

DC ENERGY

Strategic Investment

Harvard Electricity Policy Group

Risky Business

How to Allocate Risk to Allow for Optimal Ex Ante Investment

February 29, 2008

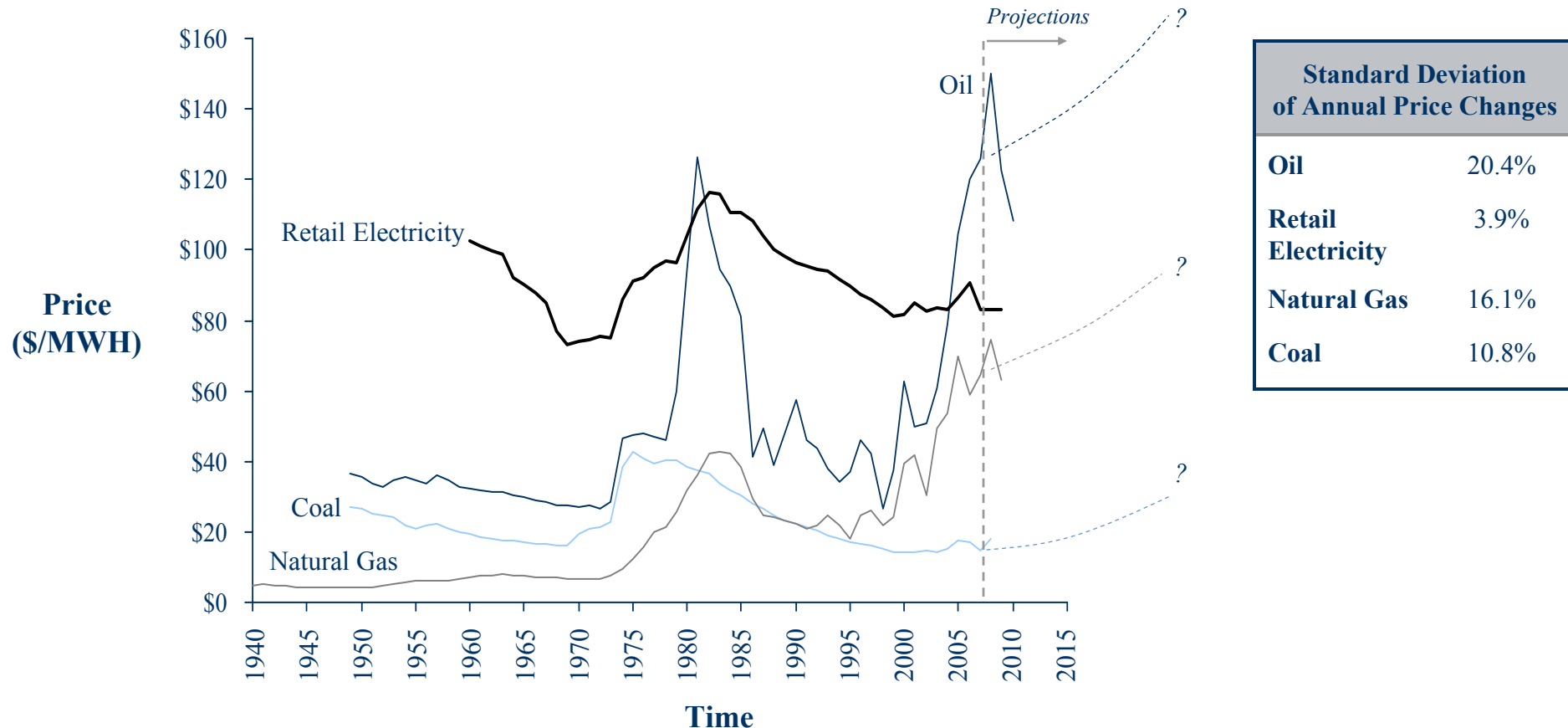
DC ENERGY
STRATEGIC INVESTMENT

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The cost of electricity is likely to increase in the future, for obvious reasons

Energy Prices – Fuel Cost History –

Fuel Price Histories

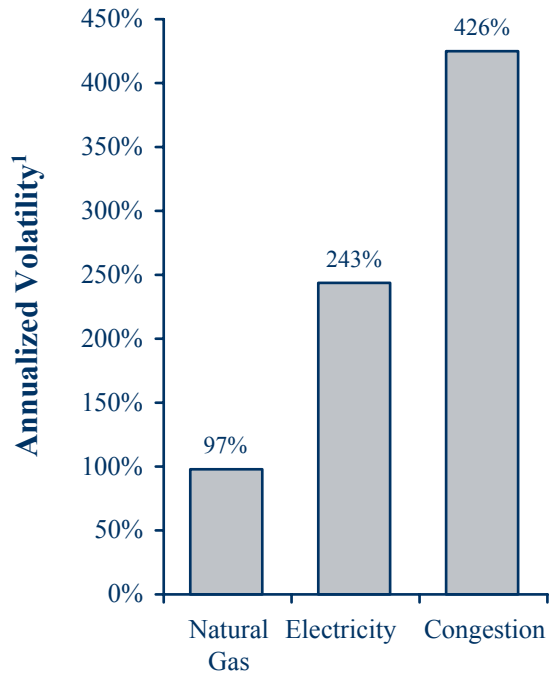


Source: Historical prices according to EIA, adjusted for inflation using BEA GDP deflator. Futures prices are growth rates of average NYMEX contracts ending in given year applied to EIA data. Retail electricity prices are direct EIA forecasts

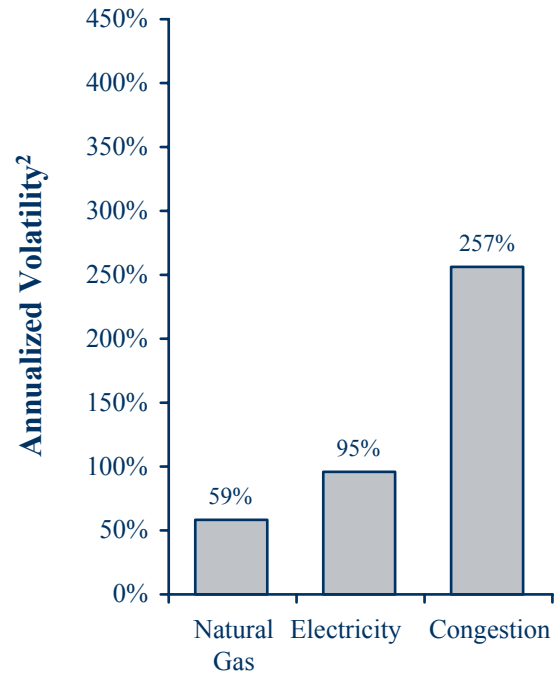
Risk and uncertainty are more critical for electricity than other commodities

Annualized Volatility by Products

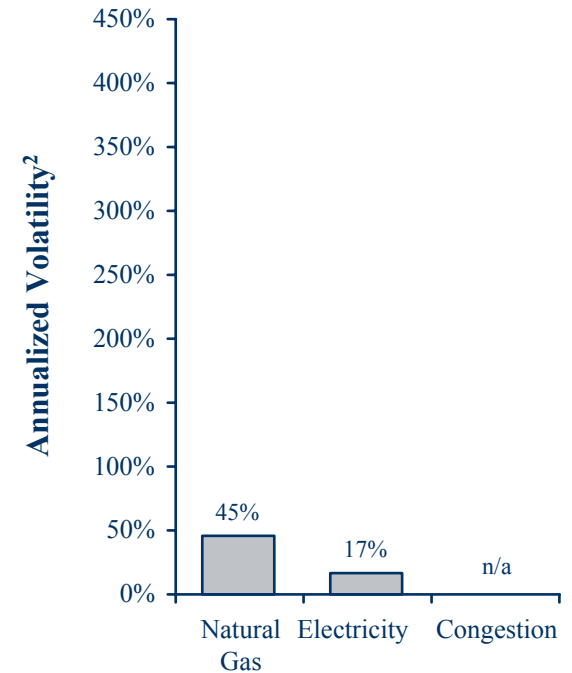
Short Term
– Balance of Day –



Medium Term
– Monthly –



Long Term
– Calendar Year –



Note: Power is based on the most liquid financial product: PJM Western Hub. Volatility represents buying and holding a PJM WH contract the day before, one month before or one year before settlement. Volatility is measured by the standard deviation in returns on the the hold period of 1 day (daily going to settlement) and one month for the monthly and annual contracts

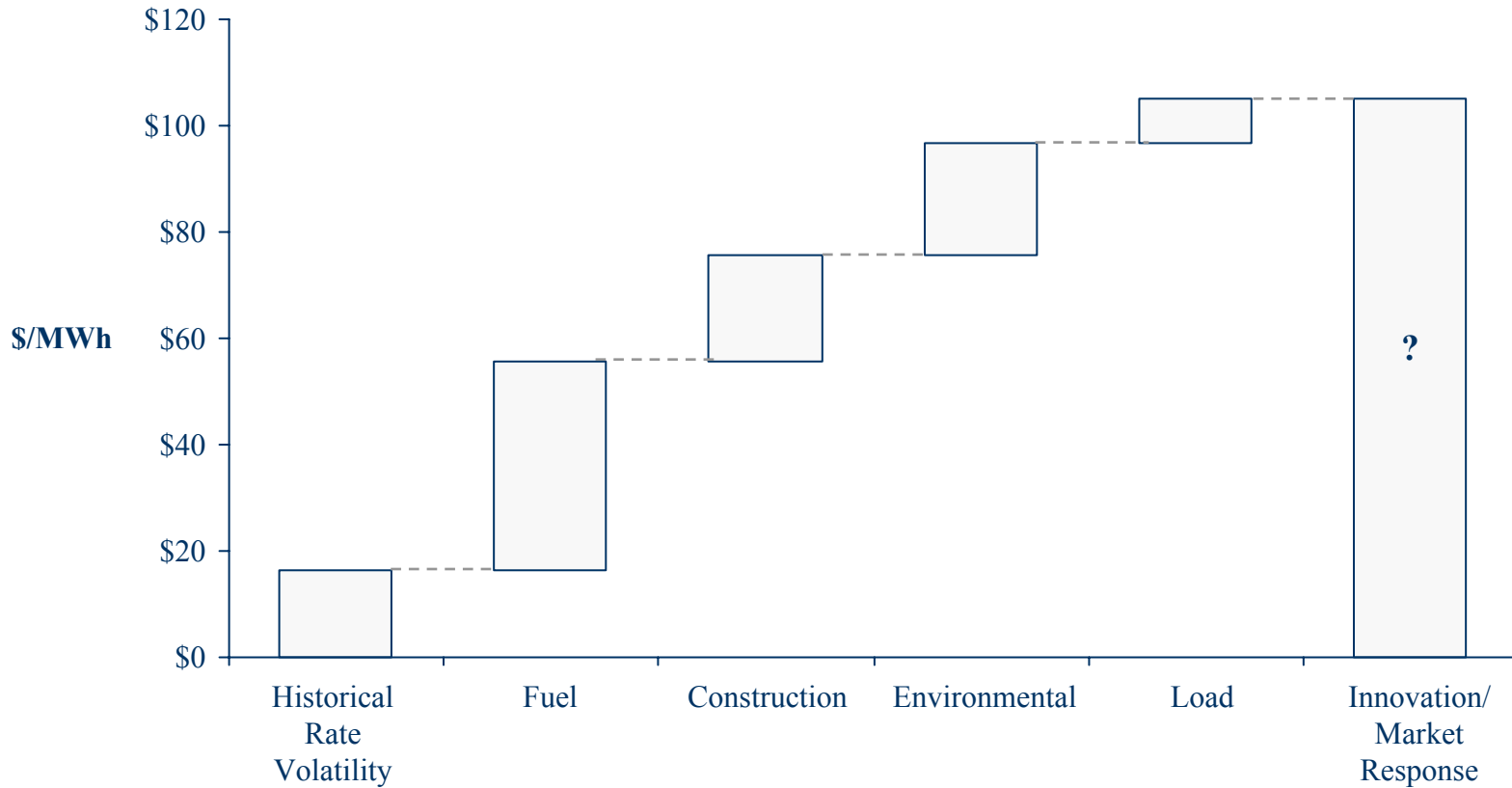
¹ Annualized Volatility = Daily Volatility x \sqrt{n} where n = trading days in one year (255)

² Annualized Volatility = Monthly Volatility x \sqrt{n} where n = trading months in one year

Source: ICE and DCE analysis

The uncertainty we face going forward is much greater than what we have experienced to date

Industry Risks

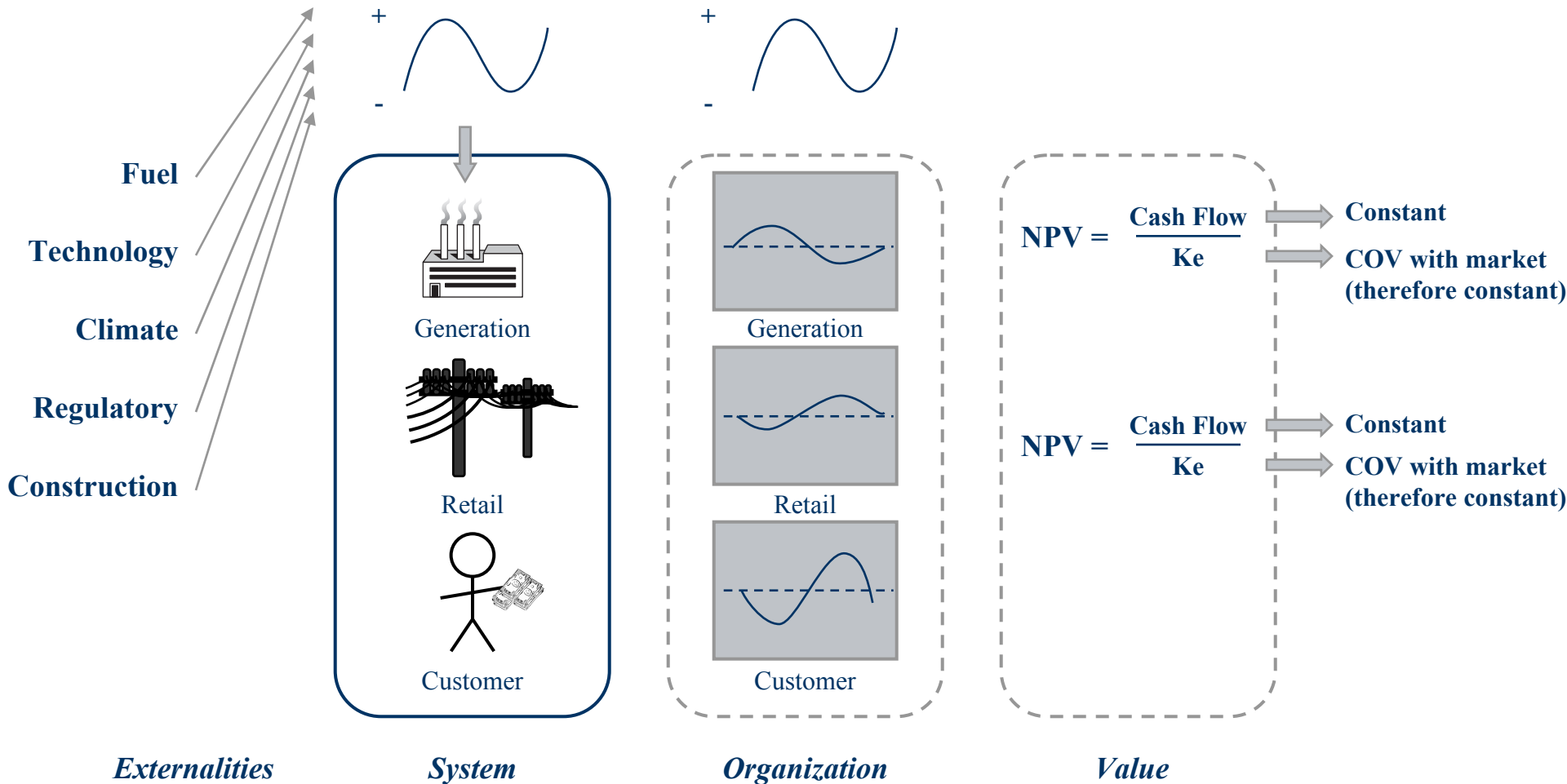


Note: Risks are based on the maximum historical real three year increase for Natural Gas, two sigma variation in annual electricity rates, ~25% nuclear cost overrun, and the difference between the minimum historical three year growth and the average growth in load. Environmental risk estimates based on the current costs of CO2 emissions in Europe for the average power plant

Sources: DOE, Edison Foundation, European Climate Exchange

Risk diversification alone does not create synergies by combining generation with retail

Uncertainty



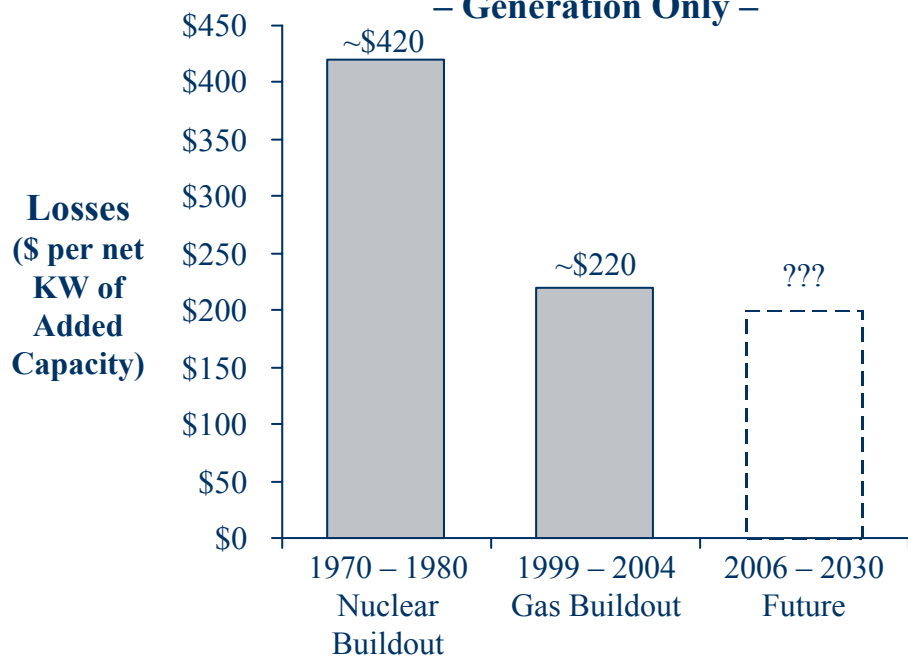
Constant regardless of organization
 (leaving aside accountability and contractual issues)

However, there is evidence to support the idea that a vertical system limits accountability to the detriment of the consumer

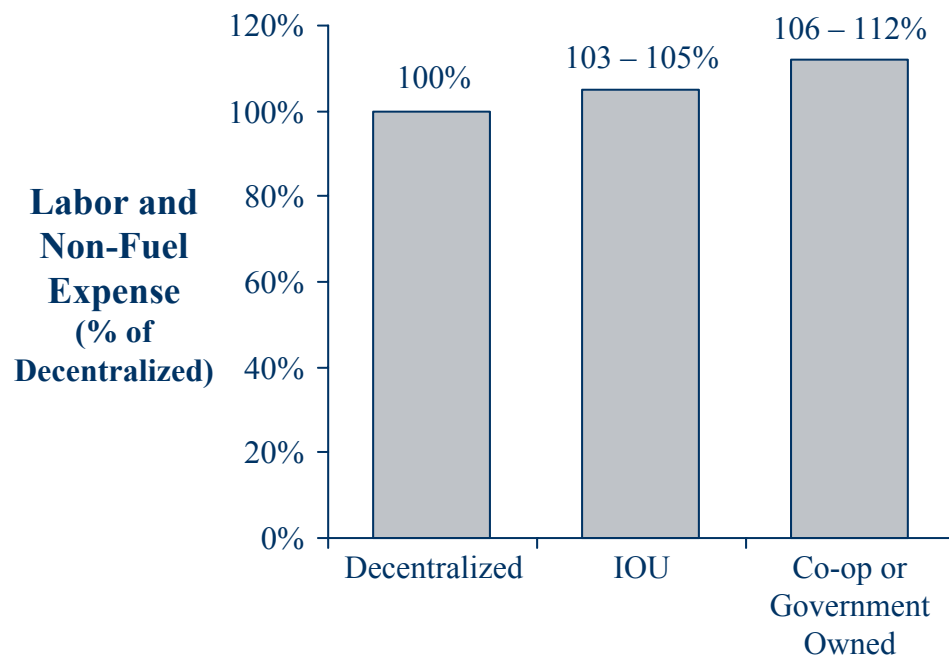
Resource Efficiency Effects

Capital Efficiency

– Generation Only –



Operating Efficiency



• Losses (\$B)	\$145	\$41	?
• Net Capacity Added (GW)	341 (88 Nuclear)	177 (159 Gas)	258

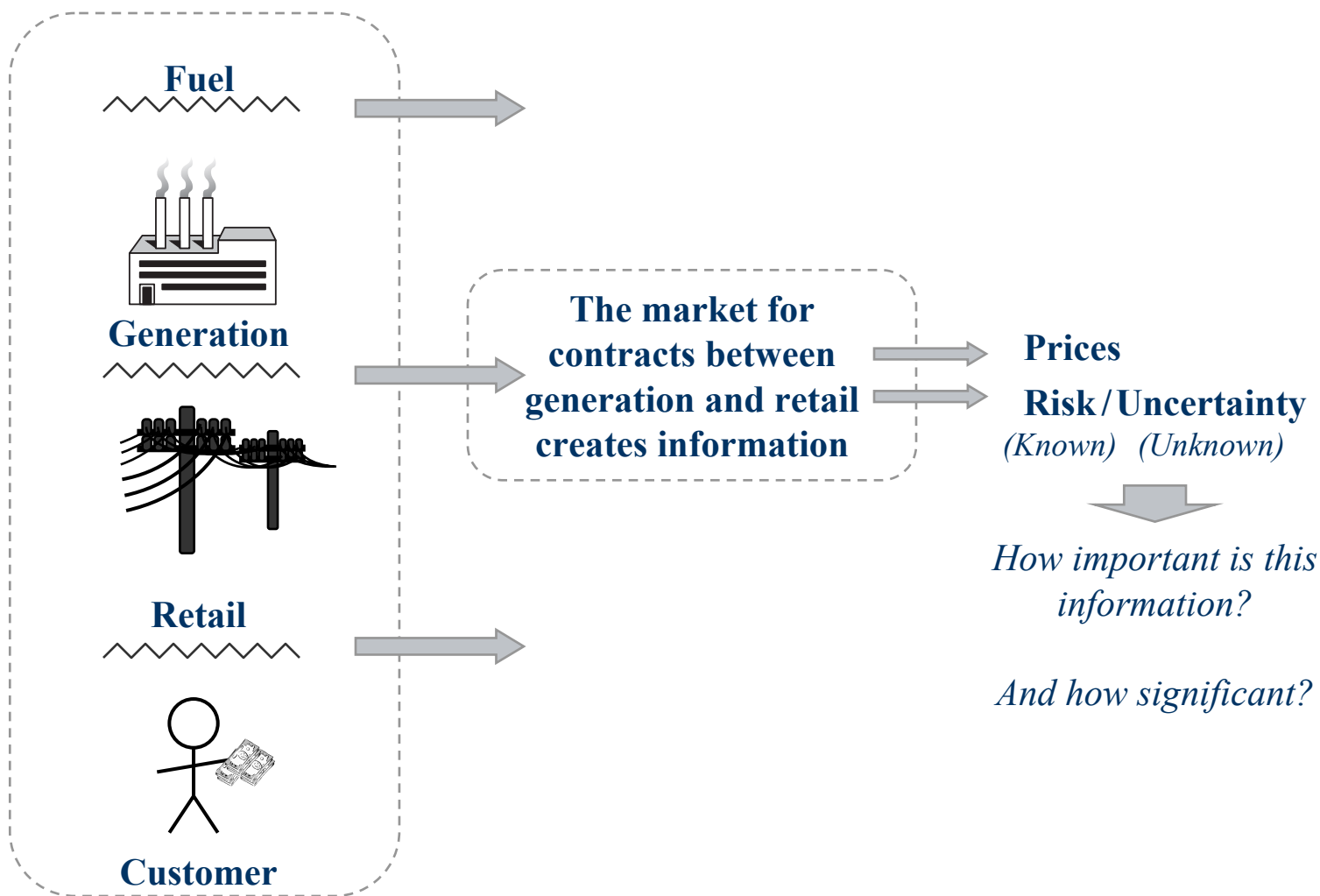
Sources: New York Times, "Nuclear Drain Put at \$100B", 2/1/88 - ~145B in 2004 dollars

EEI 2006 Financial Review, EIA 2007 Annual Energy Outlook

Fabrizio, K., N. Rose and C. Wolfram, "Do Markets Reduce Cost? Assessing the Impact of Regulatory Restructuring on US Electric Generation Efficiency", *The American Economic Review*

As importantly, disintermediation of wholesale and retail exposes important information on uncertainty that is critical for investment

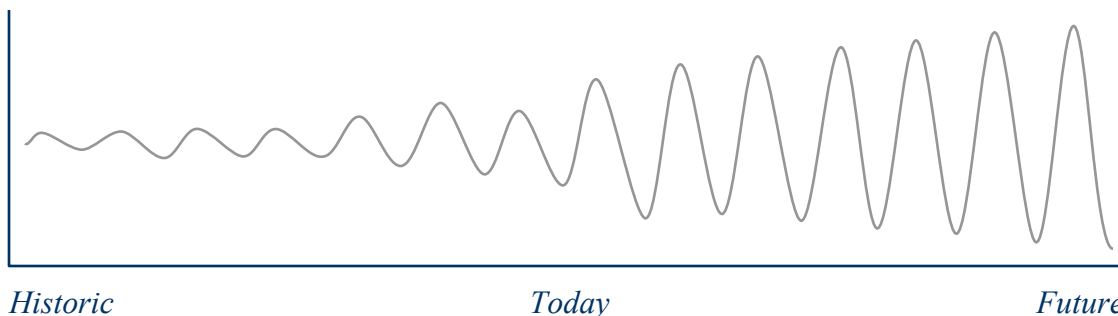
Uncertainty



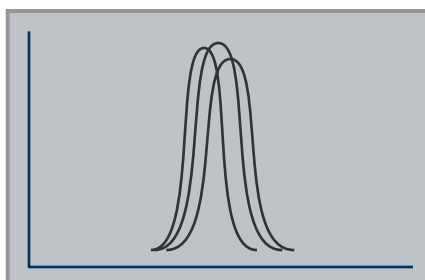
Optimal investing in an uncertain market incorporates options and betting on alternative outcomes that are valued using information on the distribution of uncertainty. Without the information, you cannot intelligently invest

Centralized vs. Decentralized

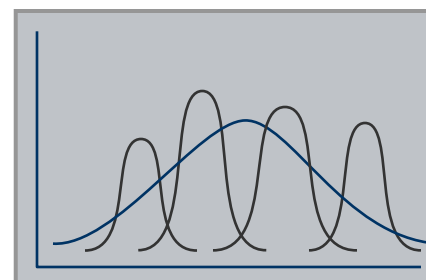
Uncertainty:



Outcome Distribution:



DCF



Short-Term DCF

+

Options

(to bet on a range of probable outcomes)

Investment Paradigm:



Centralized

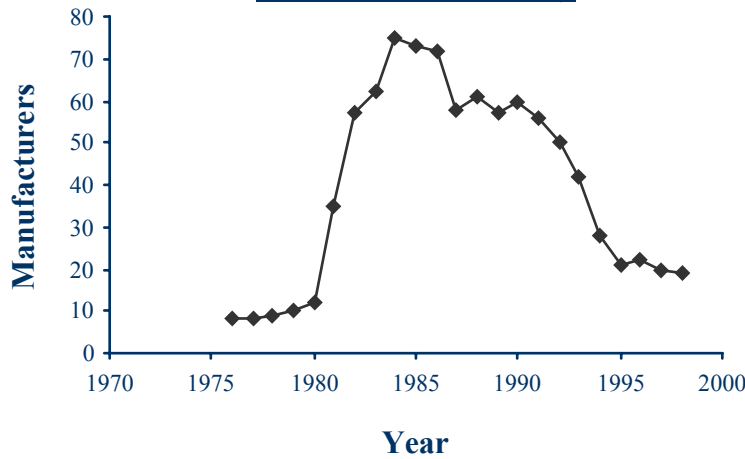


Decentralized

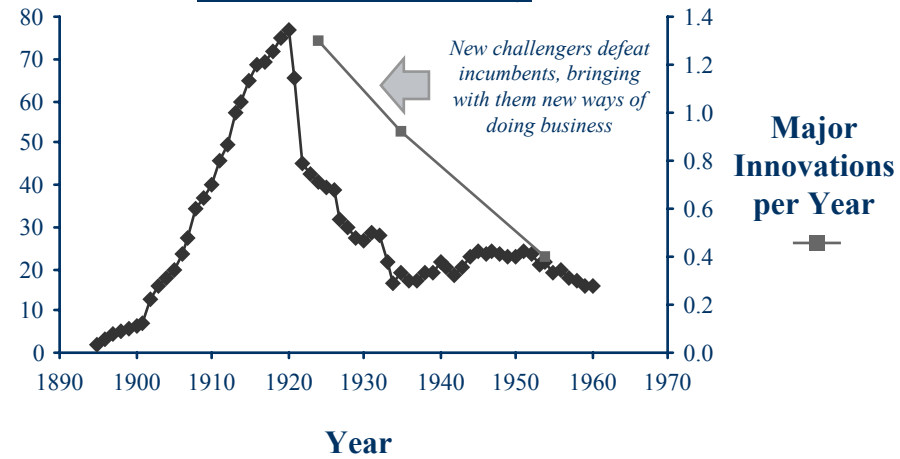
Furthermore, innovation is the direct results of multiple bets and creative destruction. Vertical integration is an obstacle to creative destruction — particularly when the vertical integration is anchored into a local monopoly

Creative Destruction

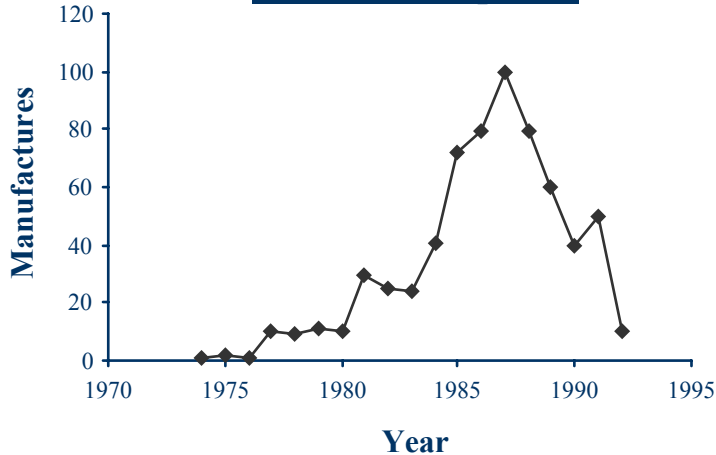
Disk Drive Industry



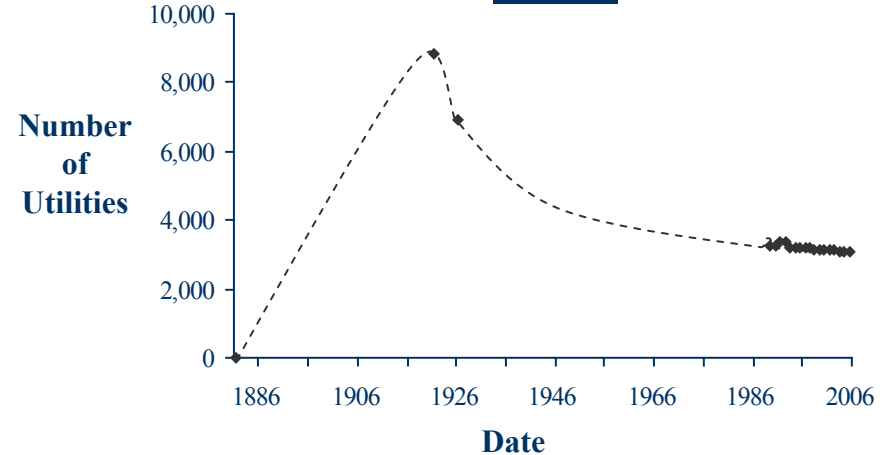
Automotive Industry



Personal Computers



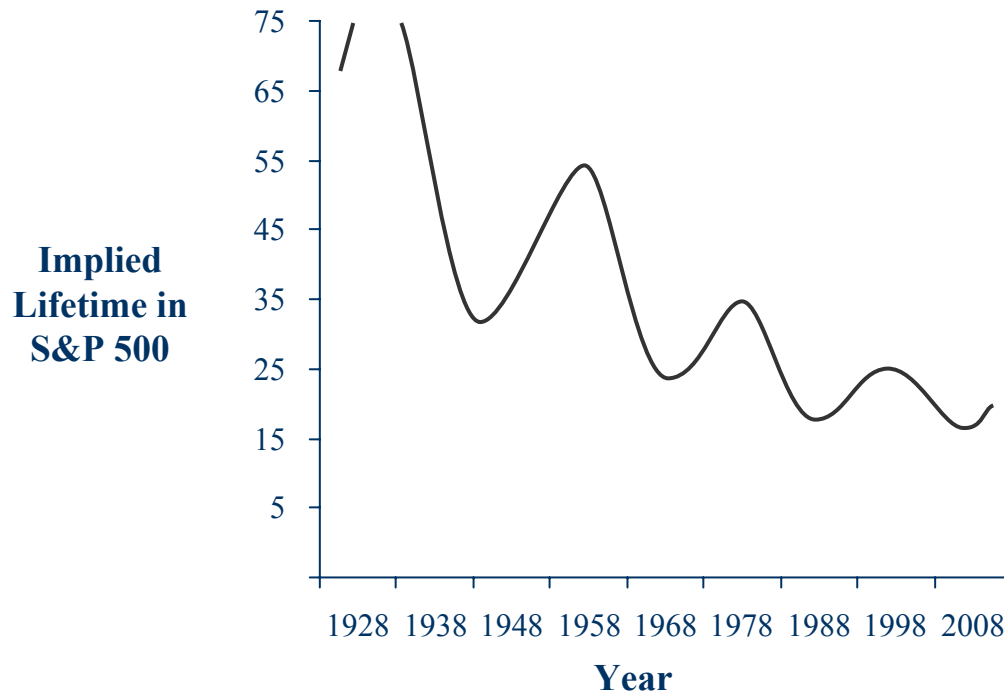
Utilities



Creative destruction is a part of all innovating industries

“Cell phone service is widely available in India at low cost because it was regarded as a luxury and therefore left to the market, while electricity is hard to obtain because it was regarded as a necessity and therefore managed by the government.” — *Martin Feldstein*

Average Lifetime of All S&P 500 Companies¹



Dow, May 1896, Industrial Stocks

- American Cotton Oil
- American Tobacco
- Chicago Gas
- Distilling and Cattle Feeding
- General Electric → *Only remaining member*
- Laclede Gas
- North American
- Tennessee Coal & Iron
- U.S. Leather
- U.S. Rubber

¹ Source: Foster and Kaplan, Creative Destruction

A diverse and open market is the best intermediary between wholesale and retail. It will provide the best forecast of uncertainty and price estimate

Individual Entities Are Irrational

- People are 2.5 times more sensitive to downside than to upside¹. Therefore individuals sell winners too quickly, and hold losses too long
- Risk adverse people systematically fail in a highly uncertain and changing market
- “Worldly wisdom teaches us that it is better for reputation to fail conventionally than to succeed unconventionally”
John Maynard Keynes
- “AT&T, the ultimate vertically integrated monopoly, was always looking for a new idea that stood the test of time”
Brooke Tunstall

Markets are Rational Even When Individuals are Not

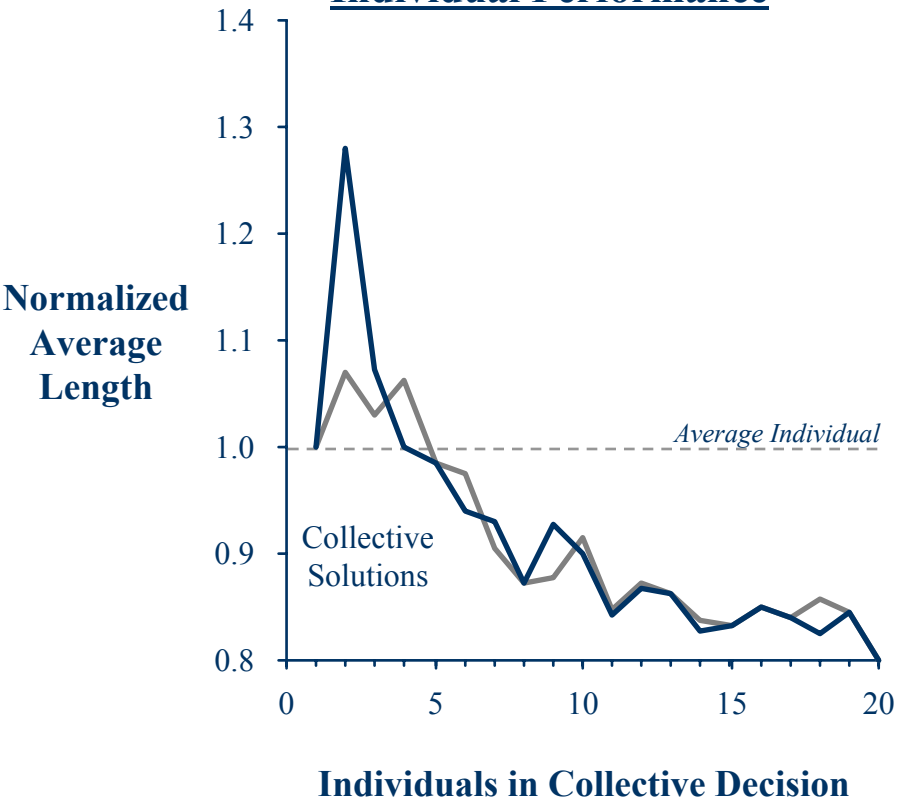
- Wisdom of crowds
- Diverse group
- Non-experts and experts
- Lack of Correlation

¹ Kahneman and Tversky

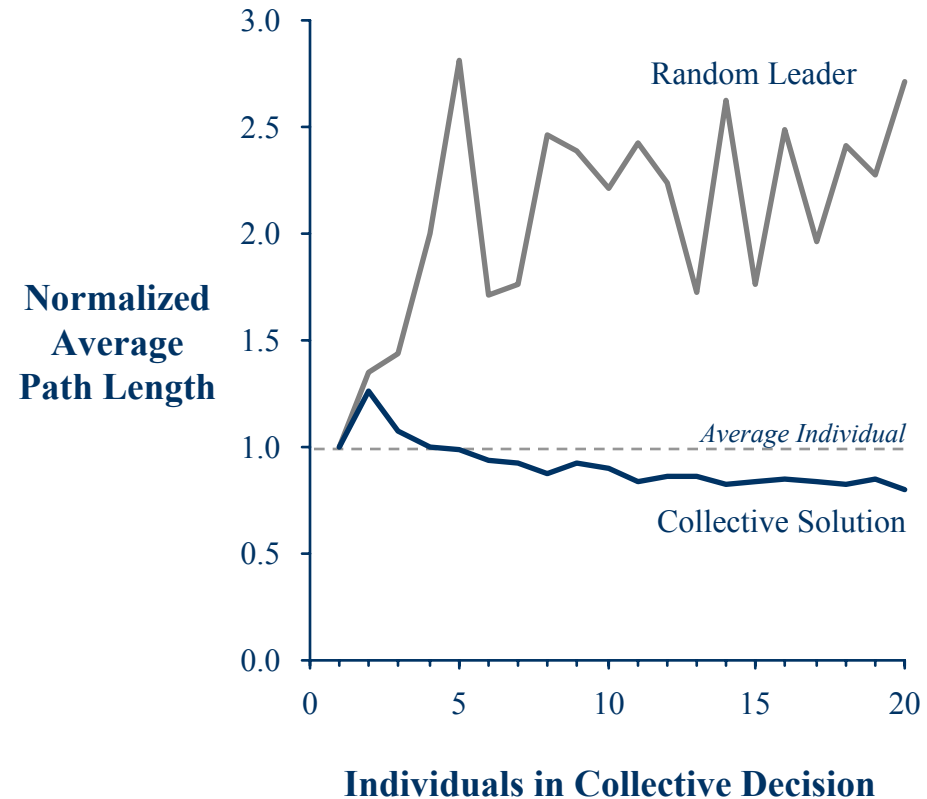
A collective decision results in a more accurate solution – as demonstrated below in the problem of solving a maze

Collective vs. Individual Decision-making

Collective Performance Beats Individual Performance



Leaders Don't Help



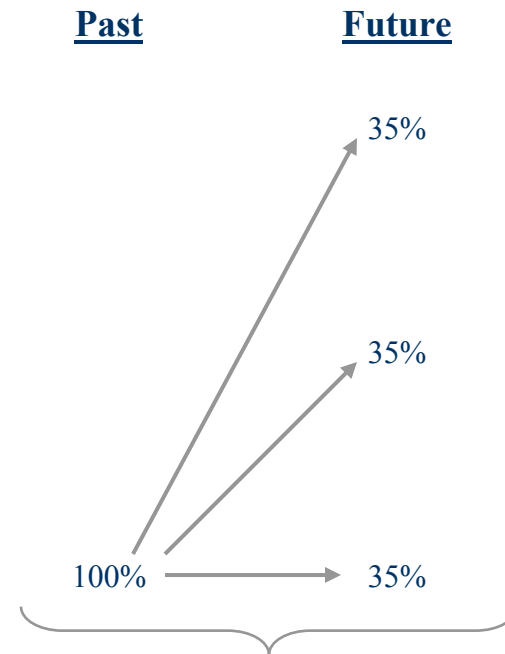
Does “Locking in” to reduce risk compromise our flexibility to adapt to opportunities and gain competitive advantage?

Energy Industry May Benefit From fewer Long-Term Commitments

Other Industries¹

	<u>Product Life</u>	<u>Process Life</u>
<u>Information</u>		
• Personal computers	<6 months	2 – 4 years
• Toys/Games	<1 year	5 – 15 years
• Semiconductors	1 – 2 years	3 – 10 years
<u>Design</u>		
• Automobile	4 – 6 years	10 – 15 years
• Machine Tools	6 – 10 years	10 – 15 years
• Pharma	7 – 15 years	5 – 10 years
<u>Asset</u>		
• Aircraft	10– 20 years	20 – 30 years
• Petro Chemicals	10 – 20 years	20 – 40 years
• Paper	10 – 20 years	20 – 40 years

What is the mix for Energy?



May be important to trade out of commitments

“It is not the strongest of species that survives, nor the most intelligent, but the one that is most responsive to change”

— *Charles Darwin*

¹ Charlie Fine, Clock speed

Many Industries Invest Without Long Term Commitments

Plant Investment

- Computers → \$500MM
- Software → \$10MM
- Newspapers → \$500MM
- Airframe Manufacturing → \$1B
- Microprocessor Fab → \$5 – \$12B
- Casino → \$2 – \$3B
- Paper Mills → \$700MM
- Cellular → \$3B

What do we need for optimal Ex Ante Investment Decisions for Generation and transmission?

Requirements

- Segmented accountability between wholesale and retail
- Market prices, which reflect uncertainty
- Creative destruction
- Diverse range of investment participants
 - Load, Generation, Transmission
 - Investment Banks
 - Brokers
 - Hedge Funds
 - Etc.
- Robust nodal market
 - Exchange
 - Clearing

NODAL Exchange

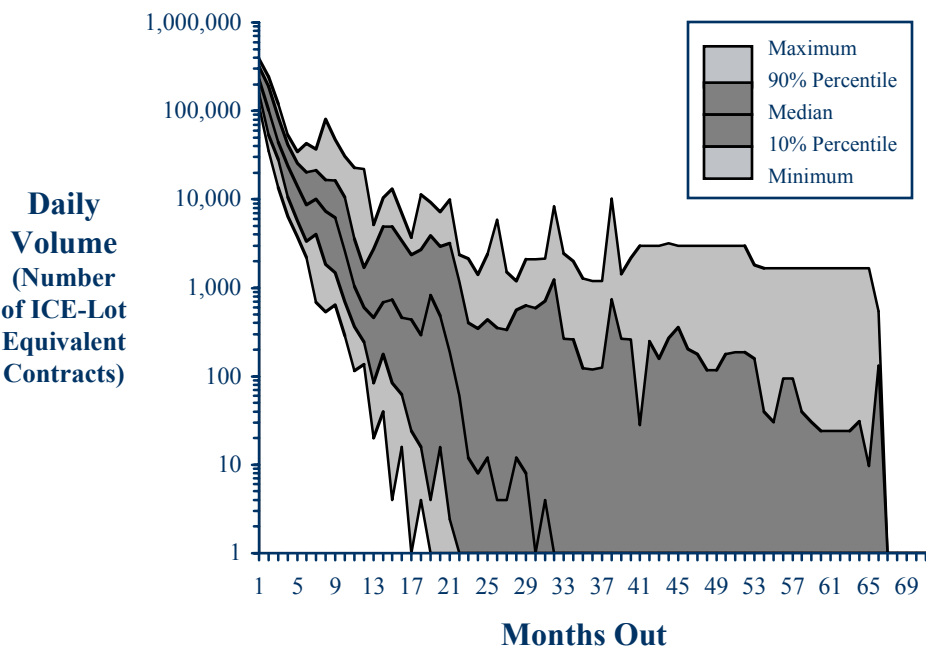
- Addresses product gap by offering energy contracts at Nodal level
 - Current month to 18 months, and out
 - Energy and spreads
 - Weekly/Daily auction
- Cleared by LCH-Clearnet
 - No counterparty default risk
 - Easy to manage
- Strong demand expressed by participants
 - Not surprising since ISO growth has been 40% – 50%/yr.
- Trading volume should eventually rival gas
- Launch by end of 2008 / early 2009

Long term liquidity needs to be preceded by ST liquidity, and by contracts designed for physical participants. With the right market structure liquidity, electricity should grow like it has for gas

Volume by Months Out

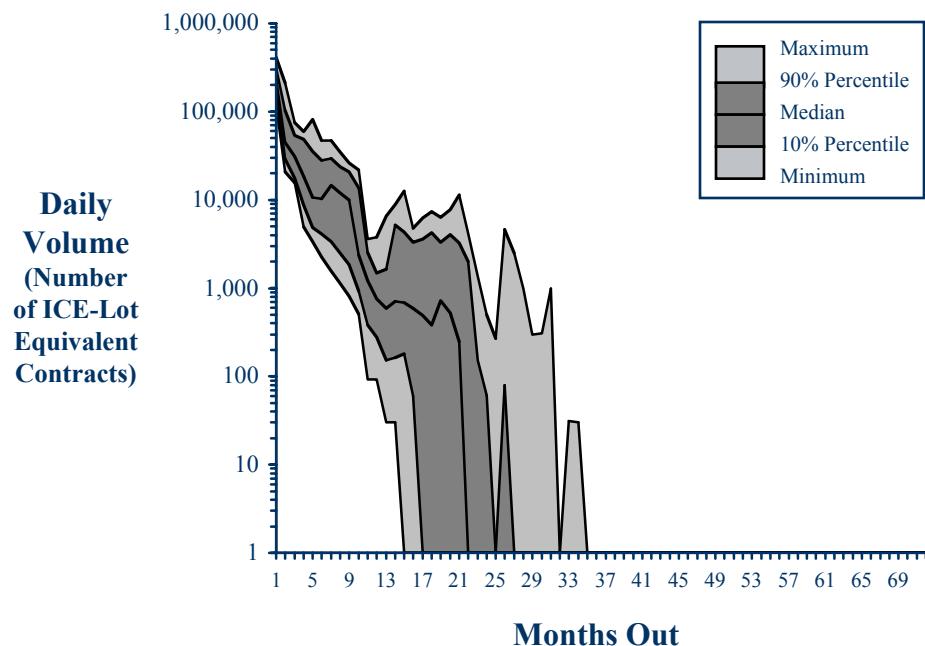
NYMEX

– 6/4/07 – 9/11/07 –



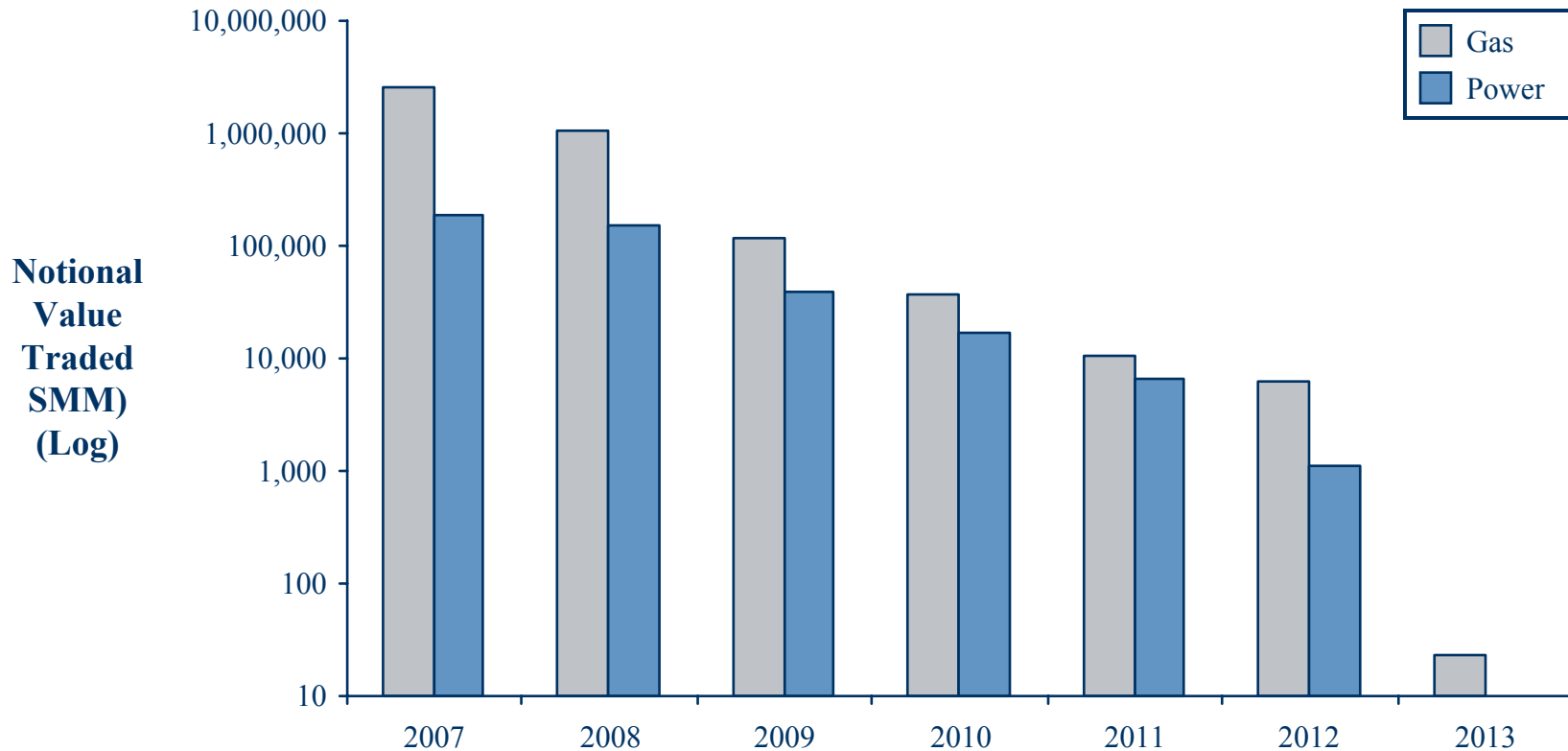
ICE

– 6/4/07 – 9/11/07 –



Today, gas trading far exceeds that of power in terms of notional value

ICE Power & Gas Trading – 2007 Trading –



• Ratio (Gas/Power)	2007	2008	2009	2010	2011	2012	2013
	13.6	6.9	3.0	2.2	1.6	5.5	N/A