

# **Nuclear Decommissioning Trust Asset/Liability Modeling**

**NRC Decommissioning Funding Workshop**

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**David R. Emerson, CFA, CAIA**  
**Senior Vice President & Principal**  
**LCG Associates, Inc.**  
**400 Galleria Parkway, Suite 1800**  
**Atlanta, GA 30339**  
**770.644.0100**  
**demerson@lcgassociates.com**  
**www.lcgassociates.com**

**Kathleen C. Taylor, CFA**  
**Senior Vice President & Principal**  
**LCG Associates, Inc.**  
**400 Galleria Parkway, Suite 1800**  
**Atlanta, GA 30339**  
**770.644.0100**  
**ktaylor@lcgassociates.com**  
**www.lcgassociates.com**

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- *Assessing assurance for a project that will not begin for over 20 years, and may take another 10 – 20 years to complete, is difficult* because of the large number of variables involved, including:
  - How will the equity and bond markets perform?
  - How will cost escalation rates change?
  - What costs are unknown?
- *Stochastic analysis can incorporate many of these variables into a Monte Carlo simulation model*, providing a range of possible outcomes and the likelihood of achieving one of these outcomes.

- *Monte Carlo simulation will not provide a definitive answer for NDT funded status*, but it will provide a range of possible outcomes.
- Monte Carlo analysis relies on a series of inputs:
  - *Asset class assumptions* – Return, Risk, Income, Turnover, Taxes
  - *Funding assumptions* – Timing of contributions, if any
  - *Liability assumptions* – Cost schedule, Escalation rate sensitivity
- *A change in any one of these inputs could have a large impact on the Success Ratio of the NDT.*
  - The Success Ratio is defined as the percentage of observations within the Monte Carlo simulation that meet or exceed the cost of decommissioning.

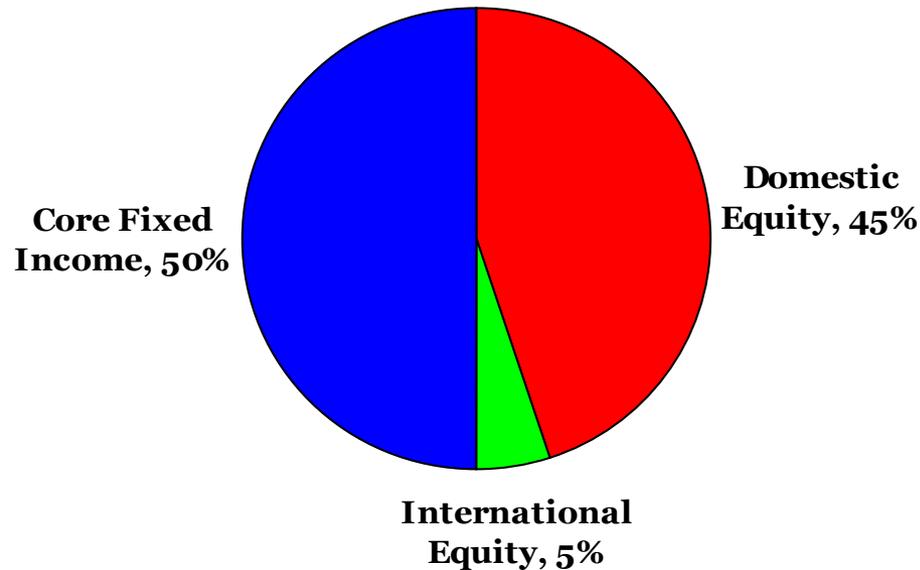
# XYZ Utility NDT: Key Data and Modeling Assumptions

**\$ Millions**

<b>Generating Unit</b>	<b>Current Assets</b>	<b>Expected Future Liability in 2011 \$</b>	<b>Current Assets as % of PV of Liability</b>	<b>Beginning and Ending of Decommissioning (with extension)</b>
<b>LCG 1</b>	<b>\$345</b>	<b>\$600</b>	<b>57.5%</b>	<b>2033/2042</b>

<b>Assumption</b>	<b>Source</b>
<b>Decommissioning Costs</b>	<b>XYZ Utility Cost Study in \$2011.</b>
<b>Cost Escalation Rate</b>	<b>XYZ Utility: 3.0%</b>
<b>Discount Rate</b>	<b>XYZ Utility: 5.0%</b>
<b>Contributions</b>	<b>None</b>
<b>Capital Market Assumptions</b>	<b>LCG Consultant Consensus based on long-term history and expectations of risk premia</b>

## Target Allocation



- *Special Transfer occurred in 2006.* All assets are now in the Qualified Trust at a 20% tax rate.
- *\$103mm in unrealized gains.*
- *Begin to de-risk in 2028, five years prior to the start of decommissioning.* De-risking will continue until the Trust has an allocation of 50% Fixed Income / 50% Cash in 2038.

- ***All-Cap US Equity:*** Based in the U.S. Broadly diversified by market capitalization, sector and industry. May have multinational exposure.
- ***International Equity:*** Broadly diversified by market capitalization, country (developed and emerging markets), sector and industry. Based outside of U.S. May have U.S. exposure.
- ***Core Fixed Income:*** Broadly diversified across sectors. Typically tracks duration of the Barclays Aggregate Bond Index.
- ***“Alternative” Investments:*** While not used for modeling purposes in this example, they are beginning to be used by several Utilities for their NDT. These include:
  - **Hedge Funds:** Directional and Non-Directional strategies designed to reduce the volatility risk while pursuing fairly consistent absolute returns.
  - **Real Assets:** Physical assets such as Real Estate, Commodities and Natural Resources. Inflation-hedge characteristics.
  - **Private Capital:** Private investments in companies through debt or equity.

## Mid-1980s

**Nuclear owners required to fund external trusts. Division of pre-1983 related costs with 1984 and on. For taxable companies, NQT and QT.**

## Mid-1980s

**Qualified Trusts must follow Black Lung Trust investment restrictions. Government bonds (Federal, state and municipal): perception of safety.**

## 1992

**Energy Policy Act specifies Prudent Investor Standard for asset allocation. Broadens allowable investments. Allows for more growth in assets over time.**

## 1990s

**Typical asset mix about half large-cap U.S. stocks and half investment grade U.S. bonds. NQT primarily municipal bonds due to tax rate.**

## 2000s

**Asset mixes expanded to include international stocks and small-cap U.S. stocks. Special Transfer provisions. Monte Carlo modeling gaining ground.**

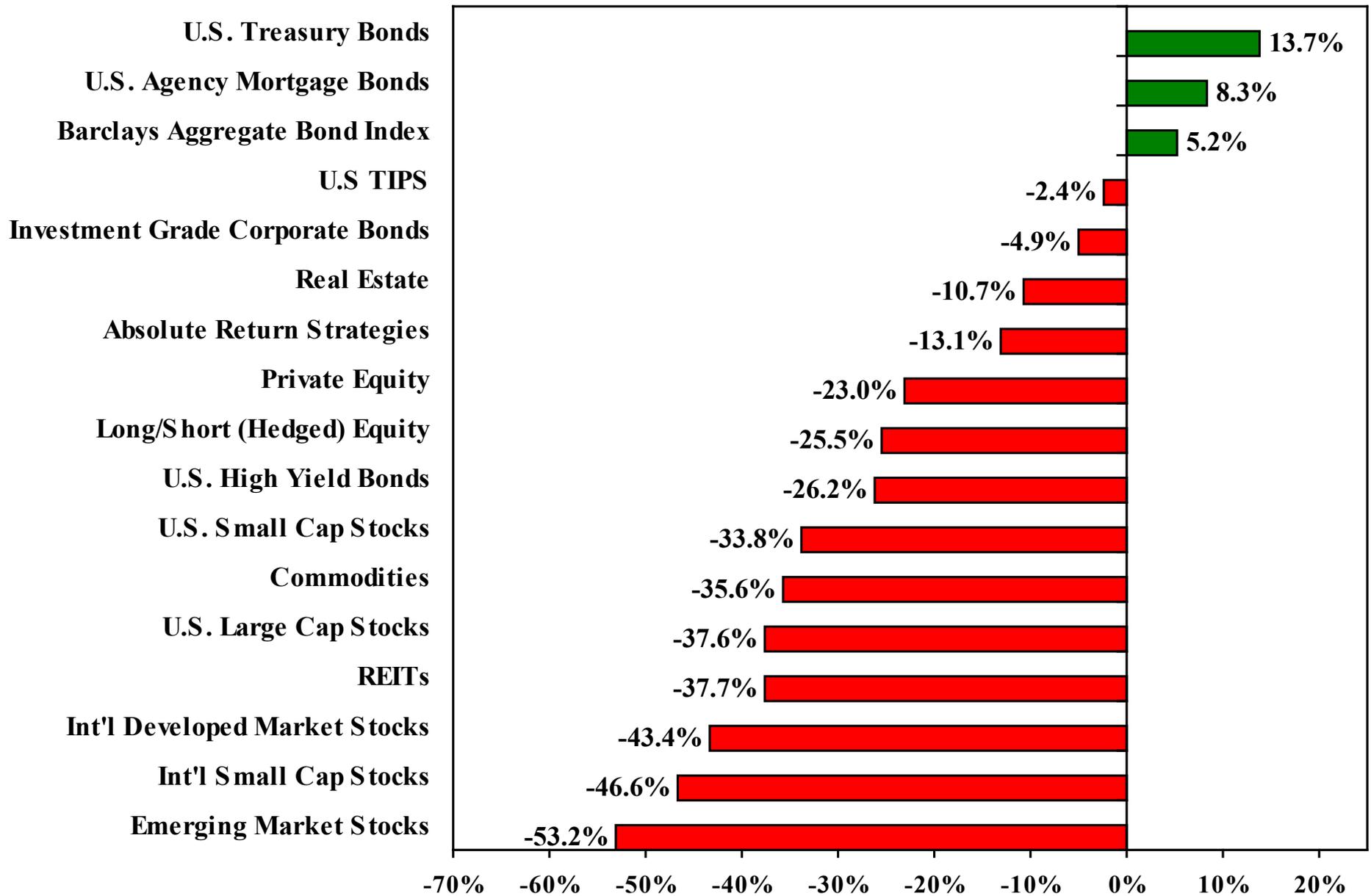
## 2008-2009

**Stock and Bond market meltdown. New thoughts on what is risky.**

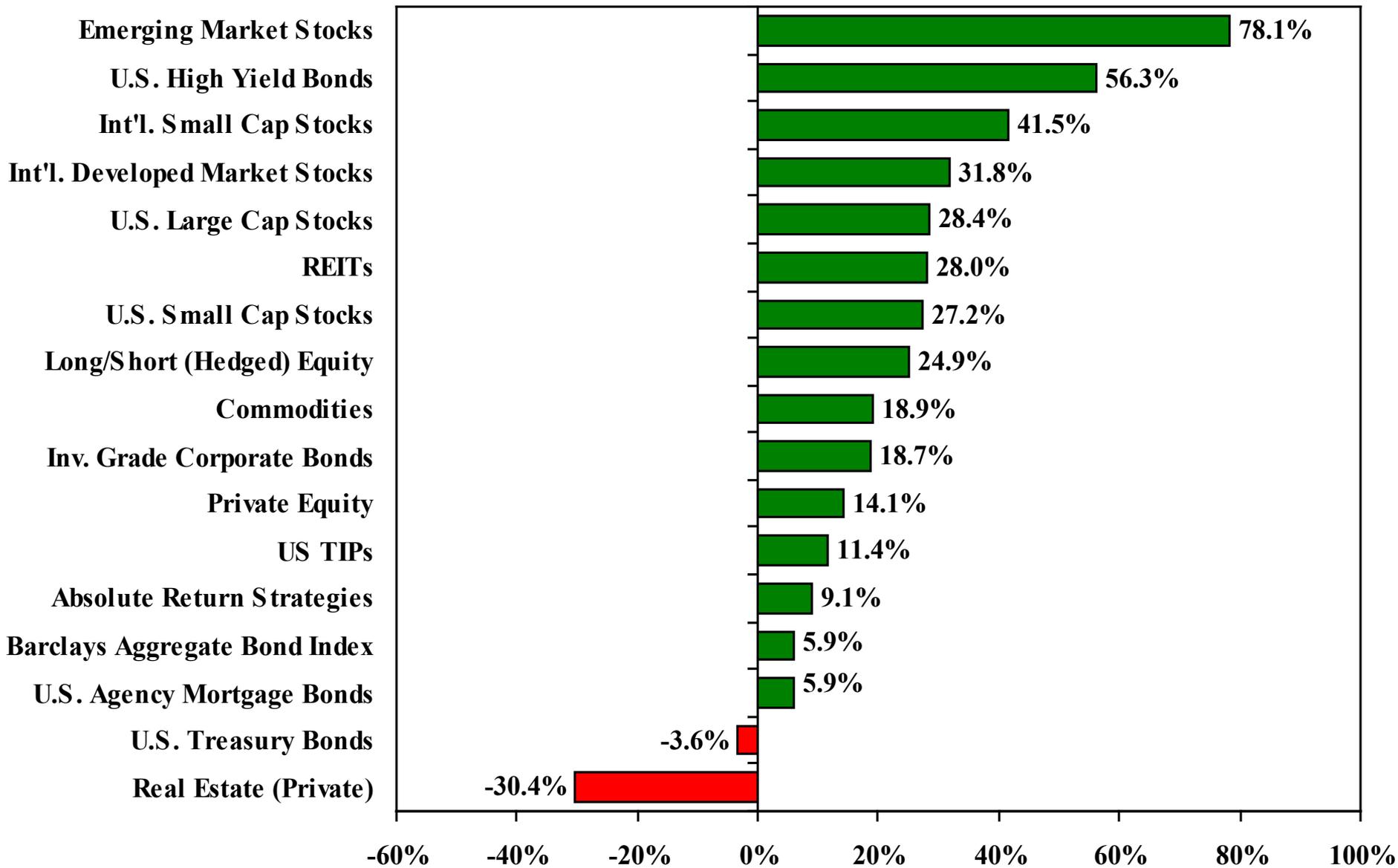
### 2010-2011

**Diversifying asset mix to include more hedged strategies as well as private capital such as private equity and real estate. Recognizes long time horizon, especially with license extension. Focus on protecting in declining markets by better diversification.**

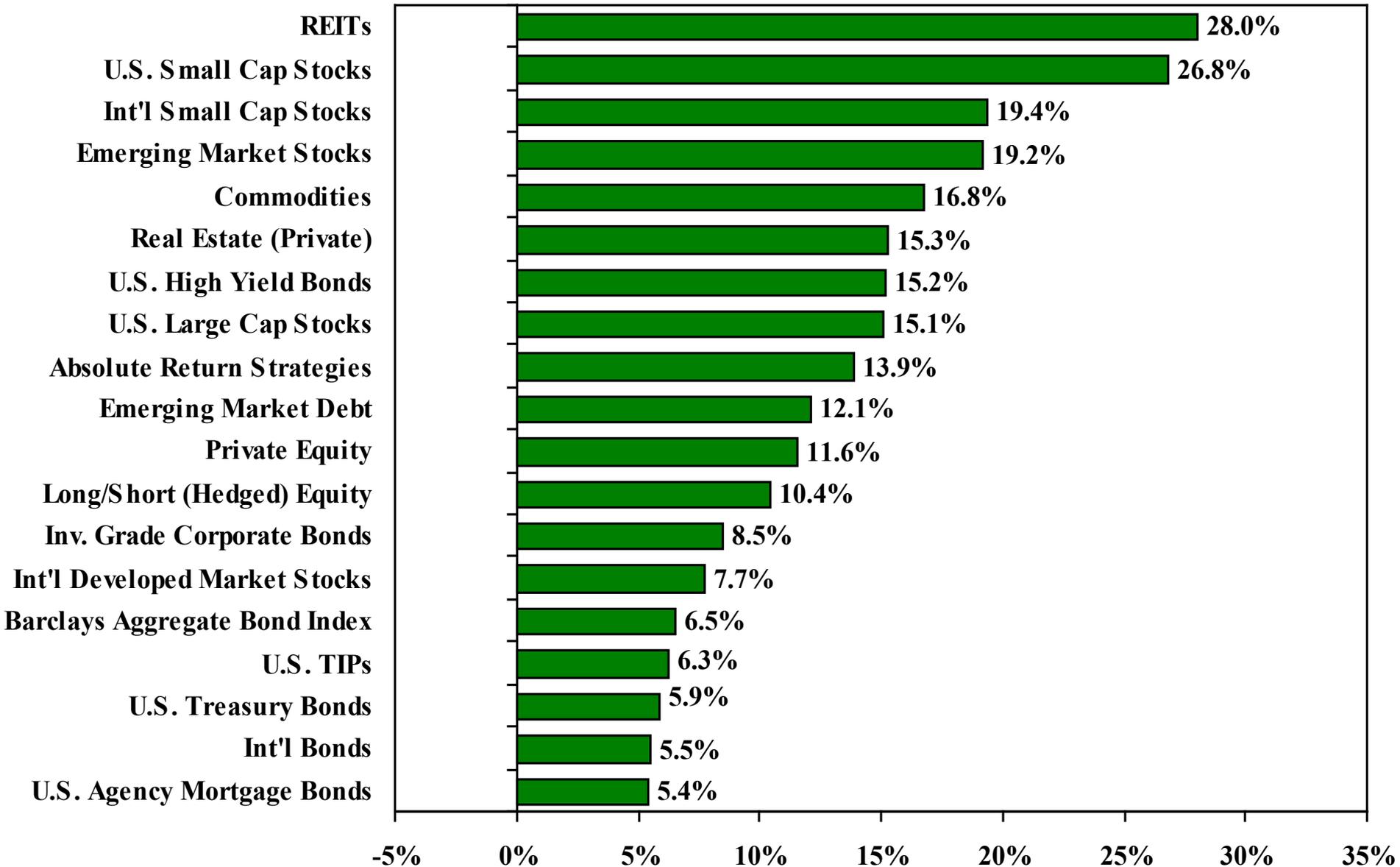
# 2008: Few Places to Hide



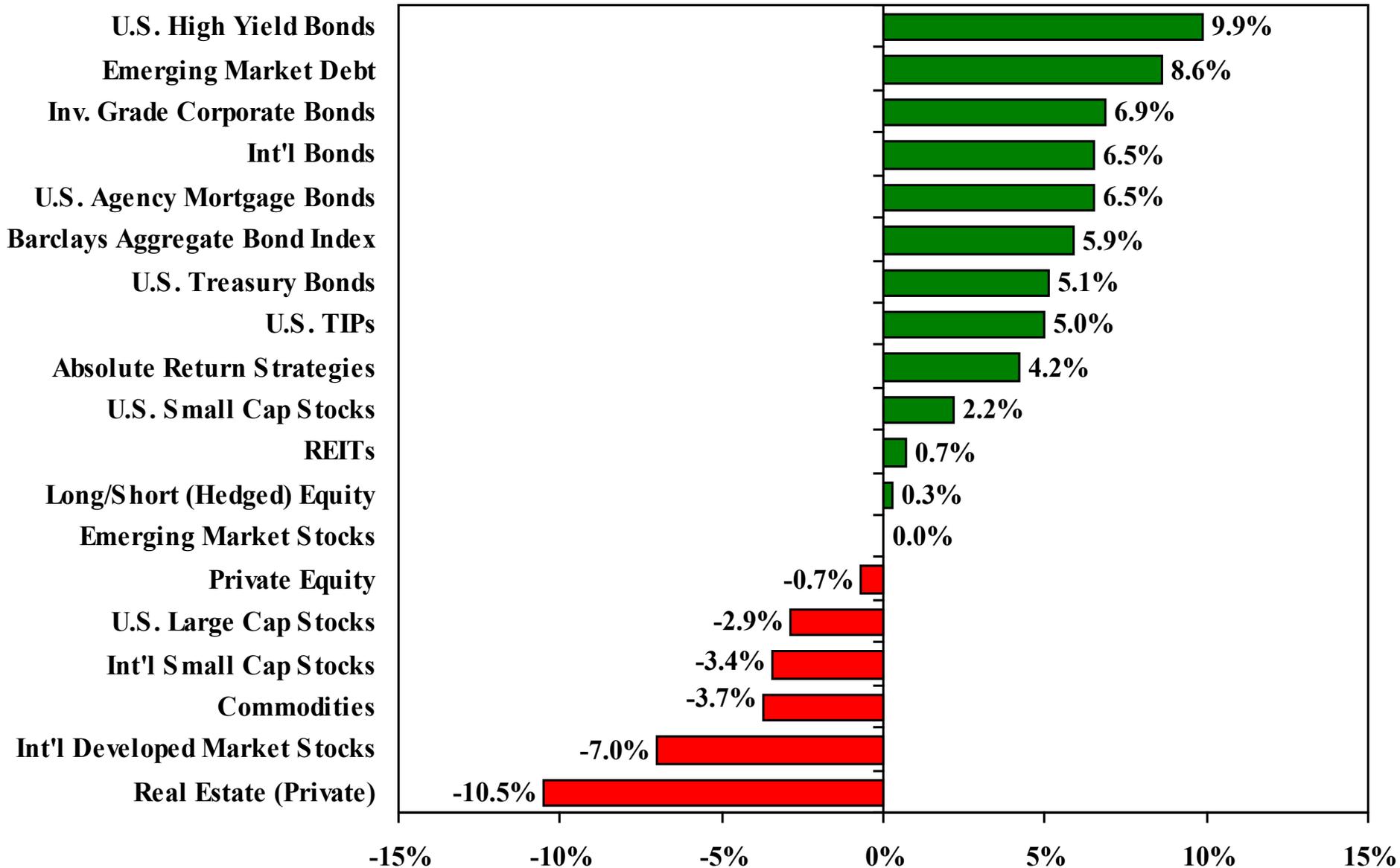
# 2009: Reversal from 2008



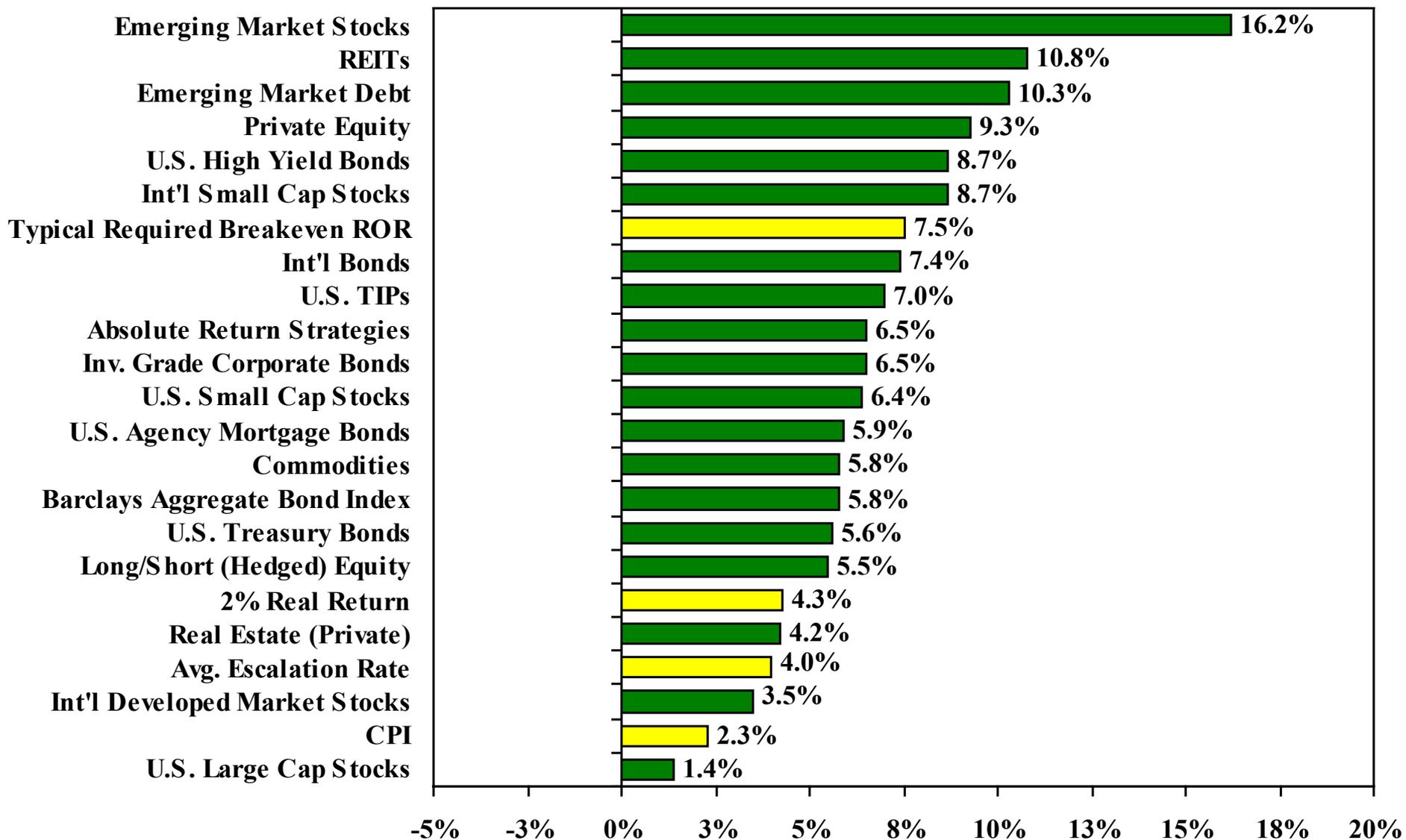
# 2010: Back to Positive for All



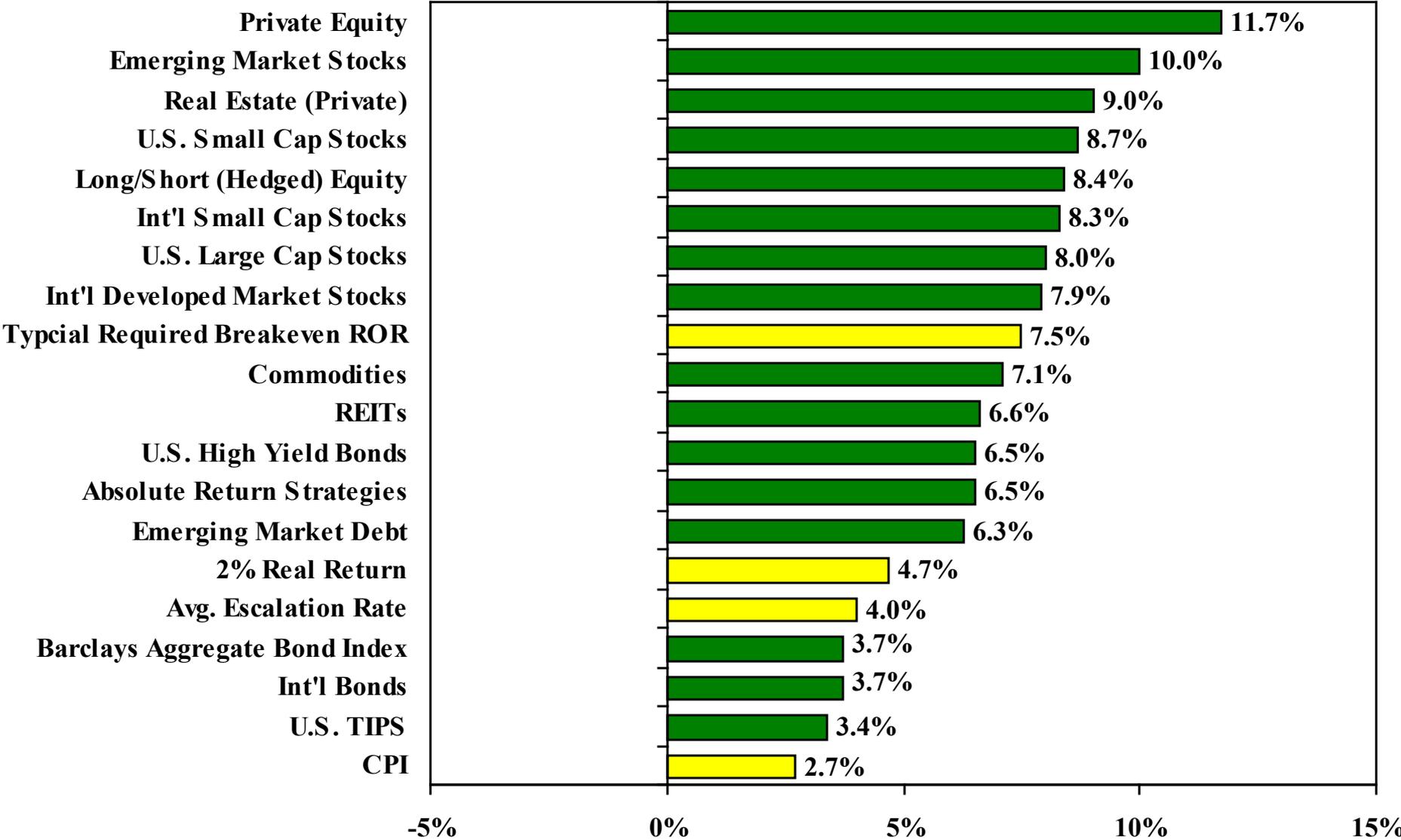
# 2008-2010: 3-Year Annual Average, Some Not Back to Even



# 2001-2010: 10 Year Annual Average



# Wall Street Consensus Forecast (next decade)



# Capital Market Return Assumptions

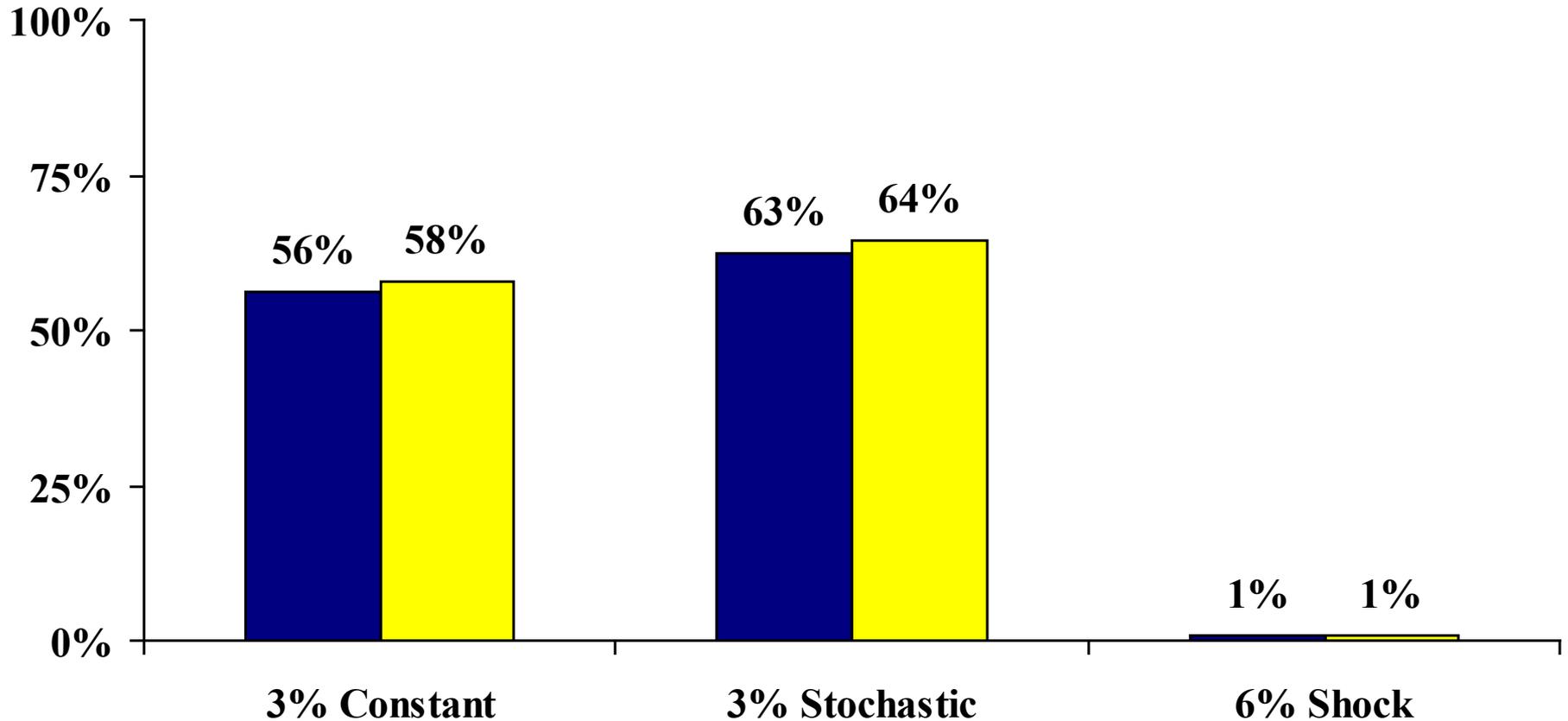
- *Capital market assumptions for modeling based on long-term historical market returns and risk* coupled with reasonable estimates of turnover, yield and trading expenses. These are expected returns. With assumed volatility and correlation results of Monte Carlo simulation will vary.

Qualified Trust Asset Class	Expected LT Return (%)	Expected LT Vol./Risk (%)	Expected Portfolio Turnover (%)	Tax on Income (%)	Tax on Realized Gains (%)	Expected Yield (%)	Trading Costs (%)
<b><i>Growth Assets/Equity</i></b>							
All-Cap US Equity	10.5	13.7	15.0	20.0	20.0	1.8	0.1
International Equity	10.0	14.9	30.0	20.0	20.0	2.5	0.2
<b><i>Income-Oriented</i></b>							
Core Bonds	5.0	4.8	7.0	20.0	20.0	4.5	0.1
Cash/Money Market	3.0	0.9	0.0	20.0	20.0	3.0	0.1

- *The Monte Carlo simulation for today's meeting focuses on varying the liability data.* The following variables were used:
  - *Escalation Rate sensitivity*
    - *3.0% constant rate* – This is the assumed rate based on the most recent cost study.
    - *3.0% stochastic rate* – This rate will fluctuate based on correlation to the asset classes.
    - *6.0% shock rate* – This is a more pessimistic scenario where the escalation rate is double the current rate.
  - *Cost Schedule sensitivity*
    - *The Decommissioning project is expected to take 10 years.* Spent Fuel storage costs may extend further.
    - *Second scenario:* extends the decommissioning period by two years by slowing the project to defer some costs.

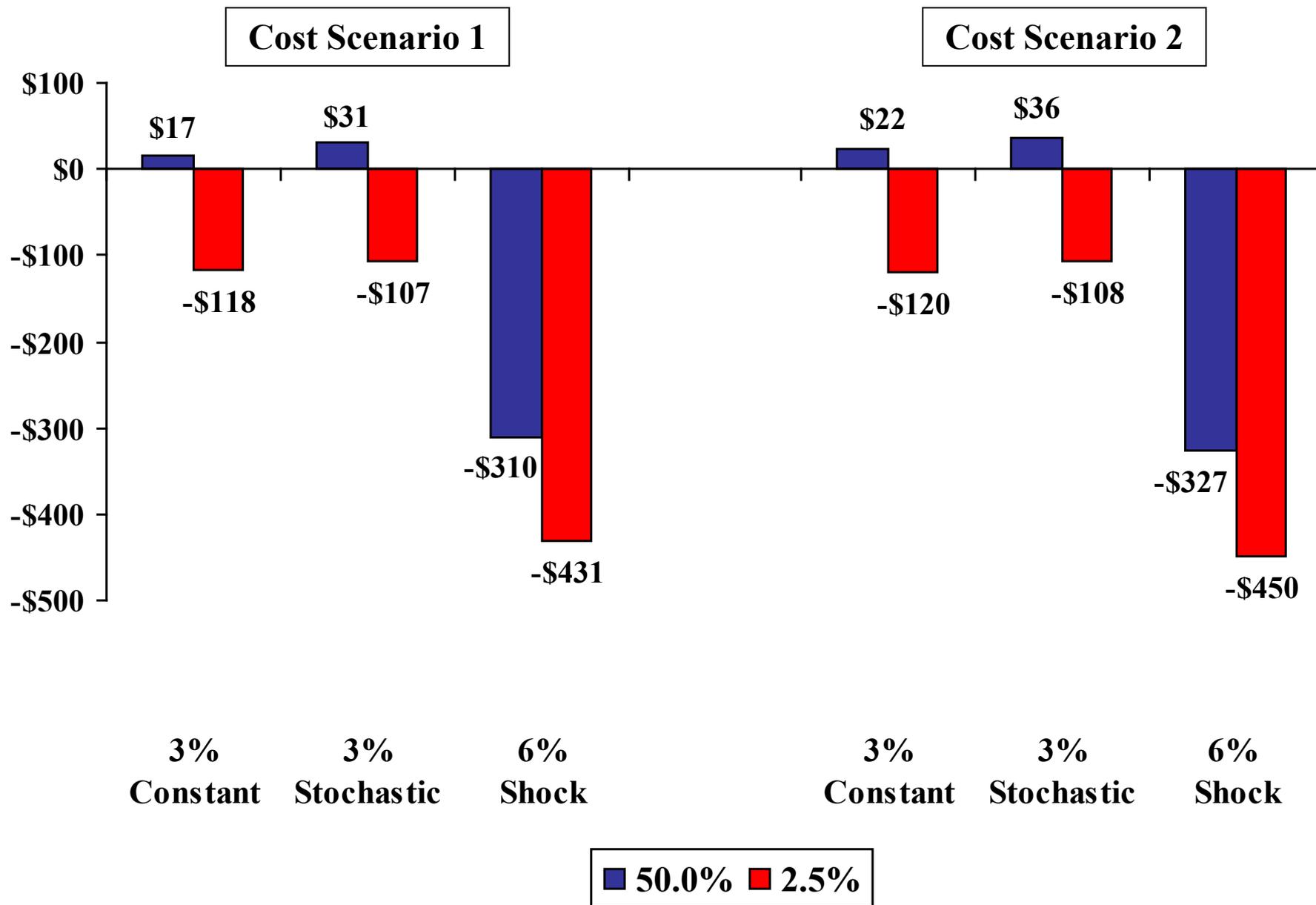
# Modeling Summary: Success Ratio

(% of Observations in Which Full Funding Occurs)

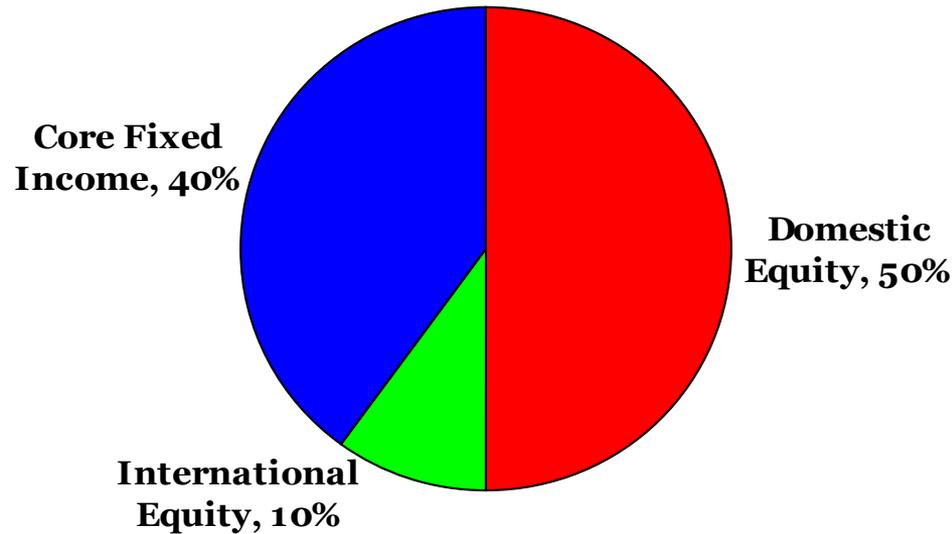


■ Cost Schedule 1 ■ Cost Schedule 2

# Modeling Summary: PV in \$2011 (\$MM)

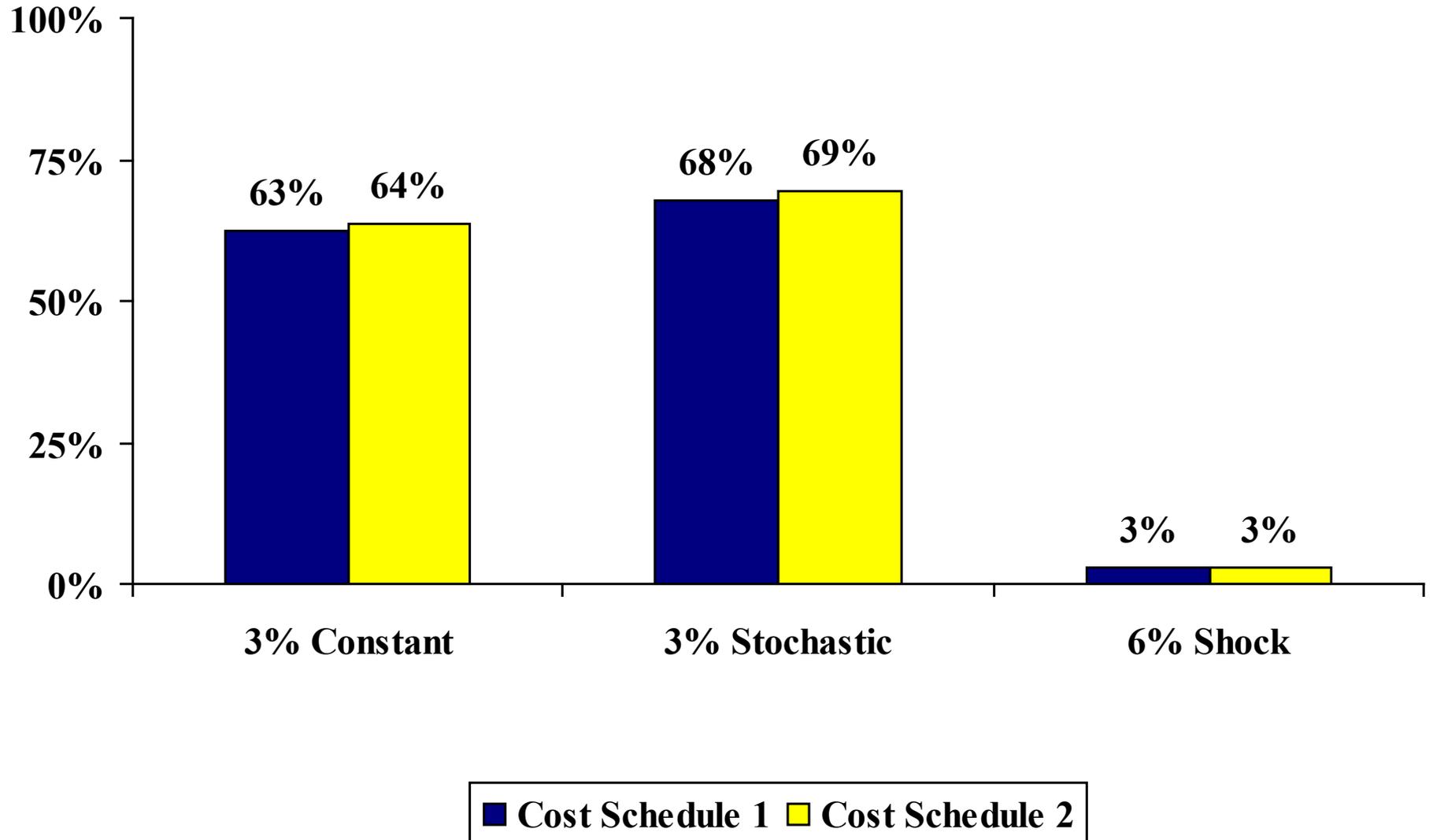


## Target Allocation

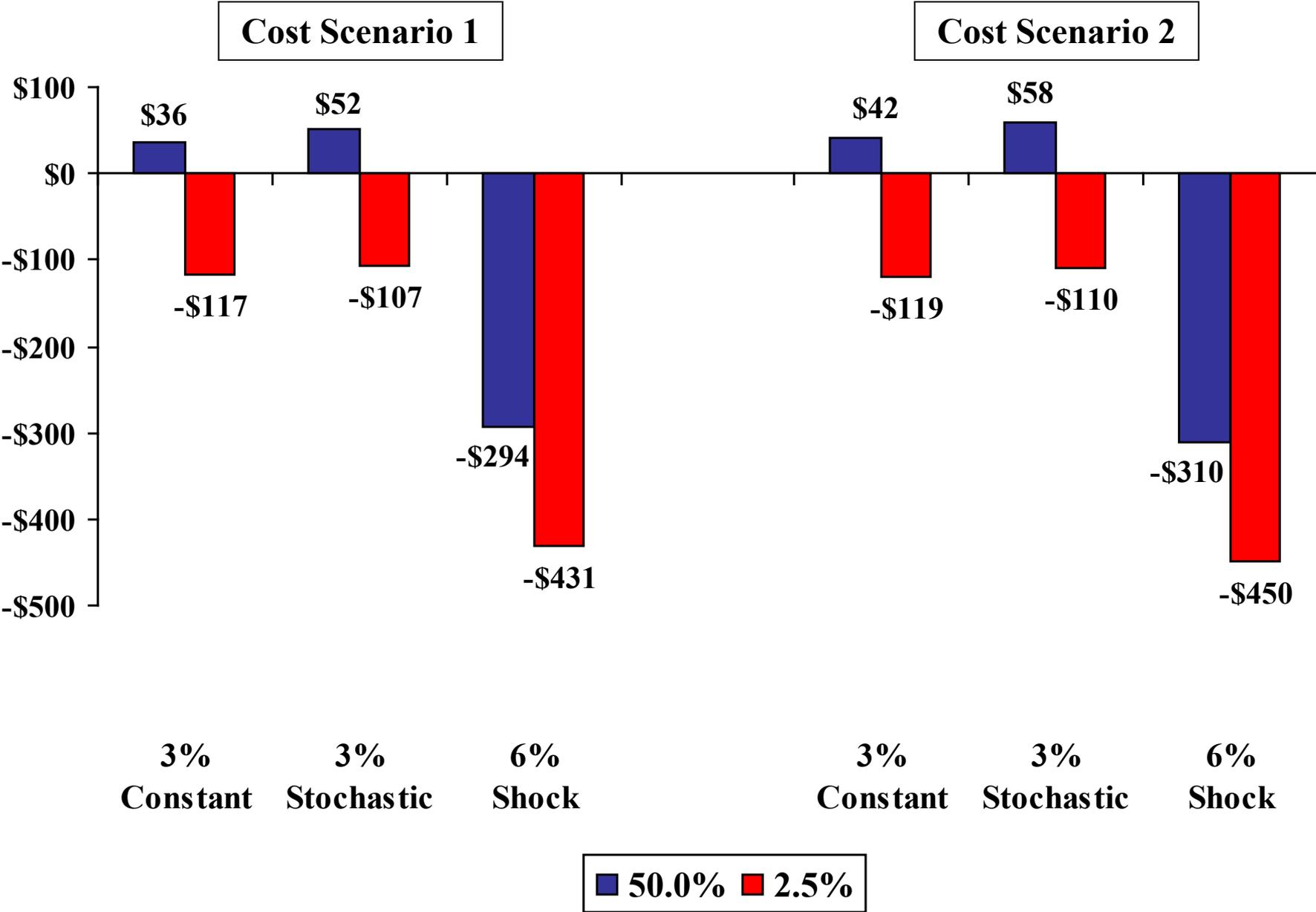


- *Given the initial study results, we can then assess whether adding risk to the Trust (increasing Growth Assets/Equities) would improve the Success Ratio.*
- *For the next model runs, we added 5% to International Equity and 5% to Domestic Equity. Total of 10 percentage point increase in Growth (Equity) Assets with corresponding decrease in Income (Bond/Cash) Assets.*

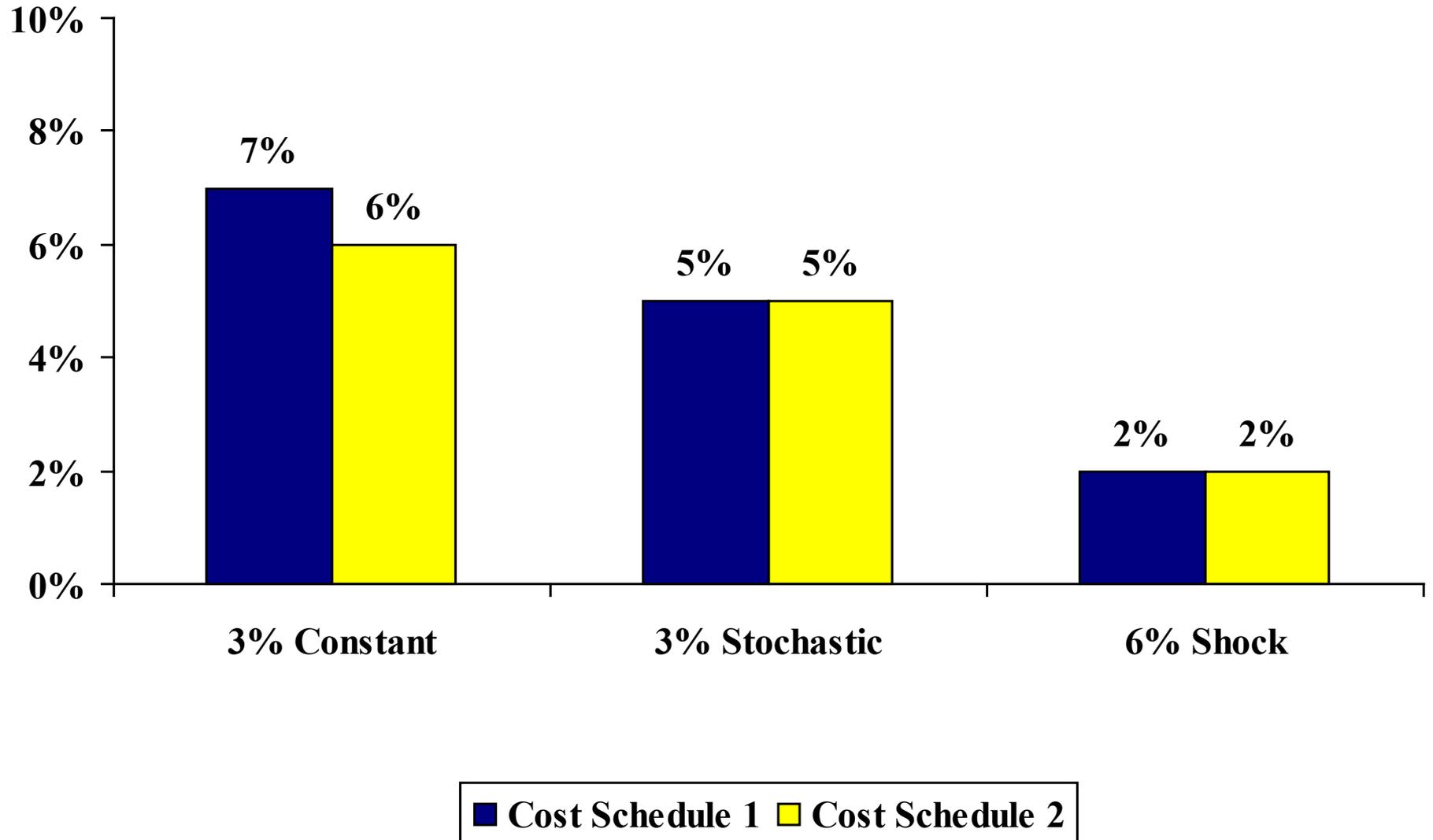
## % of Observations in Which Full Funding Occurs – Success Ratio



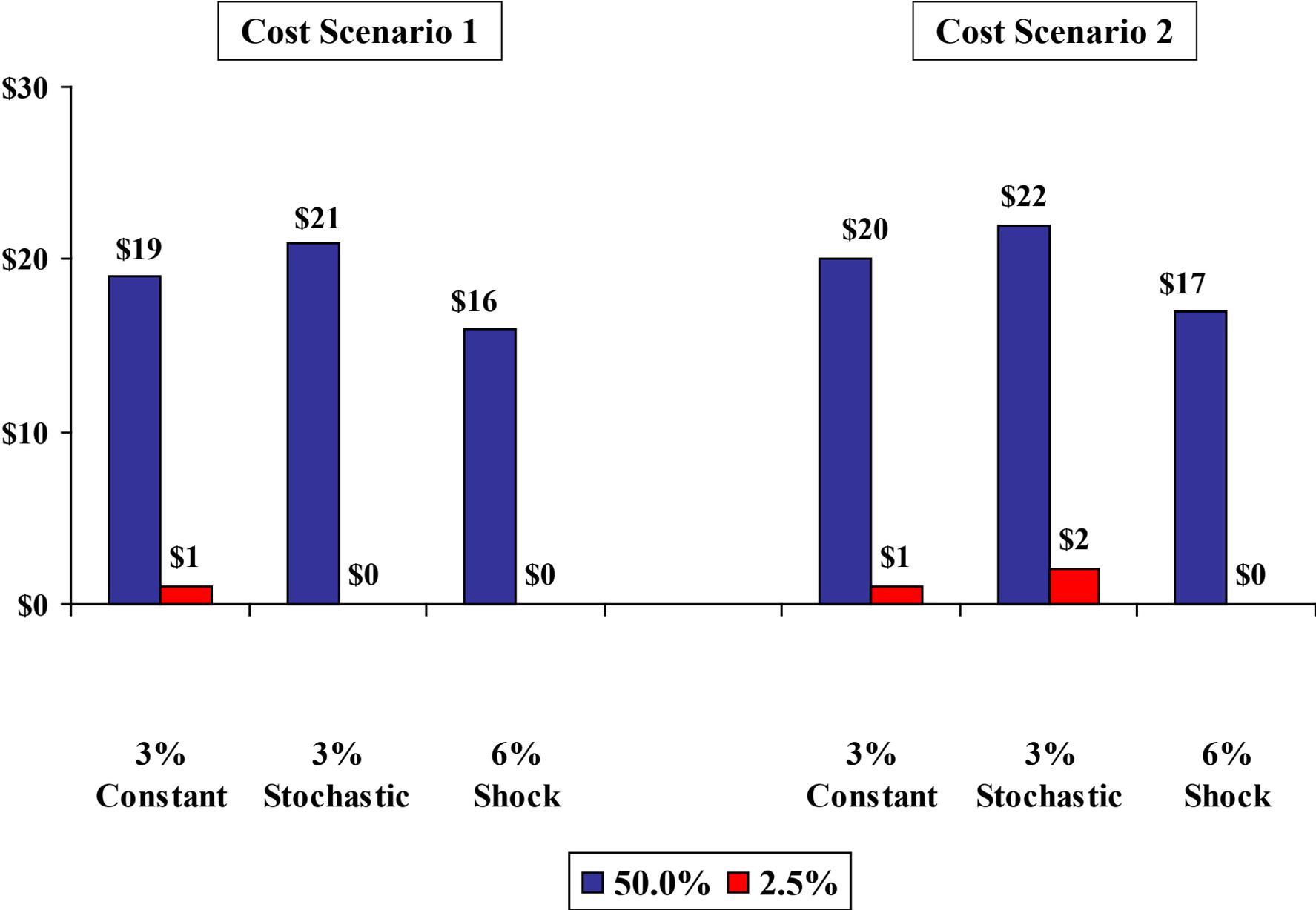
# Modeling Summary: PV in \$2011 (\$MM)



# Change in Success Ratio Between Two Asset Allocations



# Change in PV Between Two Asset Allocations



- *Monte Carlo simulation provides a good estimate of a range of potential future outcomes.* But, it is still an estimate subject to the many assumptions that are made.
- *LCG Associates, Inc. believes that stochastic modeling of the escalation rate is more robust than a constant rate.* However, given the long duration of the liabilities, the escalation rate may change given newer information. *An escalation rate shock can have significant consequences for the funded status of an NDT.*
  - *A new Monte Carlo simulation should be run every time* a new cost study or escalation rate is introduced.
- *Changing the liability schedule can make marginal improvements* to the Success Ratio, but may or may not be feasible in managing the decommissioning project.
- *Asset allocation targets and asset class assumptions are critical* when modeling the funding status. Asset allocation can and probably should be diversified further to help improve the Success Ratio.