

# **Storage Contract Evaluation: A Prerequisite for Committing Capital**

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# Storage Benefits

## **LDCs:**

- Reliably meet demand.
- Make intra-day decisions.
- Reduce bid/ask risk.
- Reduce spot risk.

## **Marketers:**

- Arbitrage calendar spreads.

# Customized Contracts

Contracts customized for LDCs can be:

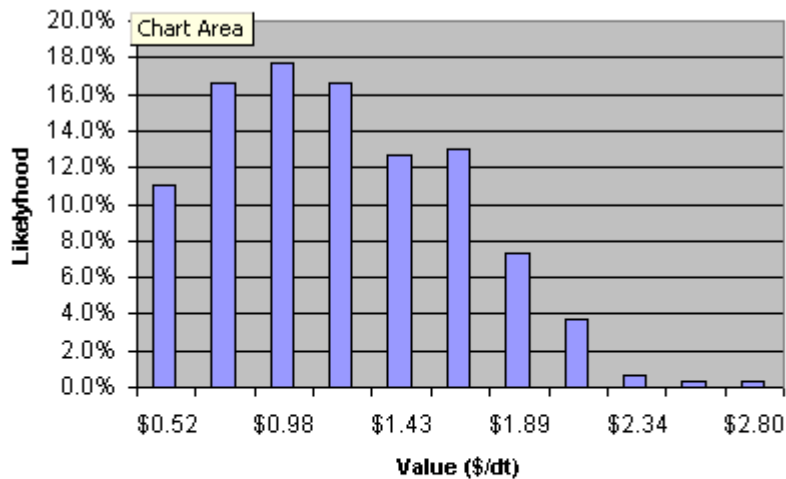
- Cheaper.
- Candidates for hedge accounting.
- Presented to the PUC as risk-management tools rather than speculative instruments.
- Even less transparent in price than standard service – they require using an industry standard model to document and justify the price you paid for the customized service.

# Typical Uses for Storage Models

- Securing or releasing storage rights.
- Evaluating incremental actions like leasing FT or adding compression.
- Apportioning the value of holding back some storage capabilities to meet physical reliability or power-generation dispatch viability. (Internal repackaging.)
- Back-testing and MTM calculations to evaluate performance of traders and originators.
- Checking compliance of hedges to facility constraints.
- Evaluating in-hole transfers.
- Minute-to-minute operational decision support.

# Form of Valuation Results

Apr05 - Mar06 Five Turn Storage Value



Percentile	\$/dt
0	\$ 0.26
20	\$ 0.63
40	\$ 0.91
60	\$ 1.18
80	\$ 1.53

<b>Expected</b>	<b>\$ 1.20</b>
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A single number won't do.

- Histogram of outcomes.
- Percentiles (e.g bid what you can recover 4 out of 5 times).
- Expected value.

# Elements of Model Credibility

1. Representation of facility/contract constraints.
2. Incorporation of known market data.
3. Appropriate and achievable trading strategy.
4. Appropriate and reasonable price process model.

# 1 - Contract Constraints

- Enforced draw-down (aquifers).
- Inventory hold-backs (Deliverability/Reliability).
- Level & season dependent injection/withdrawal rights (ratchets).

## FEA @ENERGY: Storage Valuation Version 4.1

### Storage Contract Specifications

#### Inventory Schedule

Date	Level Min.	Constraint Type	Penalty	Level Max.	Constraint Type	Penalty
4/1/2005	-			1,300,000		
11/1/2005	195,000			1,300,000		
2/15/2005	-			1,300,000		
3/31/2006	-			-		

#### Operation Schedule

Date	Inventory Level	Injection Rate	In Unit Cost	In Fuel Cost	Withdrawal Rate	Out Unit Cost	Out Fuel Cost
4/1/2005	0%	37,000	0.02	1.50%	20,000	0.02	0.00%
	10%	33,000	0.02	1.50%	35,000	0.02	0.00%
	90%	25,000	0.02	2.00%	37,000	0.02	0.00%
11/1/2005	0%	30,000	0.03	2.50%	25,000	0.02	0.00%
	20%	26,000	0.03	2.50%	40,000	0.02	0.00%

# 2 - Market Data

- Bid and ask Curves.
- Payment dates (to get discounting right).
- Contract and cash volatilities.

## FEA @ENERGY: Storage Valuation Version 4.1

### Market data

Forward price curve				Cash Volatility		Implied volatility curve		Interest rates	
Date	Bid Price	Ask Price	Payment Date	Date	Volatility	Expiry Date	Volatility	Maturity	Rate
4/9/2005	5.929	5.939	5/25/2005	4/1/2005	30.00%	3/31/2005	28%	0.0027	2.00%
4/12/2005	5.800	5.807	5/25/2005	5/1/2005	30.00%	4/30/2005	24%	0.0833	2.00%
5/1/2005	5.754	5.764	6/25/2005	6/1/2005	30.00%	11/30/2005	28%	0.25	2.50%
6/1/2005	5.767	5.777	7/25/2005	7/1/2005	30.00%			0.5	3.00%
7/1/2005	5.791	5.801	8/25/2005	8/1/2005	30.00%			1	3.00%
8/1/2005	5.799	5.819	9/25/2005	9/1/2005	30.00%			2	3.00%
9/1/2005	5.761	5.781	10/25/2005	10/1/2005	30.00%			3	4.00%
10/1/2005	5.776	5.796	11/25/2005	11/1/2005	40.00%			5	5.00%
11/1/2005	5.959	5.979	12/25/2005	12/1/2005	45.00%			10	6.00%
12/1/2005	6.131	6.161	1/25/2006	1/1/2006	50.00%			30	6.00%
1/1/2006	6.251	6.281	2/25/2006	2/1/2006	50.00%				
2/1/2006	6.206	6.236	3/25/2006	3/1/2006	40.00%				
3/1/2006	6.021	6.051	4/25/2006						

# 3 - Trading Strategy

The trading strategy used in the model must be:

- Understandable.
- Achievable.
- Consistent with risk and accounting practices.
- Not strongly dependent on parameters that cannot be calibrated or laid off in the forward market.

# 4 - Price Evolution Model

This is the last element of the model credibility picture because the choice of price evolution model should be driven by:

- Instruments available in the market
- Choice of trading strategy. The “statistical arbitrage” strategies of the boom years have given way to asset-arbitrage, for which a multivariate, multifactor price model is essential.

# Rolling-Intrinsic Strategy: Yesterday

Contract A, last night's close on NYMEX. Best intrinsic hedge:

Contract	Bid	Ask	Hedge	Price
Apr-05	6.033	6.043	-	
May-05	5.868	5.878	-	
Jun-05	5.879	5.889	-	
Jul-05	5.907	5.917	-	
Aug-05	5.915	5.935	-	
Sep-05	5.880	5.900	16	5.900
Oct-05	5.894	5.914	116	5.914
Nov-05	6.059	6.079	-	
Dec-05	6.229	6.259	-	
Jan-06	6.344	6.374	(115)	6.344
Feb-06	6.294	6.324	(15)	6.294
Mar-06	6.099	6.129	-	
			<b>Initial profit</b>	<b>\$305,769</b>
			<b>\$/dt</b>	<b>0.235</b>

# Rolling-Intrinsic Strategy: Today

Contract A, if front drops \$0.50 and back drops \$0.25:

Contract	Bid	Ask	Hedge	Price	Transact
Apr-05	5.533	5.543	-		
May-05	5.368	5.378	-		
Jun-05	5.379	5.389	19	5.389	19
Jul-05	5.407	5.417	-		
Aug-05	5.415	5.435	-		
Sep-05	5.380	5.400	113	5.400	97
Oct-05	5.644	5.664	-		(116)
Nov-05	5.809	5.829	-		
Dec-05	5.979	6.009	-		
Jan-06	6.094	6.124	(115)	6.094	
Feb-06	6.044	6.074	(15)	6.044	
Mar-06	5.849	5.879	-		
<b>Rebalancing profit</b>					<b>\$317,115</b>
<b>\$/dt</b>					<b>\$0.244</b>

# Appendix: @ENERGY Products

- Forward Curve - Data calibration tools including seasonal PCA for multifactor models.
- Basics - Options on one variable, such as Gas Daily options, average price (APO) and average strike (ASO) options, barrier options, and digital options.
- Advanced - Options on more than one underlying contract, such as spread options and best-of options.
- Swing - Nomination changes, must-take, and a rich set of aggregate constraints.
- Storage - Level-dependent ratchets, bid-ask curves and multiple trading strategies.
- Load Serve - Weather driven, hybrid stochastic/fundamental price process. Generates valuation and hedging parameters.
- Power Generation - hybrid or stochastic pricing feeds a LSMC dispatch of realistic plants. Generates valuation and hedging parameters.

# Appendix: VaR Products

- Standard risk methodologies (Parametric, Monte Carlo, and Historical Simulation)
- Tail risk estimation methodologies (EVT, ETL, Comparative Tail Analysis).
- Stress testing and scenario analysis.
- Conditional volatility and correlation calibration for extreme event analysis.
- Advanced back-testing tools.
- Flexible Excel-based user interface.

# Thank You

Financial Engineering Associates (FEA) is a leading provider of valuation, hedging, and risk management analytics to LDCs, energy marketers, producers, hedge funds, and financial firms.

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