scroll through to other contract months. Contract months in total will span from the current month to the end-month of the lease. Thus, one may hedge using months prior to the lease's begin date if the current date is still prior to the begin date.

The initial discount rates are input like the hedges, shown in blocks of 10 months, with scroll buttons to scroll through every month spanning from the current month to the end-month of the lease.

The right-hand side of this screen allows for input of the start-of-tracking inventory in MMBtus, while the leases capacity in MMBtus and end-date are shown (but not modifiable) just below for reference.

Once all data is entered, click the button "Save All" to save these initial values. Note that initial values can only be updated after the first day's trades are entered using the button "Save/Track Results." As you enter the first set of trades with that button, the model will automatically pull up the initial data input screen and ask for input.

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The button "Save/Track Results" on this sheet appears as well on the sheet 4-Output and performs the same function. Use this button when you either want to save current model results, or enter physical and hedge trades/prices, or modify trades from previous days. And even if you have no trades that day, then you must still save that day's trades, which would show all zeros if no trades were made. Doing this also causes the day's storage value results to be saved, which are needed for performance tracking that day, too.

IMPORTANT NOTE: As trade volumes actualize after their first entry into the performance tracking database – thus requiring you to modify previous days' trades through the button "Save / Track Results" – it is important to note that you do not have to rerun the model for the updated inventories and hedge volumes for those previous days. The Performance Tracker makes all necessary adjustments automatically from that modification date onward!

IMPORTANT NOTE: When the prompt-month hedge is allowed to go to settlement, you should enter an offsetting hedge trade into the performance tracker database that day that closes the prompt-month position at the settlement price.

In summary, the button "Save / Track Results" is used to enter or update raw tracking data from which the chart data and chart are calculated. A view of the trade input screen that appears when this button is clicked is as follows:

Hedge trades in MMBtus per month are entered on the left-hand side of the screen, injections, withdrawals and any miscellaneous cash flows for the day are entered on the right-hand side. Hedge contracts are shown in collections of 10 at a time; use the buttons "Previous Hedges" and "Enter More Hedges" to scroll through to the rest of the hedge contracts not shown. Contract months in total will span from the current month to the end-month of the lease. Thus, one may hedge using months prior to the lease's begin date if the current date is still prior to the begin date. Also, every hedge volume must be accompanied by a positive price, long hedge volumes are entered as positive, and shorts as negative.

In the upper right-hand side of this screen, you input your physical obligations to inject or withdraw made on the day (both same-day and next-day). Injections are positive volumes, withdrawals are negative. Any non-zero volumes entered must be accompanied by positive prices.

Important note on entering prices: If either physical or hedge trades were done piecemeal and involve several prices for the trade, just enter the volume-weighted average price for the trade.

Miscellaneous cash flows on the day may also be entered. The adjustment-to-charges miscellaneous cash flow is for when the total charges figured on the physical trade (including transport) do not match that which is figured from the corresponding fuel and commodity charges given on sheet 3-VolumeInputData. Positive cash flow values are refunds, negative values are additional charges.

The day-trading cash flows, both physical and hedges, are entered for when you close out all or part of a trade you entered into earlier that day. For example, if you bought physical that morning to inject at $3.00 per MMBtu and then sold the whole volume later that morning for $3.15, then only the cash made off that is entered as a miscellaneous day trade, and no physical injection or withdrawal is entered.

The overrun-charges cash flow is for entering the additional charge incurred for trading more than your MDQ that day. This cash flow is non-zero if calculating the charge for the additional trade using the standard fuel/comm charges would not be correct; the difference from standard charges becomes the overrun charge entered. This value is almost always entered as negative and is thought of as a surcharge for trading more physical than the day's MDQ.

The ad valorem cash flow is for any ad valorem taxes assessed that day. The value entered should be negative.

The miscellaneous cash flow named "Other" is for entering any other cash flow not fitting neatly into the previous miscellaneous cash flow categories. It is also used to true up the days cash flow from trading so that the cash flow that day given by the performance tracker equals the true cash flow that day from injecting, withdrawing and marking-to-market on hedges. Positive input values add to the cash inflow, negative values add to the outflow.
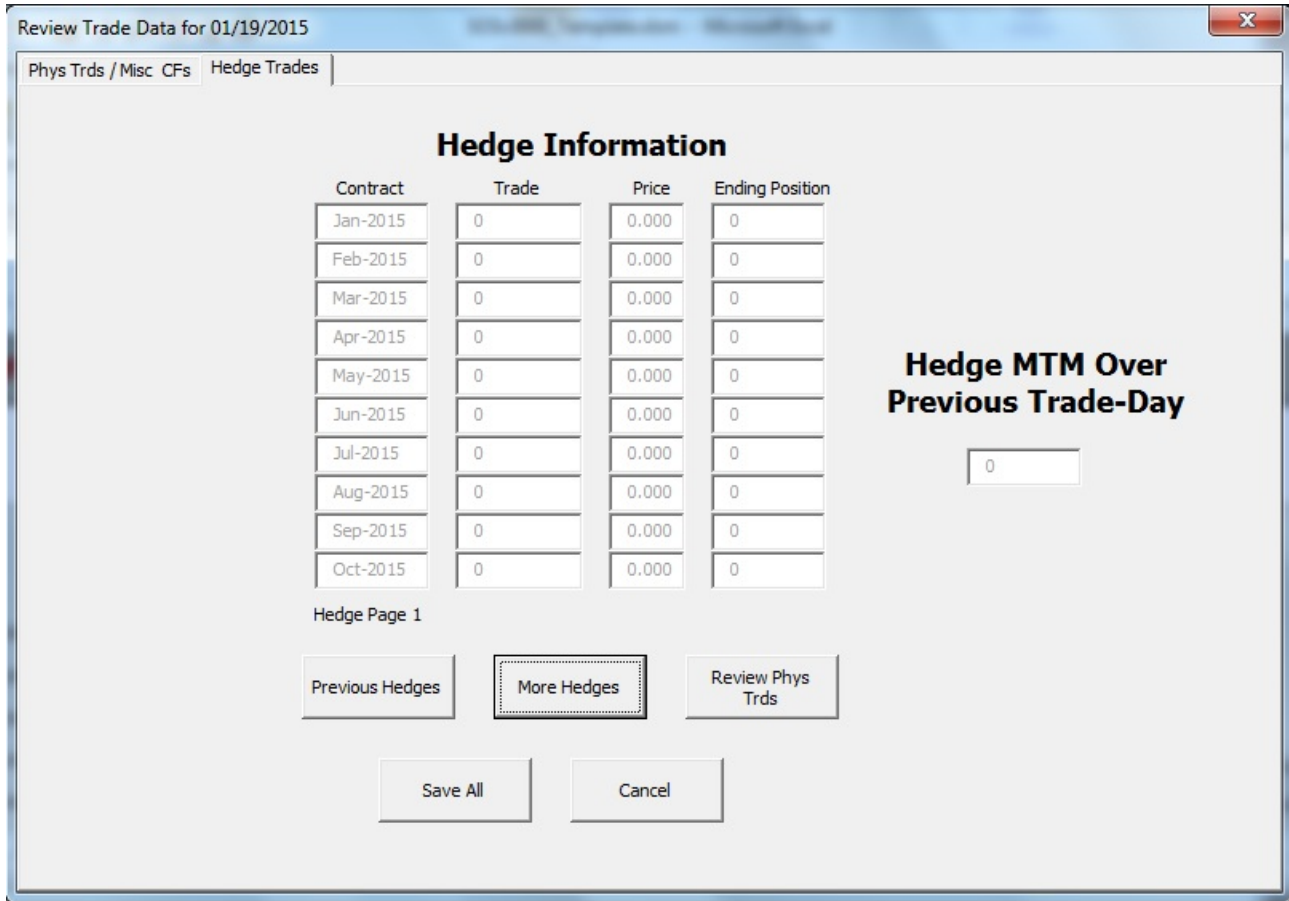
When all the trades are entered on the trade input screen, you click the button "Review & Save All." Doing this immediately calls up screens that allow for reviewing the entered trades along with other values, such as ending positions on both inventory and hedges, before they finally get saved to the performance tracking database. Specifically, a screen for physical trade and miscellaneous cash flow review and a screen for hedge trade review appear in succession and are shown below:

Physical Trades and Miscellaneous Cash Flow Review Screen:

Hedge Trade Review Screen:

When reviewing trade input, the physical and miscellaneous cash flow review screen appears first, then the hedge trade review screen succeeds it. On the former screen, not only is the physical trade shown, but also beginning inventory, ending inventory and standard charges figured on the trade are shown to aid in review. A subtotal cash flow on that activity is shown as well. The miscellaneous cash flows are shown, too, along with their subtotal and along with a total cash flow for both physical and miscellaneous cash flows. If all looks well on this screen, you would click the button "Review Hedges" to move to the latter review screen.

On this hedge review screen hedge trades are shown in blocks of 10. The buttons "Previous Hedges" and "More Hedges" allow for scrolling through all the hedge contract trades. And for aid in reviewing, ending positions for each hedge contract are shown along with that day's mark-to-market. The mark-to-market on hedges is figured as (1) the change in beginning hedge position value from the previous day to the beginning of the current day plus (2) any value change in hedge trades done on the previous day from that day to the beginning of the current day. Thus, hedge trades for the current day are only reflected in mark-to-market values from tomorrow onward.

The button "Review Phys Trds" on the hedge review screen allows you to return to the former review screen for any added review of that.

The button "Save All" on the hedge review screen allows for all entered trade information for physical trades, hedges, and miscellaneous cash flows, along with prices, to be saved to the performance tracking database.

On either of the review screens if the "Cancel" button is clicked, processing returns to the trade input screen.

Troubleshooting

Below is a list of problems that have occurred on occasion over the years.

The Calibration Failed to Converge:

If the model calibration fails, a very rare event, then no results are displayed, and an error message saying "Calibration failed to converge . . ." will appear. This is usually caused from either bad forward price or from an incompatible value for the mean-reversion speeds.

Recheck the price/rate/volatility inputs on sheet 2-PriceInputData for errors. Usually a misplaced decimal on a price or volatility is the culprit. Merely rerun the model after these changes. If the model fails again, adjust the cash and BalMo prices to be closer to the prompt price (by just a small amount). If the problem persists, contact WTM at support@WTMenergy.com. A copy of your input may be required, so be sure to save the workbook.

The Run-Time Is Exceedingly Long:

Long run-times (approximately 20 minutes per year of storage lease) do not mean that the model will not finish or results will not be shown: The model eventually finishes and shows results. Long run-times occur when either (1) current forward curves have a lot of spread, or (2) the volatilities have a large spread.

If a real-time pricing service – like ICE – is running concurrently, then run times can be excruciatingly long. We recommend that you run the model on a machine apart from ones used to run such services.

Other Excel Worksheets Freeze While Running the Model:

While working in other Excel workbooks when the model is running, those workbooks may freeze or work more slowly. This problem seems to only appear in versions of Excel 2003. The freeze is temporary and ceases when the model finishes. Cutting, copying and pasting in another workbook while the model is running can cause a workbook to freeze temporarily. We also recommend that you run the model in its own instance of Excel apart from other, already open instances having open workbooks; otherwise, each open workbook in the instance of Excel that is running the model will not be accessible while the model is running.

The Excel Screen Whites Out:

On rare occasion, when the model is running and while other Windows tasks are being performed, Windows becomes confused. This confusion may lead to the following:

(1) – part or all of the worksheet is whited out
(2) – your PC processing gets slower

These problems seem to only appear in versions of Excel 2003. These problems do not cause results to not calculate or to not be shown: The model eventually finishes as usual, and output is displayed. One sign that the model is still running is to place the mouse pointer within the spreadsheet, whether the spreadsheet is whited out or not, and see if the hourglass or spinner icon appears. If it does, the model is still running and will eventually display output. If the icon does not appear and output is not displayed, then Windows has faltered (extremely rare): End the Excel program through the Task Manager (after Excel ends and if the operating system is Windows XP or better, an "error" dialog box appears asking the user to click on either "send report" or "don't send." Click on "don't send").

Spreadsheet Does Not Run:

This problem may be due to either your license expiring, the macros not being enabled, or an input error with no corresponding error message (please tell us if this occurs; we always want an error message to display for improper input). If the input is correct and your license is up to date, then contact WTM with this problem (email a description of the problem to support@WTMenergy.com). A copy of your input may be required, so be sure to save the workbook.

A Debug Dialog Box Appears Stating That the "DLL Not Found by VBA . . .:"

This message appears when the storage valuation DLL module has been moved from its pre-assigned folder path. Specifically, the VBA code in "Module1" in the workbook contains VBA "Declare" statements that tell the workbook which Windows folder the valuation DLL module is in (The Declare statements are at the top of "Module1"). The path clause in each Declare statement must state the full path to the DLL module, starting with the disk drive (e.g., C:\SOSbyWTM\ . . .).

To fix this problem, move the DLL module to the path given in the Declare.

All Other Problems:

The above list of troubles is exhaustive at this time; however, we understand that other errors not listed above may occur, especially with any faulty Microsoft updates (a rare occurrence, but it does happen). If such errors occur, especially errors in which a debug dialog box occurs, then save the workbook with its input and contact WTM at support@WTMenergy.com. We will be happy to explore the problem and get your model running again, usually within a few hours.

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