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**2014 Asset Allocation and
Liability Study: Phase 2**

Tucson Supplemental Retirement
System

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Agenda

- Asset Allocation and Liability Process
- Asset Modeling
 - Capital market expectations
 - Alternative asset mixes
- Liability Modeling
 - Key actuarial assumptions
 - Liability characteristics
 - Funding policy
 - Impact of not meeting the investment return rate (7.25%)
 - Incorporate recommended assumption changes from actuarial experience study.
- Simulate Financial Condition
 - Unfunded liability
 - Funded status
 - Contribution volatility
- Alternative Funding Policy
- Making A Decision
 - Preliminary observations
- Appendix

Goal of the Study

- The goal of this asset-liability study is to establish a long-term strategic asset allocation policy for the Tucson Supplemental Retirement System (“TSRS”).
- An appropriate asset allocation will depend on the Plan’s investment objectives.
 - Minimize costs (employer contributions) over the long run (long-term goal)
 - *How much return generation (from beta and alpha) is necessary to lower costs and/or improve funded status?*
 - Minimize contribution volatility (short-term goal)
 - *Funded status volatility is linked to contribution volatility*
 - *Trade-off between risk reduction and higher expected contribution?*
- Investment solution is an optimal balance between sustainable funded status volatility and minimization of costs over the long run.
- Asset allocation will always vary by the unique circumstances of the Plan.
 - No “one-size-fits-all” solution exists.



Asset Allocation and Liability Process

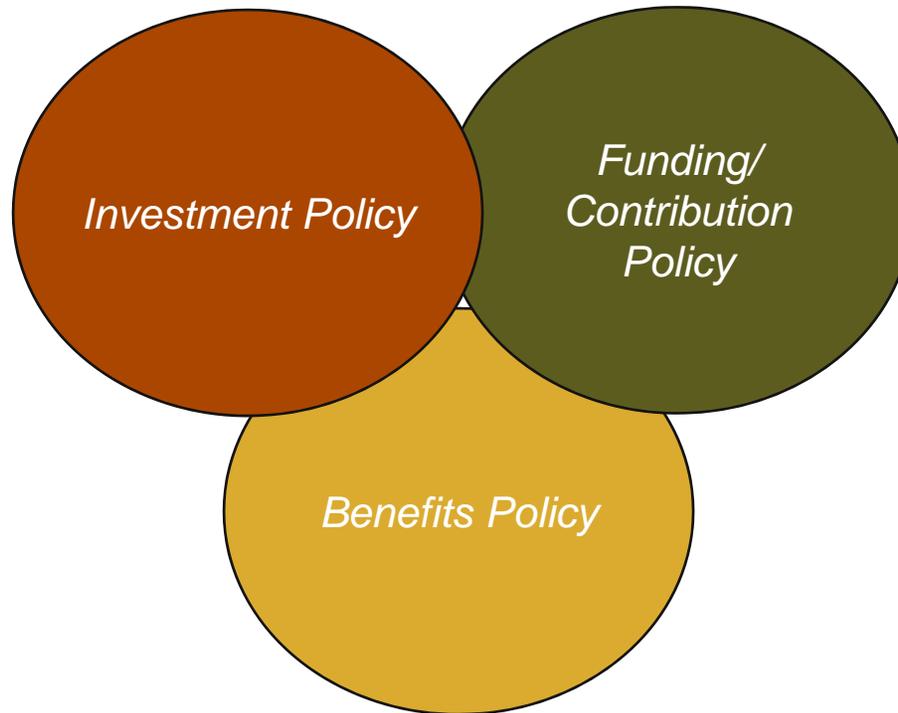
What is Asset-Liability?

- A technique of managing assets and liabilities, so that an adequate return may be earned.
- Understand the nature of the pension plan:
 - Actuarial assumptions and actuarial valuation process
 - Analysis of the current and projected future state of the Plan
 - *funding requirements, funded status, and contributions*
 - Major risk factors:
 - *market risk, inflation risk, interest rate risk, currency risk, demographic risk*
 - Investment goal or objective to fully fund the obligations over the long-term
 - Risk tolerance, including the need to take risk in order to achieve the objective.
- Determine the optimal investment (asset allocation) strategy relative to the liabilities:
 - The expected return on assets should be sufficient to support the desired level of funding of the liabilities (i.e. discount rate = 7.25%). This return assumption is typically set to fund the Normal Cost plus any unfunded liability over an amortization period. Holding contributions and benefit policy constant, for a plan to materially improve its funded status, it must achieve a return in excess of the expected return.
 - Actuarial assumptions are set over a long time horizon (working life of a participant, typically 20 years +), whereas capital market expectations are 10 years.

Nature of the Pension Plan

Evaluating the interaction of the 3 key policies that govern the pension plan with the goal of establishing the best investment strategy

- How will the assets supporting the benefits be invested?
- What risk/return objectives?
- How to manage cash flows?

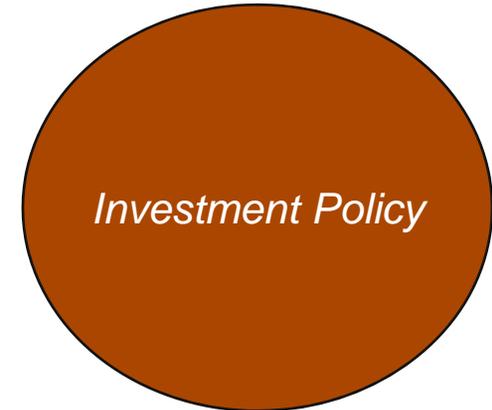
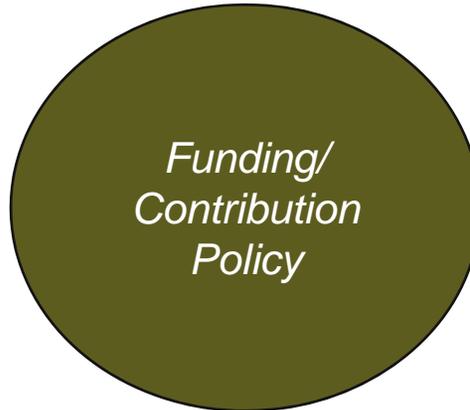
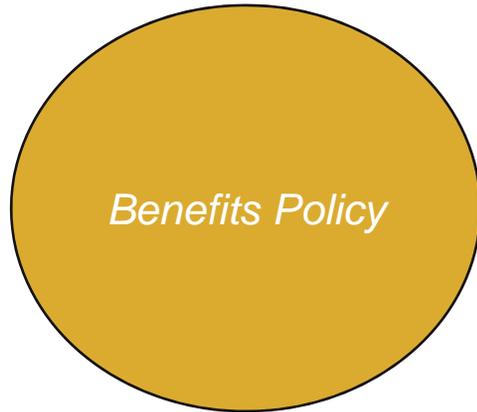


- How will the benefits be paid for (funded)?
- How will deficits be paid for?
- Amount and timing of contributions?
- What actuarial assumptions?

- What type/kind of benefits?
- What level of benefit?
- When and to whom are they payable?

Nature of the Pension Plan

- Equations of Balance



Benefit Payments = Contributions

Actuarial Liability = Unfunded/Surplus

+ Investment Returns

+ Assets

- Asset allocation is the primary determinant of investment return and asset volatility.
- Through the equations of balance, plan liabilities play a role in setting the investment strategy.

**Review Optimal
Asset Allocation
Strategy**

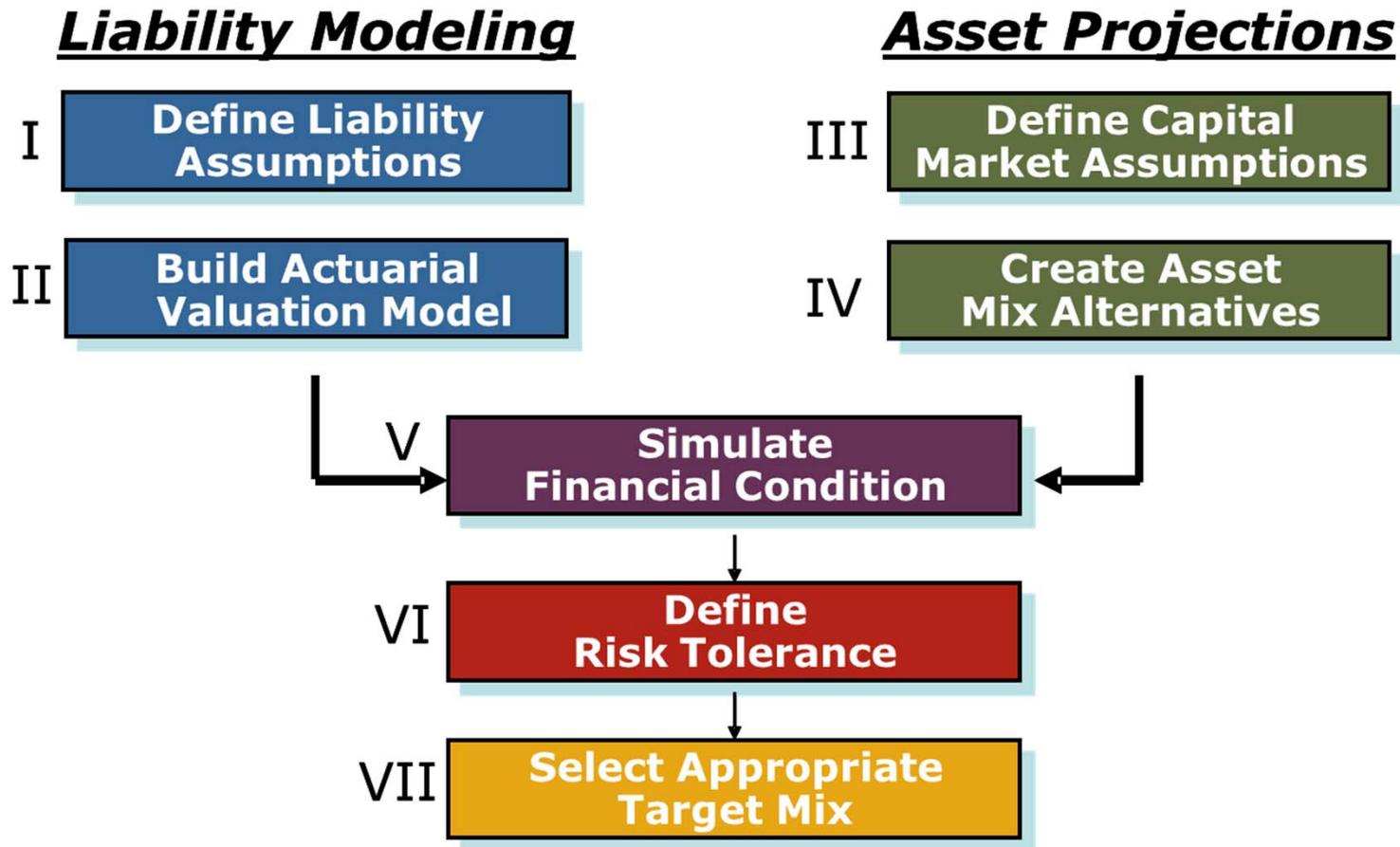
Key Components of an Optimal Investment Strategy

- In order to set the optimal investment strategy, the asset-liability study should consider these key components:
 1. Investment Goals (Objectives)
 2. Time Horizon
 3. Capital Market Expectations and portfolio optimization
 4. Peer Comparisons
 5. Cash flow and liquidity considerations
 6. Liability Characteristics
 7. Risk Tolerance
- Asset allocation is a **long-term, strategic process**
 - Analysis is not meant to be a reaction to short-term market fluctuations

Why Conduct an Asset-Liability Study?

- The cornerstone of a prudent process is the careful re-examination of an investor's long-term strategic plan.
- Explicitly acknowledge change and uncertainty in the capital markets.
- Incorporate the annual actuarial valuation process.
- Establish reasonable rate-of-return and risk expectations.
- Incorporate changes to the pension plan (e.g. changes in the benefit policy).
- Reflect expected contribution policy in coming years.
- Project and evaluate impact on assets, liabilities and funded status.
- Confirm an asset allocation policy to meet return and risk objectives.

Callan's Asset-Liability Process



- Meet fiduciary requirements to demonstrate a process when selecting /changing an investment strategy.



Asset Modeling

How are Capital Market Projections Constructed?

- Annual Process to update 10-Year Projections
 - Evaluate current environment and economic outlook
 - Examine relations between economy and historical asset class performance
 - Create 10-year risk, return, and correlation projections
 - Test projections for reasonable results
- Cover Most Broad Asset Classes and Inflation
 - Broad Domestic Equity
 - *Large Cap*
 - *Small Cap*
 - International Equity
 - *Developed Markets*
 - *Emerging Markets*
 - Domestic Fixed Income
 - International Fixed Income
 - Real Estate
 - Alternative Investments
 - Cash
 - Inflation
- Incorporates both advance quantitative modeling as well as qualitative feedback and expertise of Callan consulting professionals.

2014 Capital Market Expectations – Return and Risk

Summary of Callan’s Long-Term Capital Market Projections (2014 – 2023)

Asset Class	Index	PROJECTED RETURN		PROJECTED RISK	
		1-Year Arithmetic	10-Year Geometric*	Standard Deviation	Projected Yield
Equities					
Broad Domestic Equity	Russell 3000	9.15%	7.60%	19.00%	2.00%
Large Cap	S&P 500	8.90%	7.50%	18.30%	2.20%
Small/Mid Cap	Russell 2500	10.15%	7.85%	22.95%	1.40%
International Equity	MSCI World ex USA	9.25%	7.50%	20.20%	3.00%
Emerging Markets Equity	MSCI Emerging Markets	11.45%	7.90%	27.95%	2.50%
Global ex-US Equity	MSCI ACWI ex USA	9.80%	7.80%	21.45%	2.90%
Fixed Income					
Defensive	Barclays Govt 1-3	2.75%	2.75%	2.25%	2.80%
Domestic Fixed	Barclays Aggregate	3.05%	3.00%	3.75%	4.00%
Long Duration	Barclays Long G/C	4.70%	4.10%	11.40%	5.50%
TIPS	Barclays TIPS	3.10%	3.00%	5.30%	4.00%
High Yield	Barclays High Yield	5.60%	5.05%	11.45%	7.00%
Non-US Fixed	Citi Non-USD World Govt	3.15%	2.75%	9.40%	3.80%
Emerging Market Debt	JMP EMBI Global Diversifec	5.40%	4.90%	10.65%	6.40%
Other					
Real Estate	Callan Real Estate	7.35%	6.15%	16.50%	5.00%
Infrastructure	S&P Global Infrastructure	8.90%	7.35%	19.00%	3.00%
Private Equity	TR Post Venture Cap	13.55%	8.50%	33.05%	0.00%
Hedge Funds	Callan Hedge FoF	5.40%	5.10%	8.85%	0.00%
Commodities	DJ-UBS Commodity	4.65%	3.05%	18.25%	2.00%
Cash Equivalents	90-Day T-Bill	2.00%	2.00%	0.90%	2.00%
Inflation	CPI-U	2.25%	2.25%	1.50%	

Geometric returns are derived from arithmetic returns and associated risk (standard deviation).

Source: Callan Associates

2014 Capital Market Expectations – Correlation Coefficient Matrix

Key to Constructing Efficient Portfolios

	Broad	Lg Cap	Sm/Mid	Int'l Eq	Emerge	GlobxUS	Defensive	Dom Fix	Long D	TIPS	Hi Yield	NUS Fix	EMD	Real Est	Pvt Eq	Hedge Fd	Comm	Cash Eq	Inflation	
Broad Domestic Equity	1.000																			
Large Cap	0.997	1.000																		
Small/Mid Cap	0.965	0.940	1.000																	
International Equity	0.852	0.850	0.820	1.000																
Emerging Markets Equity	0.861	0.855	0.840	0.860	1.000															
Global ex-US Equity	0.882	0.879	0.853	0.986	0.933	1.000														
Defensive	-0.391	-0.385	-0.390	-0.370	-0.380	-0.385	1.000													
Domestic Fixed	-0.107	-0.100	-0.125	-0.100	-0.145	-0.118	0.690	1.000												
Long Duration	0.096	0.099	0.082	0.108	0.069	0.099	0.530	0.909	1.000											
TIPS	-0.050	-0.045	-0.065	-0.045	-0.060	-0.051	0.440	0.580	0.490	1.000										
High Yield	0.610	0.610	0.580	0.580	0.570	0.595	-0.100	0.025	0.218	0.030	1.000									
Non-US Fixed	-0.069	-0.065	-0.080	0.000	-0.060	-0.020	0.380	0.400	0.470	0.300	0.050	1.000								
EMD	0.589	0.590	0.560	0.560	0.600	0.591	-0.120	0.050	0.292	0.150	0.710	0.010	1.000							
Real Estate	0.735	0.730	0.715	0.650	0.645	0.669	-0.120	-0.020	0.214	0.005	0.550	0.020	0.510	1.000						
Private Equity	0.943	0.940	0.910	0.900	0.895	0.927	-0.410	-0.180	0.081	-0.090	0.620	-0.050	0.570	0.715	1.000					
Hedge Funds	0.752	0.750	0.725	0.690	0.710	0.718	-0.130	0.120	0.245	0.080	0.530	0.020	0.530	0.575	0.720	1.000				
Commodities	0.163	0.160	0.165	0.160	0.165	0.167	-0.280	-0.100	0.044	0.100	0.100	-0.080	0.190	0.180	0.160	0.170	1.000			
Cash Equivalents	-0.042	-0.030	-0.080	-0.010	-0.100	-0.040	0.350	0.100	0.037	0.070	-0.110	0.000	-0.070	-0.060	0.000	-0.070	0.070	1.000		
Inflation	-0.048	-0.060	-0.010	-0.110	0.030	-0.068	-0.360	-0.320	-0.350	0.160	0.070	-0.220	0.000	0.170	-0.060	0.210	0.470	0.150	1.000	

- Relationships between asset classes is as important as standard deviation.
- To determine portfolio mixes, Callan employs mean-variance optimization.
- Return, standard deviation and correlation determine the composition of efficient asset mixes.

2014 Capital Market Expectations – Definitions

- Arithmetic mean return: is the single-period estimate of return, and is inferred as the mean of a distribution of single-period returns (and therefore used in a mean-variance optimization tool). Put simply, it is the simple average of a sequence of returns.
- Geometric return: compound return, calculated by linking multiple periods and their arithmetic returns. The compound return is what investors actually experience over time, and reflects the impact of volatility on the investor's results. If there is no volatility, then arithmetic = geometric. If there is volatility, then the geometric return is eroded over time relative to the arithmetic average.
- The classic example: assume two periods, one where the investor gets a 50% gain, followed by one where the investor suffers a 50% loss. The arithmetic average return is zero, but the compound return is negative 25% ($1.5 * 0.5 = 0.75$).
- Risk is defined as the variability of return, and uses standard deviation to articulate the measure of risk. Higher standard deviation = greater risk; defines range of probable returns.
 - +/- one standard deviation defines 2/3 of expected outcomes; +/- two standard deviations captures 95% of outcomes.
- Example: equity geometric return = 7.6%, standard deviation = 19%.
 - Range for one standard deviation: -11.4% to 26.7%

Asset Mixes

Current Policy Target and Alternative Asset Mixes

Asset Class	Tucson Target	Min	Max	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
Broad US Equity	46%	0%	100%	23%	26%	30%	34%	38%
Broad International Equity	15%	0%	100%	16%	19%	22%	25%	28%
Broad US Fixed Income	26%	0%	100%	51%	43%	35%	27%	19%
Real Estate	8%	0%	100%	5%	7%	8%	9%	10%
Infrastructure	5%	5%	5%	5%	5%	5%	5%	5%
Totals	100%			100%	100%	100%	100%	100%
10 Yr. Geometric Mean Return	6.80%			5.73%	6.11%	6.47%	6.80%	7.10%
Projected Real Return	4.55%			3.48%	3.86%	4.22%	4.55%	4.85%
Projected Standard Deviation	13.50%			8.96%	10.43%	11.93%	13.44%	14.97%
% equity	61%			39%	45%	52%	59%	66%
% fixed income	26%			51%	43%	35%	27%	19%
% real assets	13%			10%	12%	13%	14%	15%

- Policy objective: 4.25% real return

- 10-year expected return for the policy target is 6.8%.

- Callan capital market expectations yield a lower median return than the 7.25% return required to avoid future investment losses.
- Callan expectations do not include any assumption for active management premium. In addition, Callan's inflation assumption is 2.25%, resulting in a real return expectation for the current Target of 4.55%, which is greater than the implied real return in the policy target (7.25% nominal return and 3% inflation assumption used in the actuarial valuation).

Source: Callan Associates

Current Asset Classes

- Current policy target is broadly diversified across global equity, fixed income, real estate and infrastructure investments.
- Plan has 15% target to non-US equity, or 24% of total public equity. Optimization suggests non-US equity of 40-45% of public equity exposure, closer to a global equity weighting based on current market capitalization (approximately 50% non-US equity).
- Real estate and infrastructure constitute exposures to real assets, currently at 13% of the total portfolio, and very much in line with the exposures suggested by the optimization model. The plan could consider diversifying the real asset portfolio to include other inflation sensitive investments, such as TIPS, commodities, natural resource and materials equity, MLPs, even agriculture and timber.
- Mix 5 shows an allocation that draws fixed income down below 20% in pursuit of return, yet the expected return for Mix 5 is still below the 7.25% return assumption used in the plan valuation. Callan would be reluctant to recommend or support an asset allocation with fixed income exposure much below that of Mix 5. We believe a total return plan for a public fund like TSRS should have a meaningful exposure to fixed income to provide diversification and downside risk protection in potential bear equity markets.

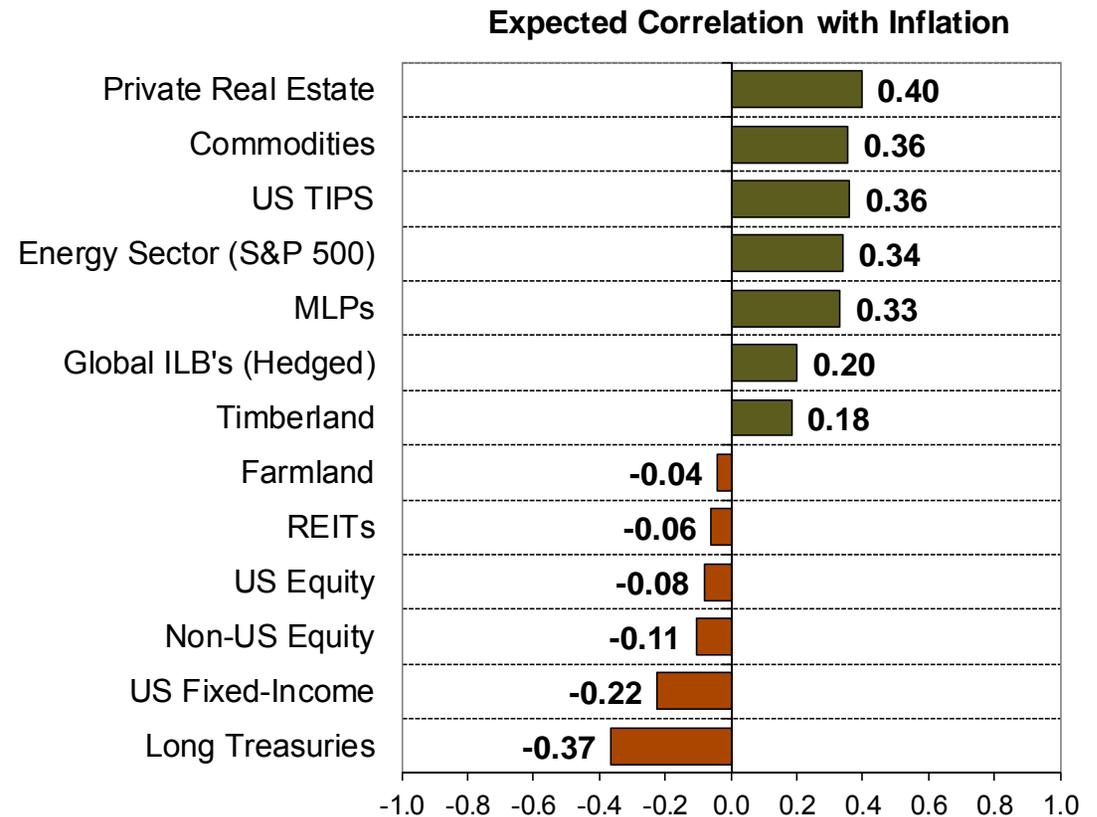
Current Policy Target Allocation

Review and Observations

- Using Callan's 2014 capital market assumptions, the expected return for the policy target is 6.8% over the next 10 years, below the 7.5% adopted in the 2013 valuation, and below the 7.25% recommended in the experience study. However, the Plan still has a reasonable chance of achieving this result (45% probability for the current target to reach 7.25%). Three important points should be considered:
 - Callan's return expectations are for a 5-10 year outlook; the actuary sets expectations for a 30-year horizon. Reversion to long-run average returns will yield higher returns than Callan's 5-10 year outlook.
 - Callan's shorter-term inflation assumption is 2.25%, implying a real return (net of inflation) of 4.55%. The actuary used a long-term inflation assumption of 3.0%, suggesting a real return of 4.25%.
 - Callan's expectations reflect passive exposure to broad, liquid markets, with no assumption for potential value-added from active management.
- While return expectations are lower for the next five- to ten-year horizon, we do not believe the risk/return posture of the Plan should be radically changed. TSRS will need to retain a strong orientation toward risk assets (equity) in pursuit of return to achieve its funding goals.
- Whether the plan should pursue more or less exposure to risk assets than the current policy target mix should not be unduly influenced by subdued expectations for the shorter-term 5-10 year horizon. We do not believe investors are likely to be compensated for greater risk taking in the shorter term.
- We believe the Plan could consider private equity as a potential source of higher return, but it comes at the cost of greater illiquidity. The time horizon for private equity is very long, 10 to 15 years. Taking on additional illiquidity and the long time horizon may be more appropriate once the future of the Plan is settled politically. Substantial board education would be required.

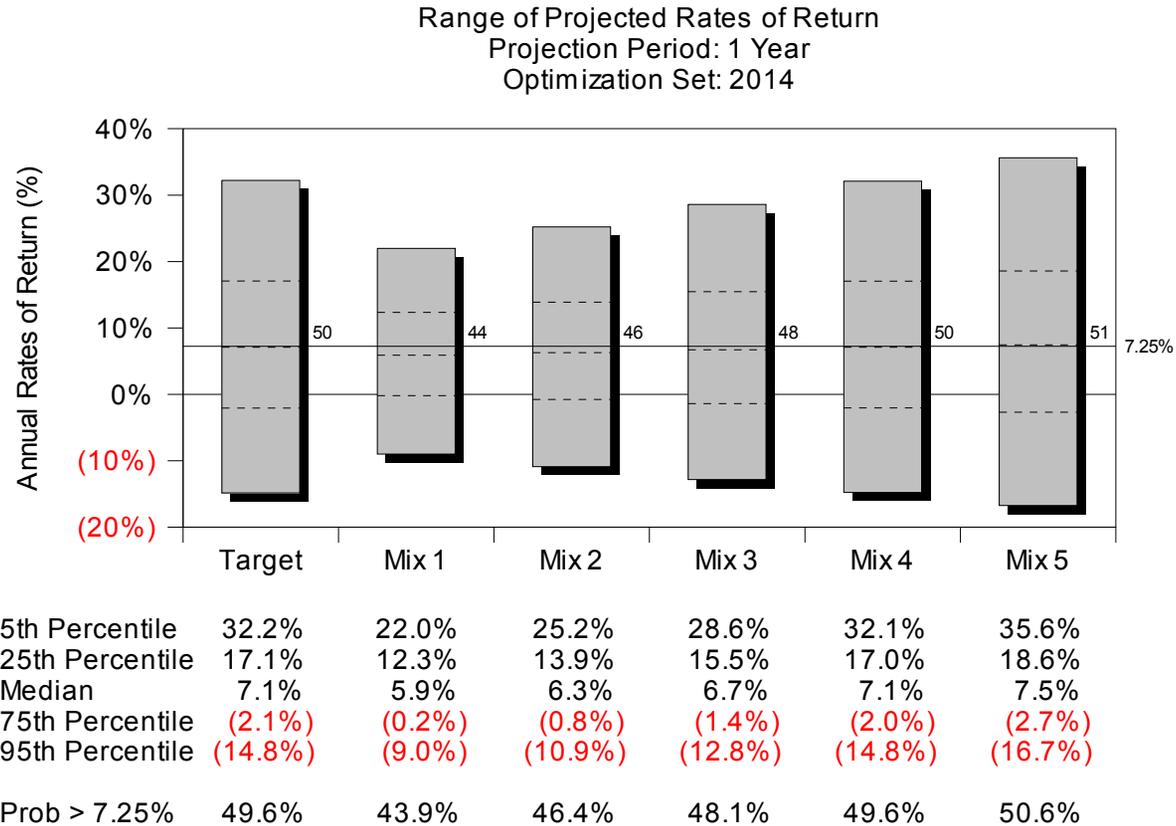
Expected Correlations with Inflation (CPI)

- Most real assets have a positive correlation with inflation, although far from perfect.
- Nominal bonds and equities are a poor hedge against inflation over the short-intermediate time horizon. (Over the long run, higher inflation will translate into higher returns).
- MLPs, energy equities, TIPS and commodities are expected to have correlation with CPI in the .35 range.



2014 Capital Market Expectations

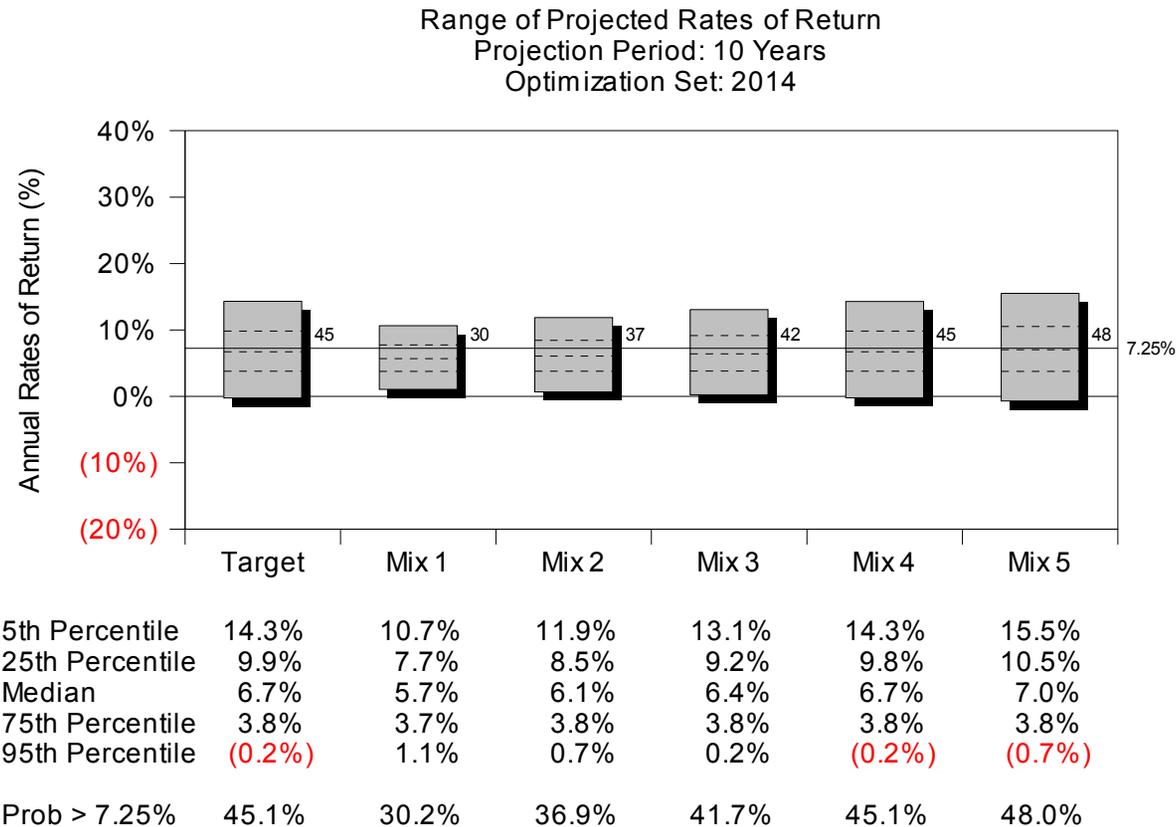
1-Year Range of Projected Returns



Source: Callan Associates

2014 Capital Market Expectations

10-Year Range of Projected Returns



- **Current Target falls short of the 7.25% policy return in the median case, but still stands a reasonable chance (45%) of attaining it over 10 years.**

Source: Callan Associates

Role of Asset Classes/Strategies

- Capital Accumulation
 - U.S. equity
 - Non-U.S. equity
 - Emerging markets
 - Private equity
 - High yield
 - Public/private real estate
- Diversification/Expand Opportunity Set
 - TIPS
 - High yield
 - Non-U.S. equity
 - Emerging markets
 - Global
 - Non-U.S. fixed income
 - Commodities
 - Private equity
 - Private real estate
 - Hedge funds
 - Infrastructure
 - Timber
- Lower Volatility
 - Stable value
 - Short duration fixed income
 - Hedge funds
- Flight to Quality
 - Treasury bonds
 - Cash equivalents
- Alpha Generation
 - Small/Mid Cap U.S. equity
 - Non-U.S. equity
 - Emerging markets
 - Private equity
 - Private real estate
 - Hedge funds
- Inflation hedge
 - TIPS
 - REITs
 - Private real estate
 - Infrastructure
 - Commodities
 - Timber
 - Equity
 - Other real assets

Colored strategies = illiquid investments

Asset Allocation Viewed through Another Lens

Evaluate Economic Growth and Inflation Scenarios

Economic Growth

Inflation	Low (Falling) Growth, High (Rising) Inflation Inflation Linked Bonds (TIPS) Commodities Infrastructure	High Growth, High Inflation Real Assets (e.g., Real Estate, Timberland, Farmland, Energy)
	Low Growth, Low Inflation (Deflation) Cash Government Bonds	High Growth, Low Inflation Corporate Debt Equity

- Investors seek economic diversification to a range of scenarios like inflation, deflation, stagflation and growth given the uncertainty.
- Allocations are based on key return drivers like inflation and growth:
 - There are other factors influencing returns, like leverage and liquidity.



Liability Modeling

Key Components

Liability Characteristics

- Plan document defines the type and level of benefits:
 - Final average pay benefits are sensitive to future growth in salaries
 - Benefits may increase in retirement to protect against inflation
- Actuarial valuation determines the liabilities and indicates sensitivities.
- Demographic assumptions:
 - Mortality / Longevity
 - Termination
 - Death
 - Disability
 - Largest risk is that plan participants live longer than you expected.
- Economic assumptions:
 - Discount rate: serves as your targeted return, inflation + real return
 - Salary inflation: inflation + productivity + individual merit
 - Cost of Living adjustment: adjusts with inflation, or is fixed

Build Integrated Asset/Liability Model

- Incorporate most recent actuarial valuation and experience study to build an integrated model of the Plan:
 - Match current valuation
 - Project liabilities 10 and 20 years out
 - Integrate with assets and project financial condition of the Plan
 - *Expected case assumptions built into current actuarial valuation*
 - *Recommended changes from the experience study incorporated into the model, the projections and the simulations*
 - Simulate range of potential outcomes to evaluate tolerance for risk

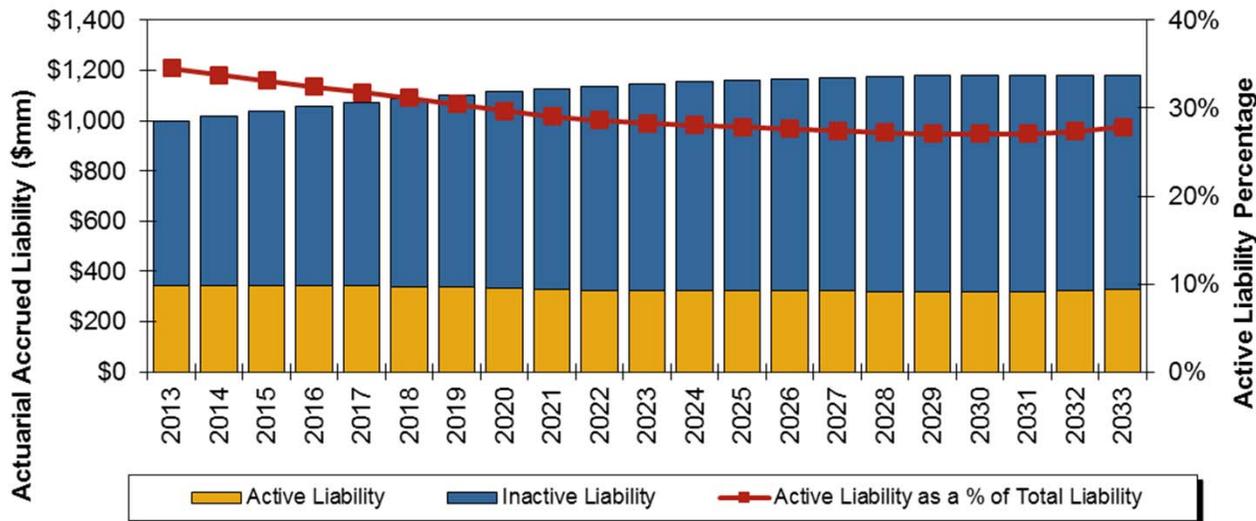
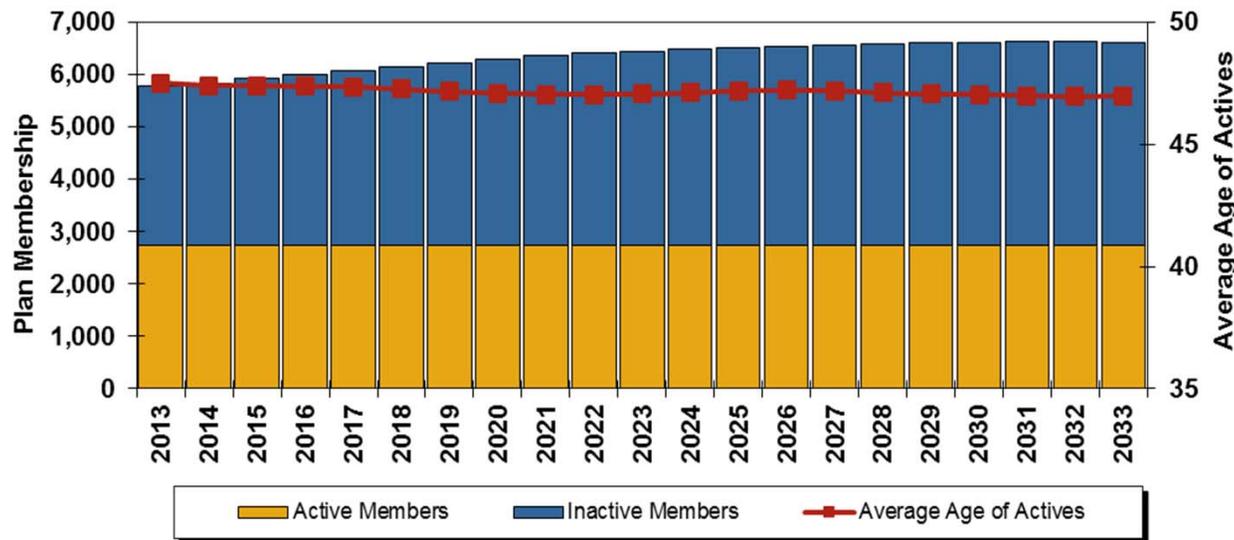
Liability Modeling

6/30/2013 Funded Status	
Actuarial Accrued Liability (AL)	\$997 mm
Market Value of Assets (MVA)	\$641 mm
Actuarial Value of Assets (AVA)	\$600 mm
Unfunded Actuarial Accrued Liability (AL - AVA)	\$348 mm
Actuarial Funded Ratio (AVA/AL)	60.2%
Market Funded Ratio (MVA/AL)	64.3%

Key Actuarial Assumption	Assumption
Investment Return Rate	7.25% per year
Salary Increase Rates	3.25%
Price Inflation	3.0% per year

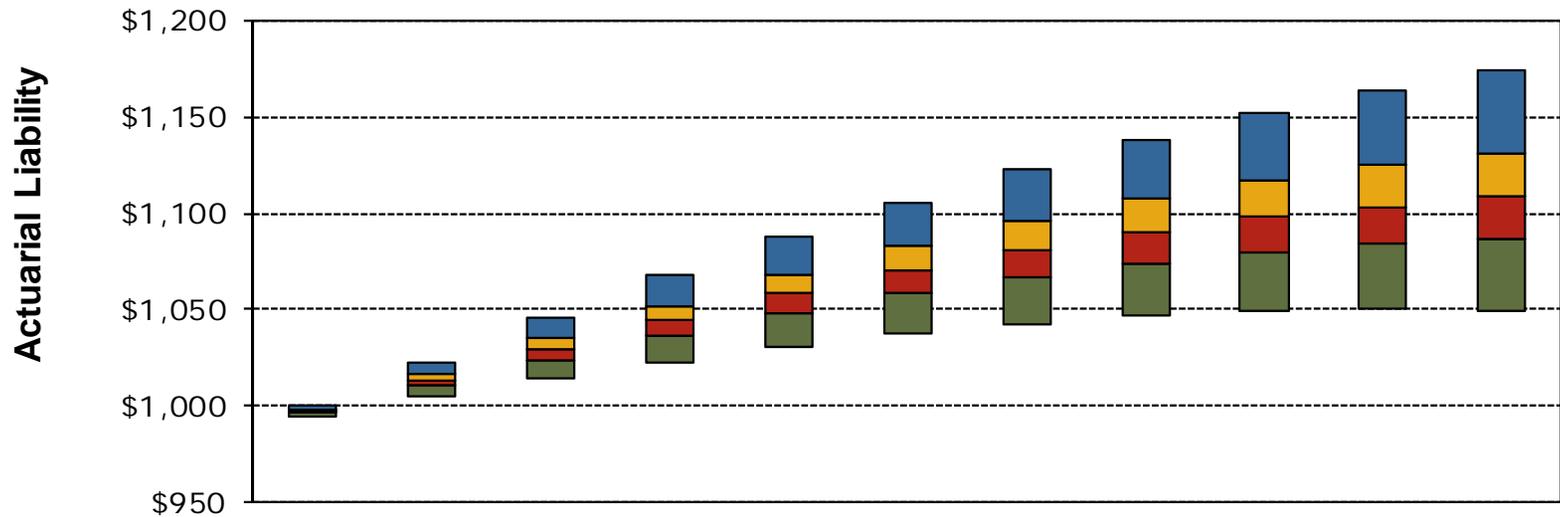
- For purposes of asset-liability modeling, Callan builds an actuarial liability model which initially matches actuarial liabilities and normal cost within 5%.
 - Results are then scaled to match the actuarial report exactly.
 - Liability model is based on the June 30, 2013 actuarial valuation report for TSRS.
 - June 30, 2013 actuarial report reflects new funding policy and changed the amortization period for the unfunded liability, increased from 15 to 20 years (open). Employee contributions for select Tier I and Tier II members are now set to 50% of normal cost for each class.
- Recommended assumption changes presented in the January 2014 experience study are incorporated in the projections and the analysis.

Baseline Liability Projection



- Assumes 0% workforce growth.
 - Future new hires replace future plan exits via retirement, death, disability and withdrawal.
 - New entrant demographics are based on recent hires.
- Inactive members – retirees and term-vesteds – are expected to increase significantly over the next 10 years.
- Average age of active employees is decreasing slightly. Population is getting younger as older employees retire.
- Inactive liability is increasing faster than active liability.
- Active liability, as a percentage of total liability, falls from 34% to 28% over the next 10 years.

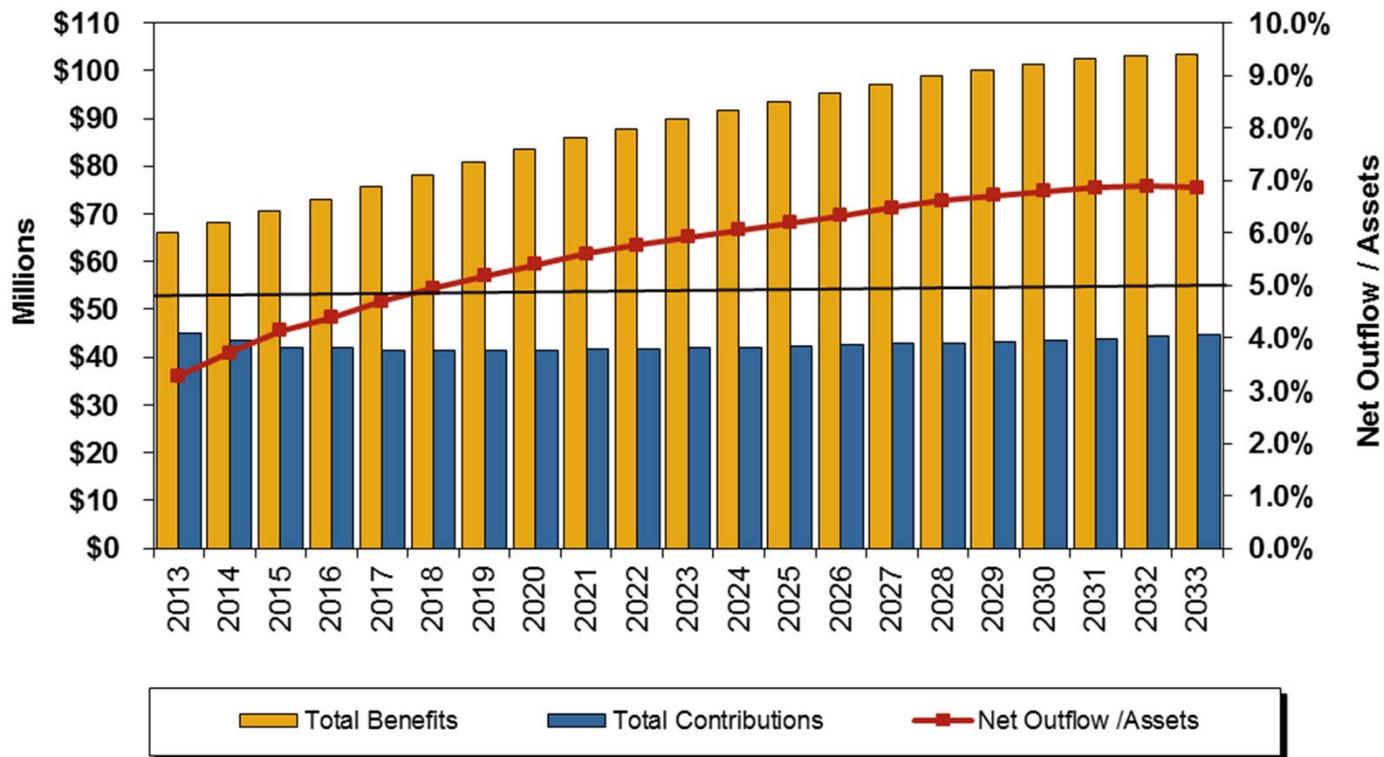
Simulated Actuarial Liability Projection



Percentile	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
97.5th	\$997	\$1,022	\$1,046	\$1,068	\$1,088	\$1,106	\$1,122	\$1,138	\$1,152	\$1,164	\$1,174
75th	997	1,016	1,035	1,052	1,068	1,083	1,097	1,108	1,117	1,125	1,131
50th	997	1,014	1,030	1,044	1,059	1,070	1,081	1,090	1,098	1,103	1,108
25th	997	1,011	1,024	1,036	1,048	1,059	1,067	1,074	1,079	1,084	1,087
2.5th	997	1,005	1,014	1,022	1,030	1,037	1,042	1,047	1,049	1,050	1,050
Range	0	17	32	46	57	68	80	91	102	114	124
Median Liability Growth		1.6%	1.6%	1.4%	1.4%	1.1%	1.0%	0.8%	0.7%	0.5%	0.5%

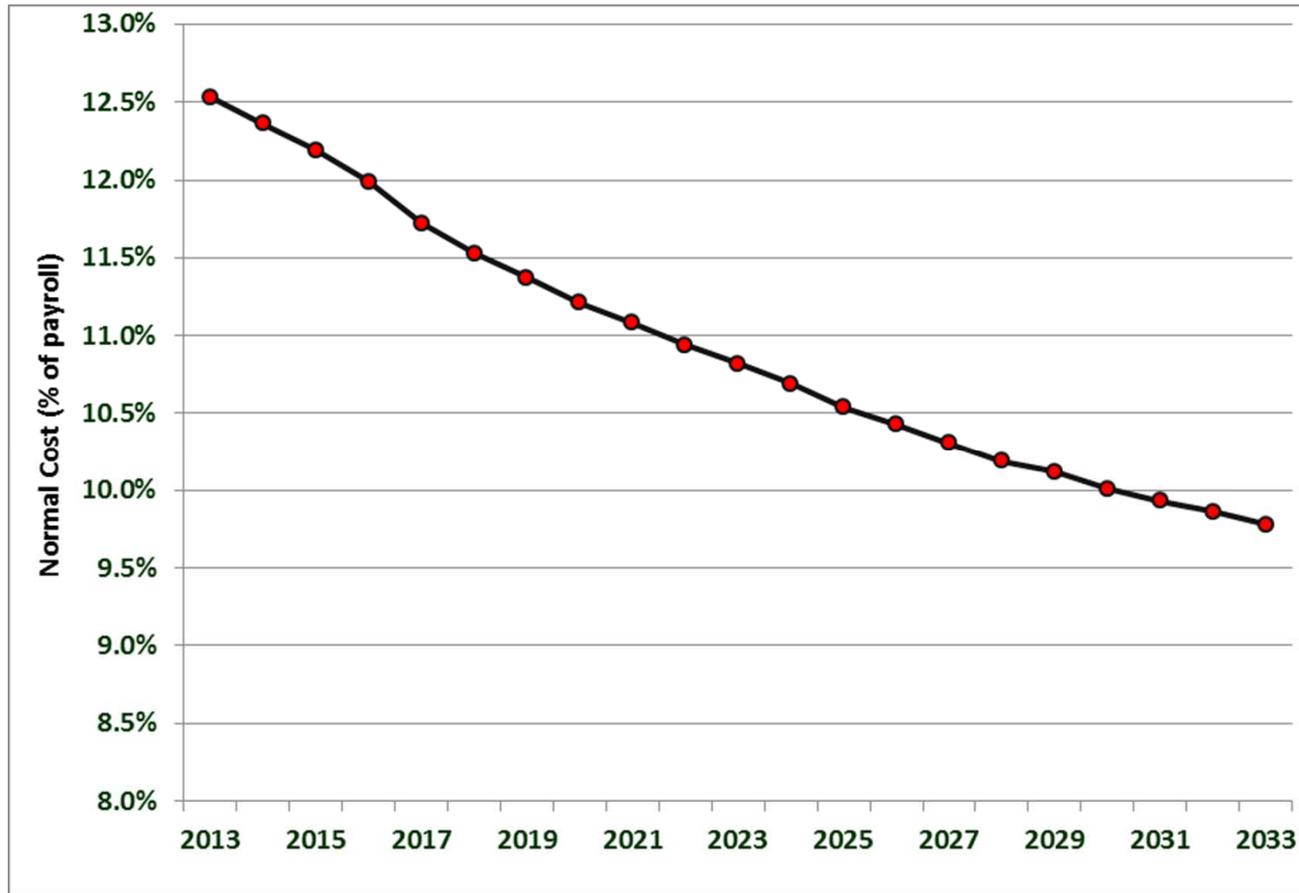
- Liabilities increase with interest cost (7.25%) and normal cost; they are reduced by benefit payments.
- Median liability growth (net of benefit payments) starts at 1.6% and falls to 0.5% over the ten year horizon.
 - Across the scenarios above, the 10-year annualized liability growth ranges from 1.6% to 0.5%.
 - Modest volatility stems from inflation uncertainty as it feeds through to future salary growth.

Plan Liquidity Needs



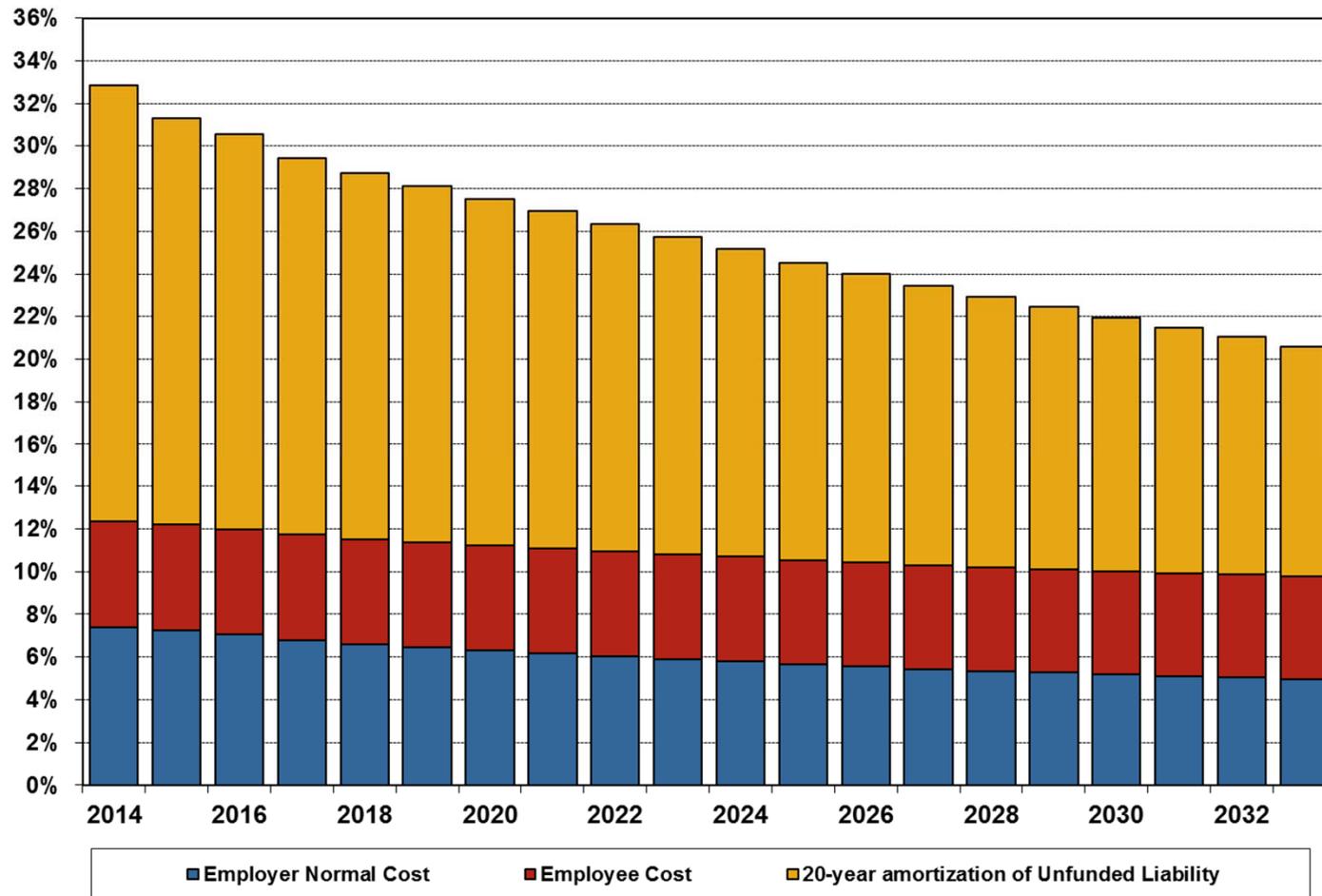
- Net Cash Outflow = Benefits – Contributions
 - Net Outflow < 5% of assets is manageable.
 - 5 -10% depends on amount of illiquid investments (currently 13%)
 - Net Outflow rises toward 7% of assets by 2023
- Based on 7.25% return/3.0% inflation and the current funding policy
- Negative cash flows are significant but currently manageable, but may become more challenging within the next 10-12 years. Liquidity needs don't preclude increasing illiquid investments at this time, but exposure to illiquid asset classes will need to be continually evaluated as the plan progresses.

Normal Cost

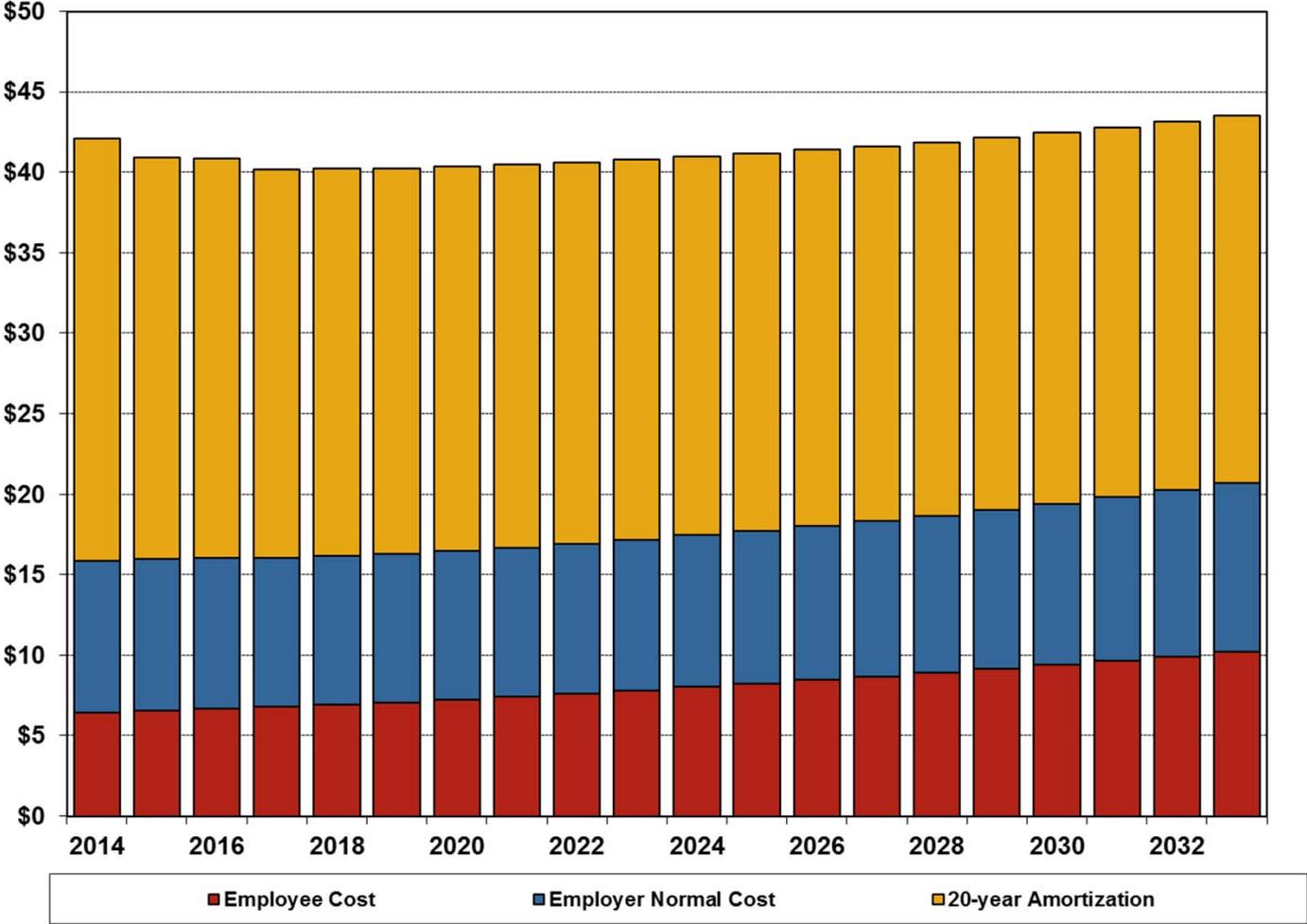


- Total Normal Cost (employer normal cost plus employee contribution rate) is expected to fall over the next 20 years as new hires are placed into Tier II, bringing the cost of the plan down
 - Changing demographics also is a factor, to some extent (average age and service are falling over the next 20 years).
 - Normal Cost represents the accrual of each year's additional benefit by participants. Open plans generate Normal Cost; frozen plans do not. Normal Cost does NOT include the amortization of any unfunded liability.

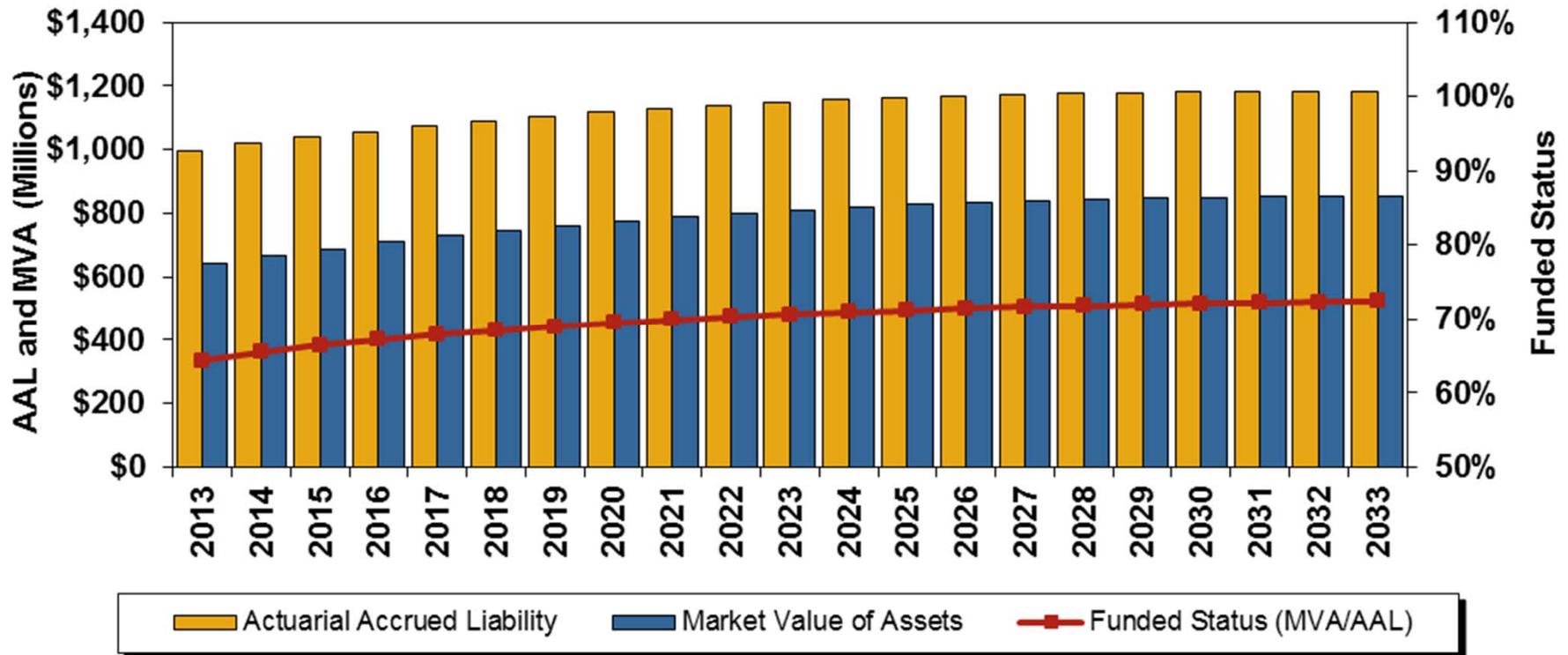
Components of Contribution – Rate



Components of Contribution – Level



Plan Funded Status



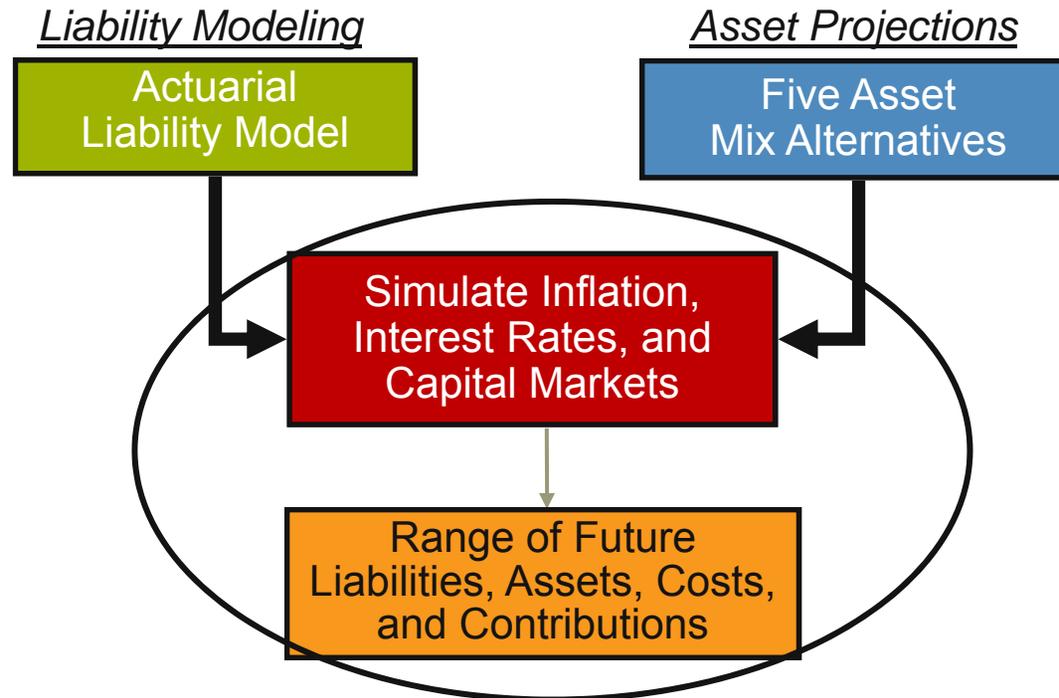
- Current funding policy (Normal cost + amortization of unfunded liability over open 20 year period) will result in modest improvement in funded status over next 20 years, from 64.3 to 72.4%.
- Assumes plan earns 7.25% return.
- Open 20-year amortization leads to only very gradual reduction in unfunded liability.



Simulate Financial Condition

Simulate Financial Condition

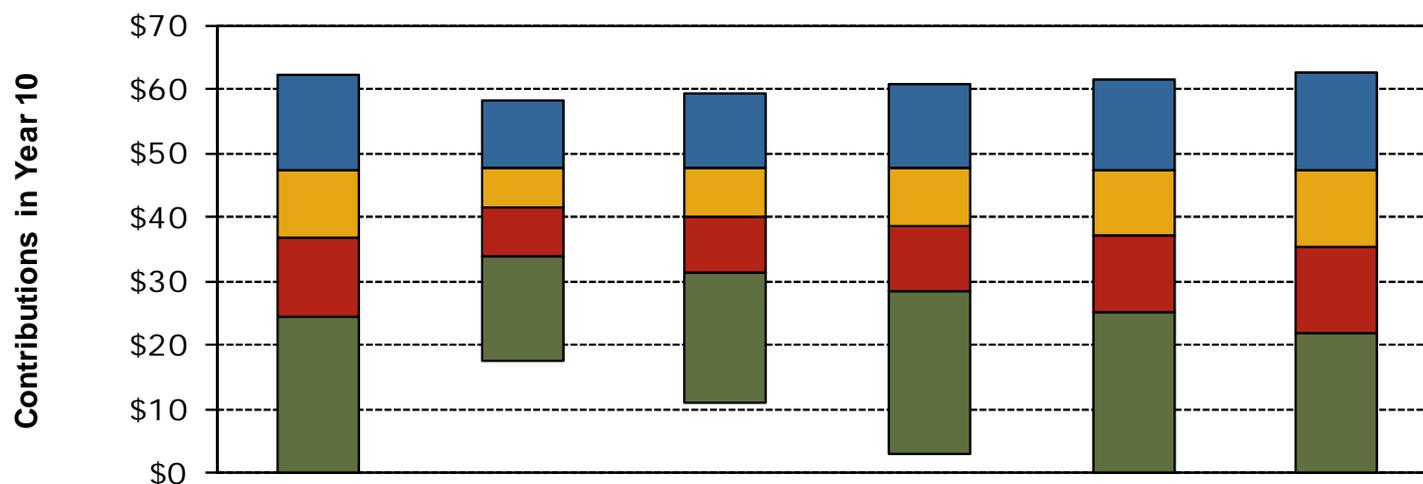
Risk Tolerance



- Simulation analysis will be used to assess risk tolerance.
- **What is simulation analysis (also called stochastic forecasting)?** The modeling of uncertainty associated with the capital markets.
- Simulate three (3) key variables: inflation rate, interest rate, asset class returns. 2000 simulations per year, per asset mix.
- Develop a range of outcomes and the likelihood of their occurrence (probability distribution)

Simulate Financial Condition

Contributions in Year 10

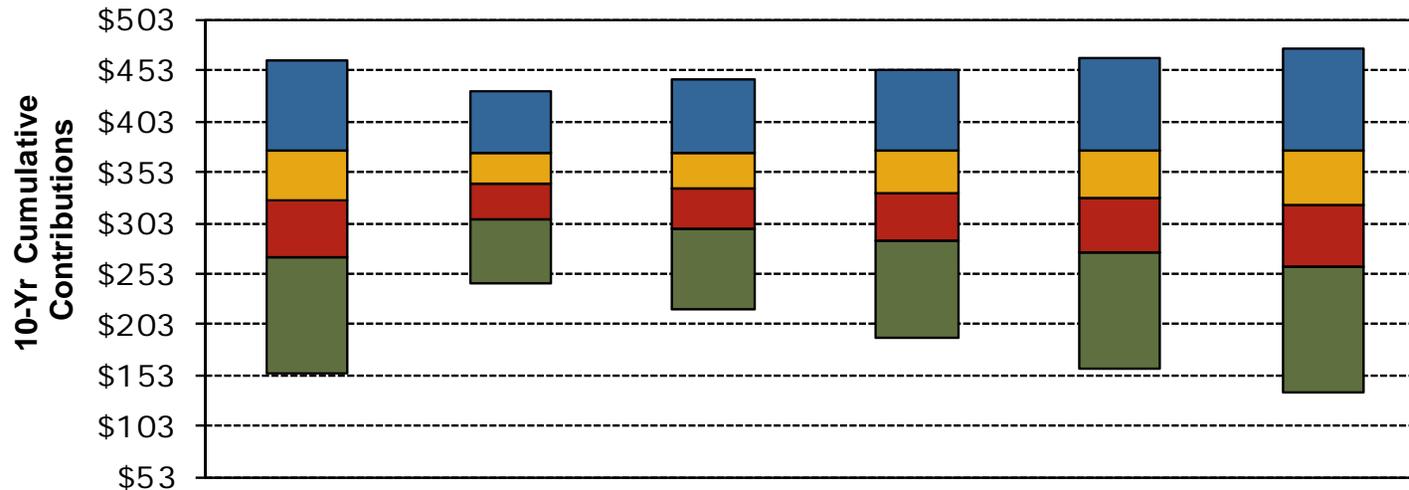


Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$62	\$58	\$59	\$61	\$62	\$63
75th	47	48	48	48	47	47
50th	37	41	40	39	37	35
25th	25	34	31	29	25	22
2.5th	0	18	11	3	0	0
Downside	25	17	19	22	24	27

- Funding policy = normal cost plus amortization of unfunded liability
- More aggressive mixes have lower expected contribution and greater probability of zero contribution in the best case, but higher contributions in the 97.5th percentile due to higher risk.

Simulate Financial Condition

Cumulative Contributions over 10 Years

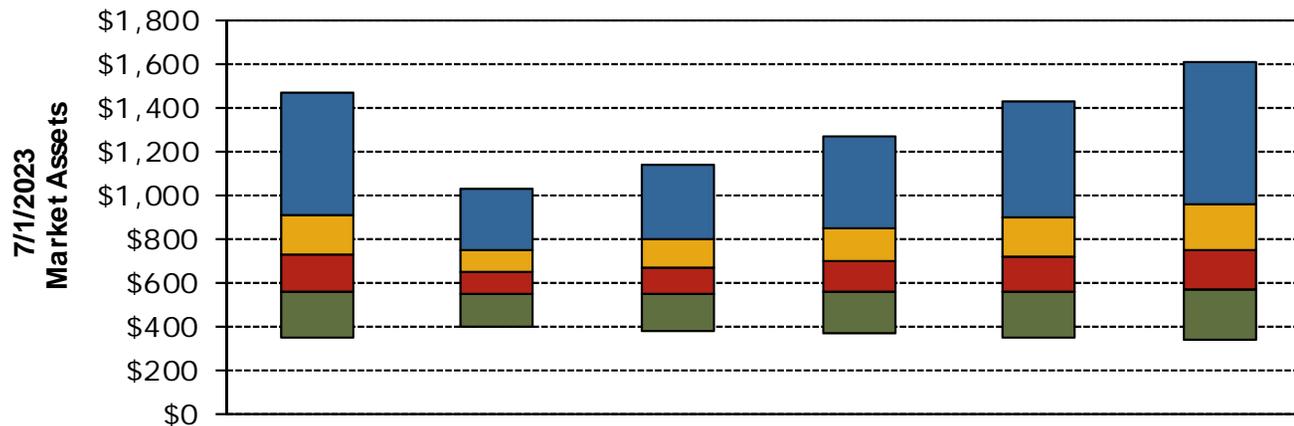


Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$464	\$432	\$443	\$454	\$464	\$474
75th	375	372	373	374	375	375
50th	325	342	338	332	327	321
25th	269	308	297	285	274	260
2.5th	156	243	218	189	160	137
Downside	139	91	106	122	138	153

- Funding policy = normal cost plus amortization of unfunded liability
- More aggressive mixes have lower expected cumulative contributions and better results in the best case, but higher contributions in the 97.5th percentile due to higher risk.

Simulate Financial Condition

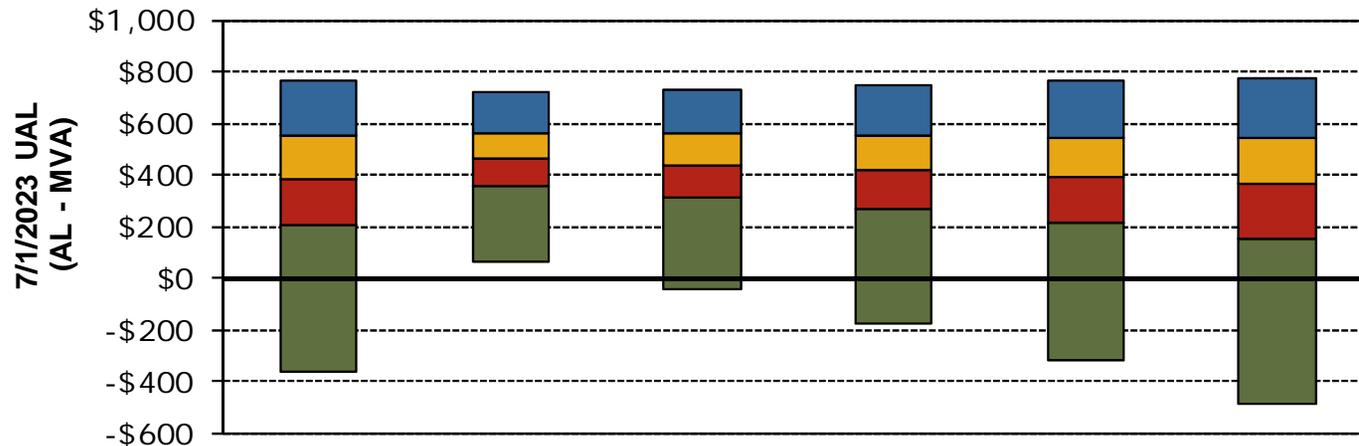
Market Value of Assets in Year 10



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	\$1,470	\$1,024	\$1,137	\$1,266	\$1,425	\$1,612
25th	910	751	796	849	901	957
50th	723	645	671	695	721	746
75th	561	548	552	557	561	565
97.5th	344	396	380	363	348	333
Expected Return	1,126	629	758	902	1,078	1,278
Downside	380	250	292	332	373	413

- More conservative mixes have lower asset values in the 50th percentile
 - Higher expected returns lead to higher asset values
 - Larger contributions for lower returning mixes can make up some of the difference
- More aggressive mixes generally have lower asset values in the 97.5th percentile
 - Greater volatility means larger losses in down investment markets
 - Larger contributions for poorer performing mixes can make up some of the difference

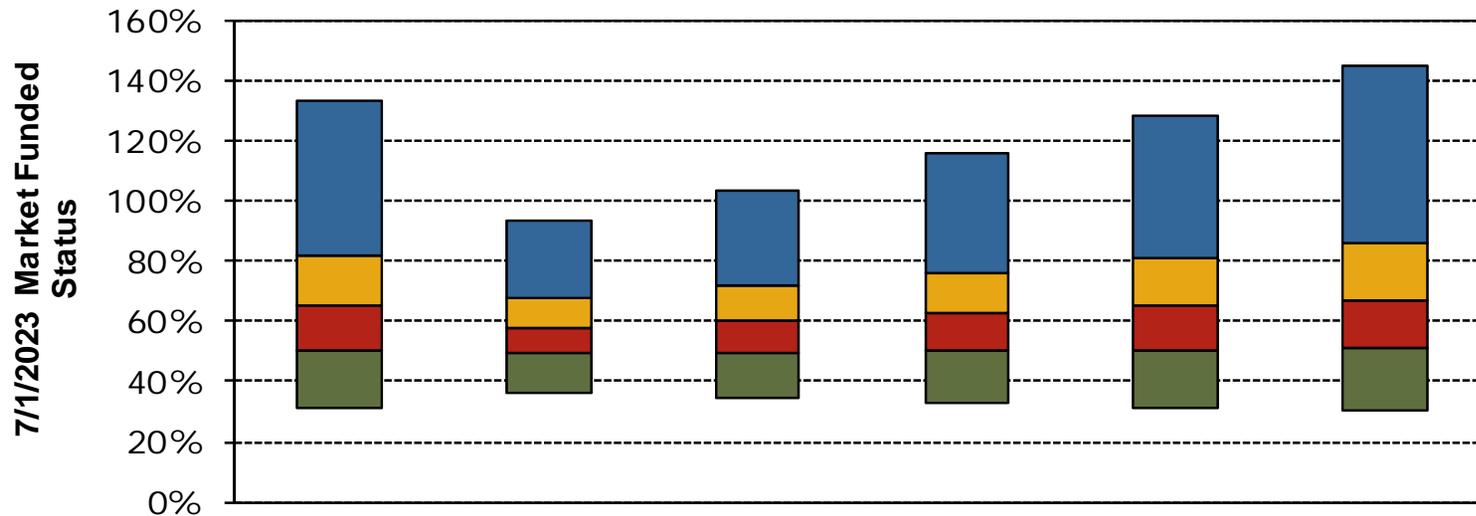
7/1/2023 Unfunded Liability



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$765	\$720	\$732	\$747	\$765	\$779
75th	550	564	558	553	548	544
50th	385	466	441	416	391	364
25th	203	359	316	266	212	153
2.5th	-363	69	-42	-173	-315	-481
Range (97.5-2.5)	1,129	651	774	920	1,079	1,260
Downside	380	254	291	331	374	415

- Unfunded Liability = Actuarial Accrued Liability – Market Assets
 - 7/1/2013 Unfunded Liability = \$385 mm for the current target mix
- More aggressive mixes are better funded in the 50th percentile
 - Higher expected investment returns result in higher asset values given the liabilities
- More aggressive mixes are more poorly funded in the 97.5th percentile
 - Asset losses due to greater volatility leads to more underfunding

7/1/2023 Market Funded Status



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	133%	94%	104%	116%	128%	145%
25th	82%	68%	72%	76%	81%	86%
50th	65%	58%	60%	63%	65%	67%
75th	51%	49%	50%	50%	50%	51%
97.5th	31%	36%	34%	33%	31%	30%
Expected Return	6.6%	6.0%	6.6%	7.0%	7.5%	8.0%

- Funded Status = Market Value of Assets / Accrued Liability
 - 7/1/2013 Market Funded Status = 65% for the policy target
- None of the mixes are projected to be fully funded in 10 years in the expected case.

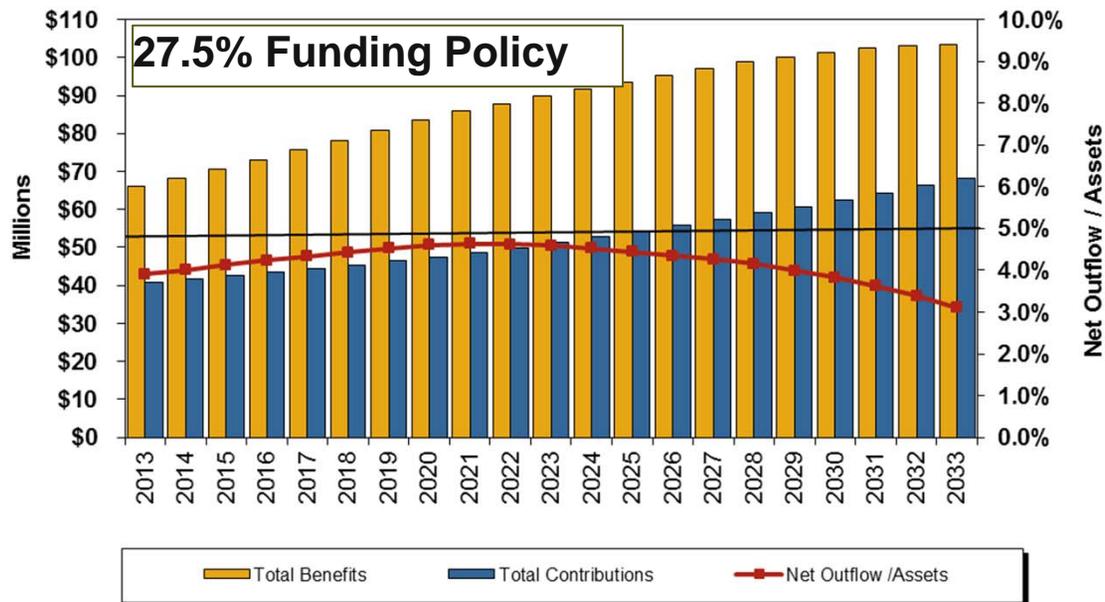
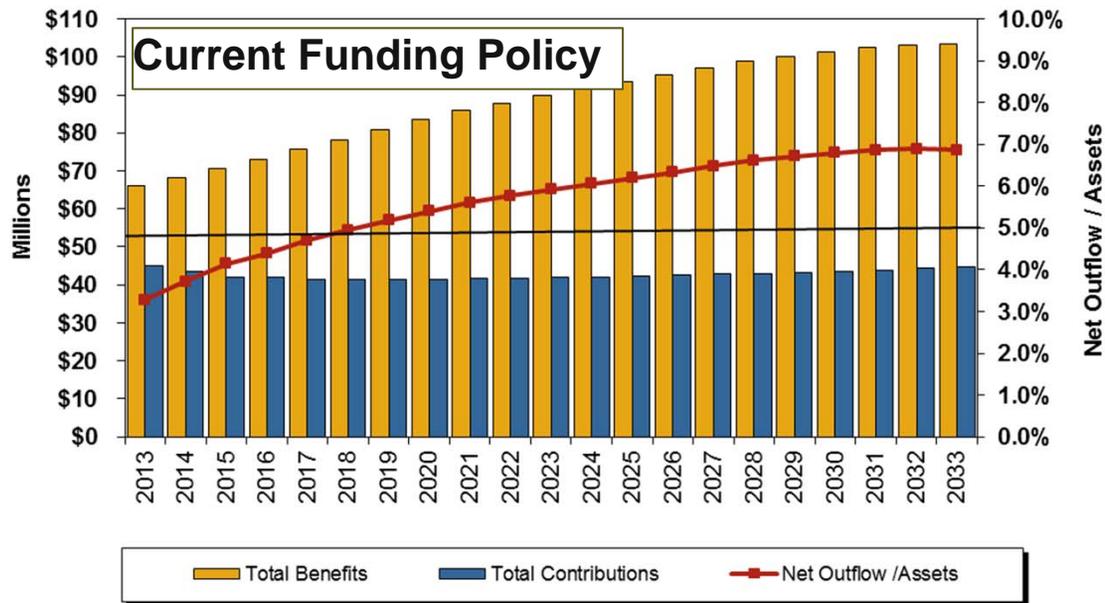


Alternative Funding Policy

Alternative Funding Policy

- The TSRS Board approved an alternative funding policy: constant 27.5% of payroll employer contribution for the next 20 years to help the plan reach 100% funding.
- Over the first 10 years of the forecast period, the 27.5% policy will result in comparable contributions and therefore funded status for TSRS; improvement in funded status is concentrated in the second 10-year period.
- Under Normal Cost + 20-year open amortization of unfunded liability, employer contributions drift down from current rate close to 30% of payroll to 16% by year 20; contributions are maintained at 27.5% of payroll over the entire 20 year period under alternative funding policy.
- Funded status improves to 100% by year 20, and liquidity needs subside from almost 5% at 10 years out to 3% by year 20.
- However, range of simulated funded status is wider under alternative policy, as contribution rates are fixed at 27.5%.
 - Only variability in contribution comes from potential variation in payroll, the impact of inflation.
 - Under Normal Cost + open amortization of unfunded, contribution rates would respond to adverse market results, dampening impact on funded status.
 - Under fixed 27.5% contribution rate, all market volatility is absorbed by fund asset values and resulting funded status.

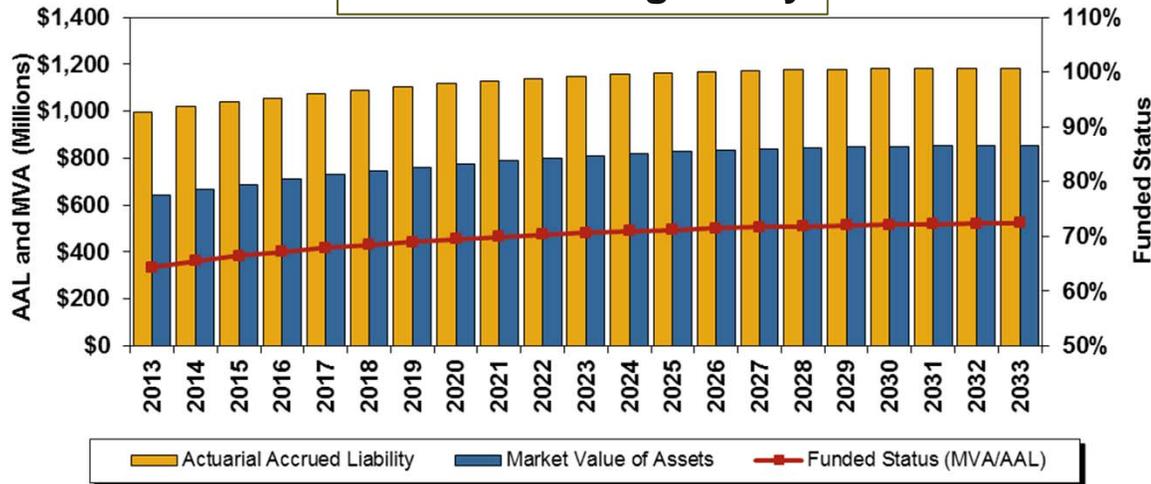
Plan Liquidity Needs – Alternative Funding Policy



- Based on 7.25% return/3.0% inflation and the current funding policy.
- Negative cash flows are significant and rising. Liquidity needs don't preclude increasing illiquid investments, but exposure to illiquid asset classes will need to be continually evaluated.
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Negative cash flows rise more slowly through 2022, then reverse and decline toward 3% of assets by year 20, the consequence of greater contributions after year 5 and particularly year 10.

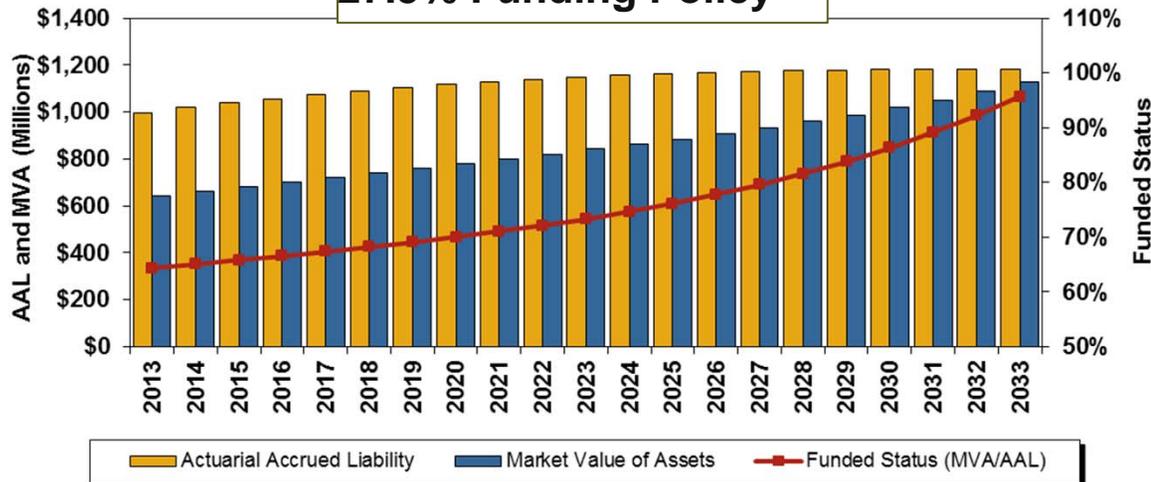
Plan Funded Status – Alternative Funding Policy

Current Funding Policy



- Based on 7.25% return/3.0% inflation and the current funding policy.
- Current funding policy will result in modest improvement in funded status over next 20 years, from 64.3 to 72.4%.

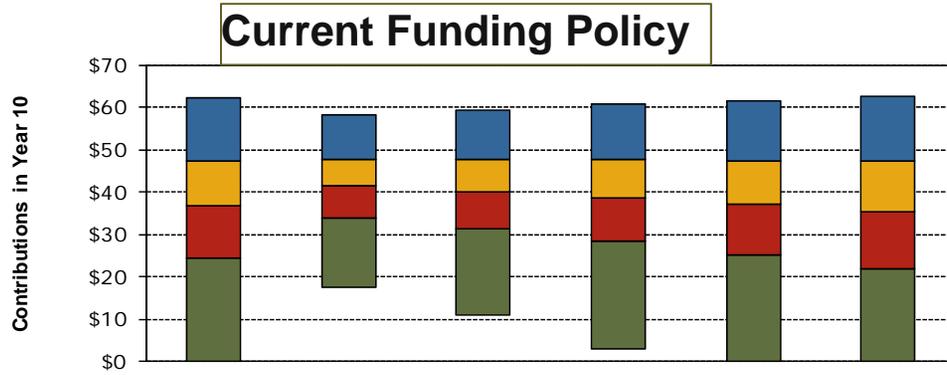
27.5% Funding Policy



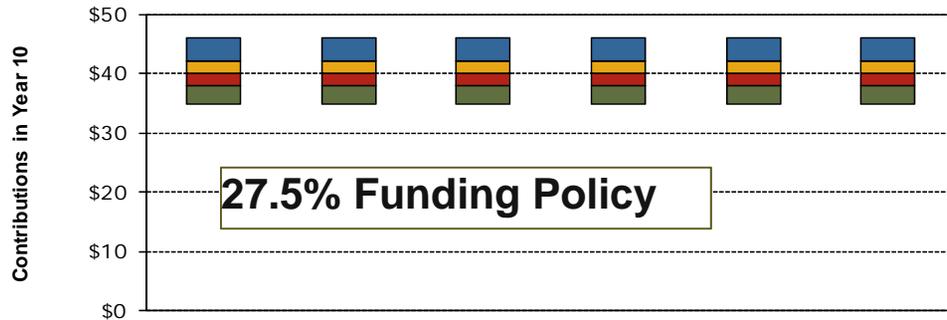
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Alternative funding policy will result in asset growth and funded status that approaches 100% by year 20, with most of the improvement coming after year 10.

Simulate Financial Condition

- Contributions in Year 10



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$62	\$58	\$59	\$61	\$62	\$63
75th	47	48	48	48	47	47
50th	37	41	40	39	37	35
25th	25	34	31	29	25	22
2.5th	0	18	11	3	0	0
Downside	25	17	19	22	24	27



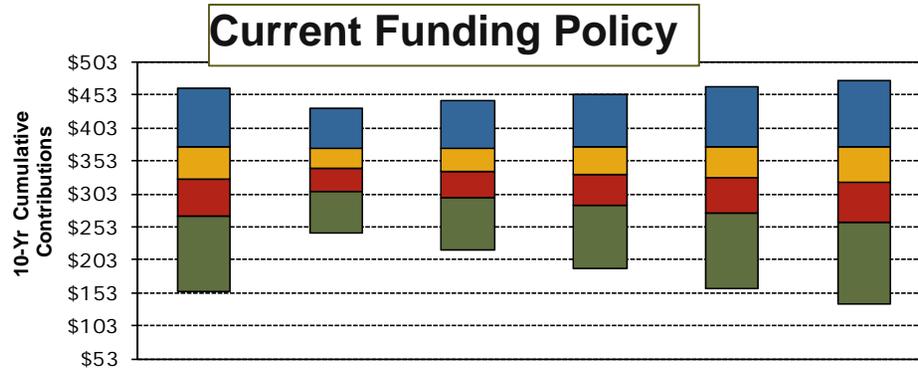
Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$46	\$46	\$46	\$46	\$46	\$46
75th	42	42	42	42	42	42
50th	40	40	40	40	40	40
25th	38	38	38	38	38	38
2.5th	35	35	35	35	35	35
Downside	6	6	6	6	6	6

- Based on the current funding policy.
- Contribution volatility stems from market impact on unfunded liability, plus modest volatility stemming from inflation impact on payroll.

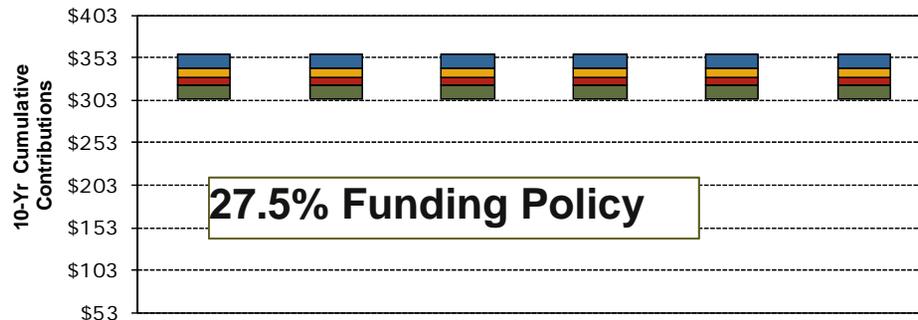
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Contribution volatility solely from inflation impact on payroll. No impact from market volatility.

Simulate Financial Condition

- Cumulative Contributions Over 10 Years



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$464	\$432	\$443	\$454	\$464	\$474
75th	375	372	373	374	375	375
50th	325	342	338	332	327	321
25th	269	308	297	285	274	260
2.5th	156	243	218	189	160	137
Downside	139	91	106	122	138	153



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$358	\$357	\$358	\$358	\$358	\$358
75th	341	341	341	341	341	341
50th	331	331	331	331	331	331
25th	322	322	322	322	322	322
2.5th	305	305	305	305	305	305
Downside	27	26	27	27	27	27

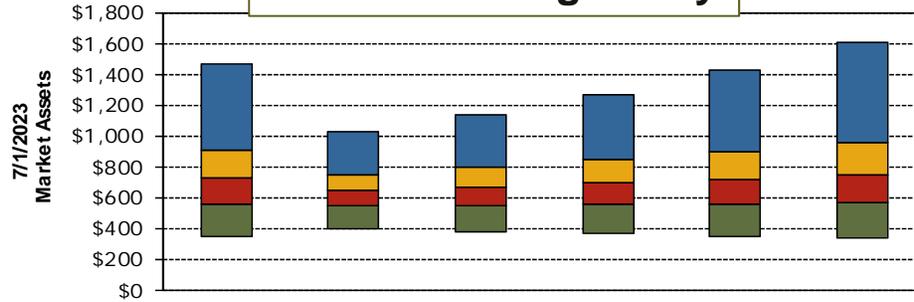
- Based on the current funding policy.
- Contribution volatility stems from market impact on unfunded liability, plus modest volatility stemming from inflation impact on payroll.

- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Contribution volatility solely from inflation impact on payroll. No impact from market volatility.

Simulate Financial Condition

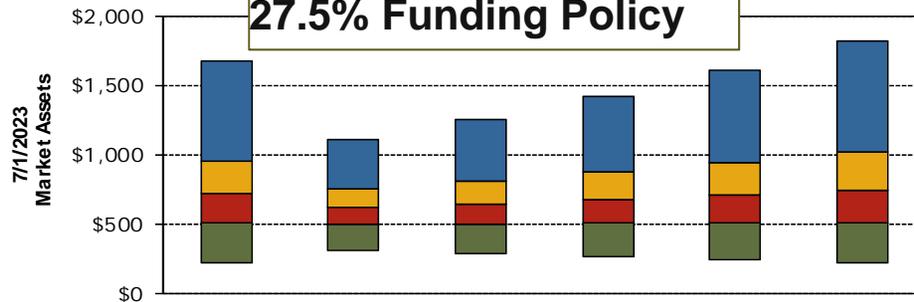
- Market Value of Assets in Year 10

Current Funding Policy



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	\$1,470	\$1,024	\$1,137	\$1,266	\$1,425	\$1,612
25th	910	751	796	849	901	957
50th	723	645	671	695	721	746
75th	561	548	552	557	561	565
97.5th	344	396	380	363	348	333
Expected Return	1,126	629	758	902	1,078	1,278
Downside	380	250	292	332	373	413

27.5% Funding Policy



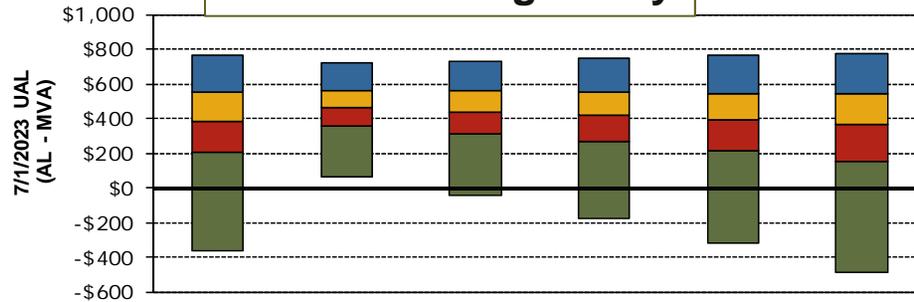
Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	\$1,671	\$1,105	\$1,258	\$1,422	\$1,604	\$1,814
25th	951	757	814	875	943	1,016
50th	716	622	647	678	710	742
75th	507	498	501	505	508	510
97.5th	222	307	286	263	240	217
Expected Return	1,449	799	972	1,159	1,364	1,596
Downside	494	315	361	415	469	524

- Based on the current funding policy.
- Asset volatility stems from market volatility, dampened by contributions that respond to market movements. Contributions are also greater for asset mixes with lower returns.
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Asset volatility stems from market volatility, with no dampening effect from contributions, which do not respond to markets. Range of assets is wider than under current funding policy.

Simulate Financial Condition

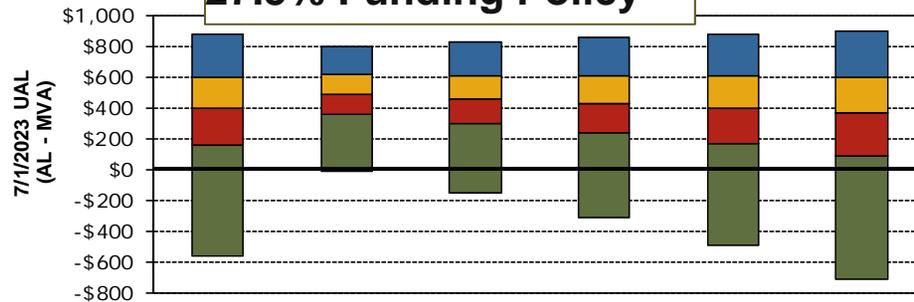
- Unfunded Liability in Year 10

Current Funding Policy



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$765	\$720	\$732	\$747	\$765	\$779
75th	550	564	558	553	548	544
50th	385	466	441	416	391	364
25th	203	359	316	266	212	153
2.5th	-363	69	-42	-173	-315	-481
Range (97.5-2.5)	1,129	651	774	920	1,079	1,260
Downside	380	254	291	331	374	415

27.5% Funding Policy

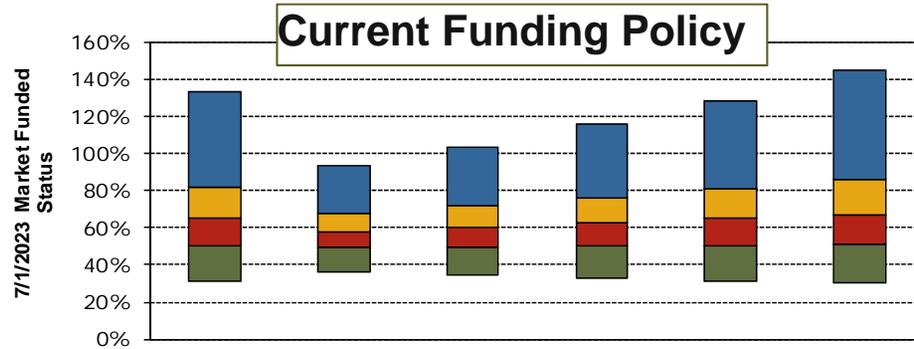


Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$877	\$800	\$824	\$852	\$876	\$897
75th	601	612	609	605	604	599
50th	395	487	459	428	398	367
25th	153	353	296	236	165	91
2.5th	-560	-4	-149	-310	-494	-710
Range (97.5-2.5)	1,437	805	973	1,162	1,369	1,607
Downside	483	314	365	424	477	530

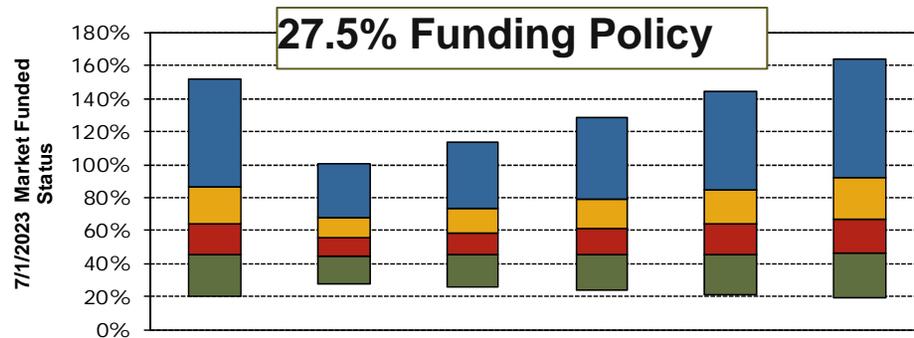
- Based on the current funding policy.
- Unfunded liability volatility stems from market volatility, dampened by contributions that respond to market movements. Contributions are also provide a cushion for asset mixes with lower returns.
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Unfunded liability volatility stems from market volatility, with no dampening effect from contributions. Expected case in 10 years is comparable, but range of unfunded liability is wider than under current funding policy.

Simulate Financial Condition

- Market Value Funded Status in Year 10



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	133%	94%	104%	116%	128%	145%
25th	82%	68%	72%	76%	81%	86%
50th	65%	58%	60%	63%	65%	67%
75th	51%	49%	50%	50%	50%	51%
97.5th	31%	36%	34%	33%	31%	30%
Expected Return	6.6%	6.0%	6.6%	7.0%	7.5%	8.0%



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	152%	100%	114%	128%	145%	164%
25th	86%	68%	73%	79%	85%	92%
50th	65%	56%	59%	61%	64%	67%
75th	46%	45%	45%	45%	46%	46%
97.5th	20%	28%	26%	24%	21%	19%
Expected Return	6.6%	6.0%	6.6%	7.0%	7.5%	8.0%

- Based on the current funding policy.
- Funded status volatility stems from market volatility, dampened by contributions that respond to market movements. Contributions are also provide a cushion for asset mixes with lower returns.
- Alternative funding policy – flat 27.5% of payroll employer contribution rate.
- Funded status volatility stems from market volatility, with no dampening effect from contributions. Expected case funded status in 10 years is comparable, but range of funded status is wider than under current funding policy.



Making A Decision

Risk Metrics for TSRS

- Simulation generates a range of potential outcomes for the financial condition of the Plan:
 - Plan assets
 - Liabilities
 - Benefit payments
 - Annual and cumulative dollar contributions
 - Employer contribution rates
 - Funded status
- Key metric for TSRS:
 - Contribution rate for employers: seek strategies to stabilize rate
 - *Probability of maintaining current 28% rate; reduce volatility of the rate around the current level*

Summary Observations

- The liability and demographic profiles suggest the Plan has a sufficiently long time horizon in which to assume investment risk.
 - Average age of active employees is decreasing. Population is getting younger as older employees retire.
- Liquidity needs are significant and could become increasingly important to the Plan's asset allocation.
 - Net outflow grows to 7% over the next 20 years
 - Current allocation to illiquid investments is 13%
 - Potentially some room for additional illiquid investments, but caution is advised as the plan progresses
- Liability growth is moderate and slows over the next 10 years
 - Median liability growth (net of benefit payments) starts at 1.6% and falls to 0.5% over the ten year horizon
 - Normal Cost is expect to fall over the next 20 years as new hires are placed in Tier II, bringing the cost of the plan down
 - Active liability, as a percentage of total liability, falls from 34% to 28% over the next 10 years
 - Liability volatility stems from inflation uncertainty feeding through future salary growth
 - *TSRS has 13% in diversified real assets exposure – private real estate and infrastructure*
 - *TSRS could maintain up to 15% in real assets exposure to diversify the plan's stocks and bonds, and to provide inflation-sensitive investments*
- Capital market expectations represent passive exposure (beta only) to the capital markets with the exception of private markets where objective benchmarks don't exist.
 - Private real estate and infrastructure have some active management premium (alpha) embedded in the return expectation, which can help with the plan's reach for return.

Summary Observations, continued

- An alternative contribution policy that fixes contributions for employers at 27.5% for the next 20 years is projected to improve funded status, approaching 100%.
 - Funded status remains similar to that under the current Normal Cost + 20 year amortization of unfunded liability policy for next 10 years. The improvement in funded status is concentrated in years 11 through 20 of the forecast horizon, when the 27.5% contribution rate greatly exceeds the rate under the existing policy.
- Alternative policy fixed at 27.5% transfers all market risk to plan asset values, and therefore funded status volatility.
 - Current policy allows contributions to adjust to market volatility through the amortization of the unfunded liability.
- Plan's liquidity needs are reduced in the expected case under the alternative contribution policy, particularly in years 11 through 20.
 - Liquidity needs over the next ten years are reduced modestly under the alternative policy; under both contribution policies, liquidity needs are manageable over the next ten years, but regular monitoring is recommended, particularly in the event of extreme market volatility.
 - Countering the result under the expected case, funded status volatility rises under the alternative contribution policy, raising the probability of liquidity concerns in the worse case outcomes.
- Plan needs to pursue return in order to close funding gap. Current target contains an appropriate tilt toward growth assets. Private equity is one of the few assets that is expected to generate higher return than public equity, and could be added to pursue greater return. The added illiquidity and long time horizon require clarity around the future political status of the Plan and substantial education for the Board to understand the investment and to ensure ownership of the allocation.
- Other strategies to enhance return include shifts in the implementation of existing asset classes:
 - More active risk, tilts toward higher returning segments of asset classes such as small cap, emerging markets

Take More Risk?

Factor	Description	Supports risk taking?
Return Objective	<ul style="list-style-type: none"> Achieve the Investment Return Rate of 7.25% over the long-term 	Yes
Time Horizon	<ul style="list-style-type: none"> Ongoing Plan – indefinite time horizon 	Yes
Liability Growth	<ul style="list-style-type: none"> Liabilities grow with normal cost and interest (7.25%) Interest cost is high but normal cost is declining Traditional final salary benefits with 2.25% accrual 	Some
Funded Status	<ul style="list-style-type: none"> Funding gap is wide and 10-year funded status is not expected to improve under current funding policy and current target mix 7/1/2013 Market Funded status = 64% 	Some*
Contribution Risk	<ul style="list-style-type: none"> Funding policy does reflect impact of poor investment performance % of pay would most likely need to rise if investment returns are well below 7.25% for a prolonged period of time 	Some

** Some Plan Sponsors lean on a more aggressive asset allocation to assist with closing a Plan deficit over the long run. Of course, a more aggressive asset allocation can make the financial situation worse, if investment performance is worse than expected.*

Disclaimers

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Appendix

Current Environment – January 2014

U.S. Economic Growth Continues

- Economic growth in the U.S. surprised on the upside in 2013, the overall economy is in much better shape than expected just a year ago, and we believe growth will continue.
- Federal policies present risks.
 - Fiscal
 - Monetary - the end of the age of Quantitative Easing?
 - European debt crisis lurches forward; is there a strategy?
- Consumers will cautiously increase spending in response to gains in employment, income and asset values.
- Homebuilding will surge through 2015, but could then stall from lack of consistent demand.
- Interest rates will rise significantly over the next four years as monetary accommodation is withdrawn.
- The energy boom is creating jobs, investment and a competitive advantage.
- Net exports will support growth, but not yet.
- Inflation has subsided and is not a current threat to economic growth. The risk of future inflation remains.

The Capital Markets at the Start of 2014

U.S. Equity Markets Rally, Emerging Markets Suffer, Fixed Income Responds to the Fed

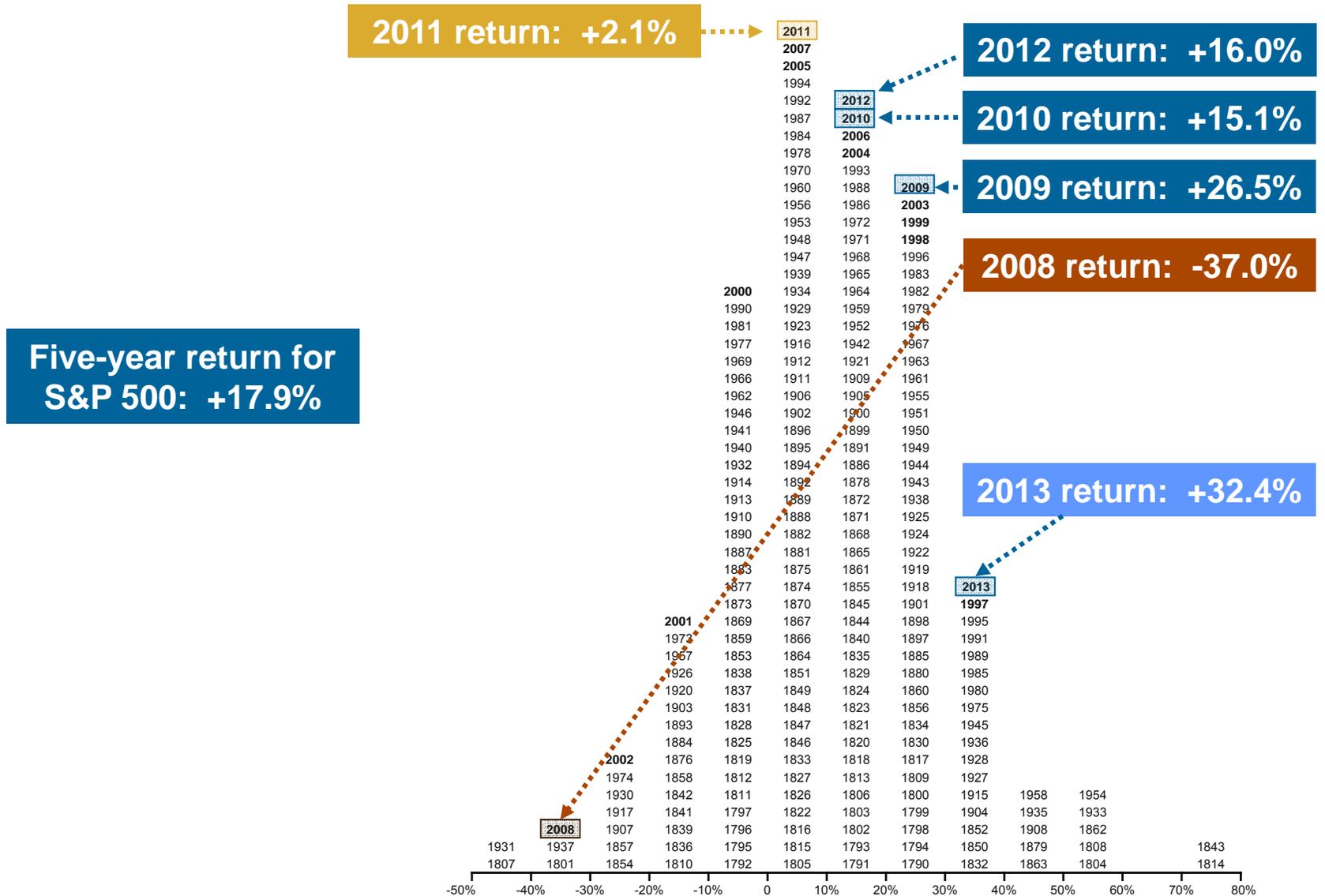
- Results for 2013 showed a sharp jump in all U.S. equity segments, on top of a strong 2012. Developed international markets lagged the U.S. despite a 23% return, while emerging markets suffered a sharp setback, especially compared to the U.S.
- Five-year equity returns through 2013 are now free of the 2008 crisis and are very strong. Ten-year returns no longer include the 2000 – 2002 downturn, but are now losing 2003. Fifteen-year equity returns are still below long-run averages, and are equal to those of fixed income.

	2008	2009	2010	2011	2012	2013	Average Annual Returns		
							5 Years 2009–13	10 Years 2004–13	15 Years 1999–13
Broad U.S. Stock Market									
Russell 3000	-37.31	28.34	16.93	1.03	16.42	33.55	18.71	7.88	5.32
S&P Super Composite 1500	-36.72	27.25	16.38	1.75	16.17	32.59	18.34	7.75	5.24
Large Cap U.S. Stocks									
Russell 1000	-37.60	28.43	16.10	1.50	16.42	33.11	18.59	7.78	5.08
S&P 500	-37.00	26.47	15.06	2.11	16.00	32.39	17.94	7.41	4.68
Small Cap U.S. Stocks									
Russell 2000	-33.79	27.17	26.85	-4.18	16.35	38.82	20.08	9.07	8.42
S&P 600 Small Cap	-31.07	25.57	26.31	1.02	16.33	41.31	21.37	10.65	10.32
Non-U.S. Stock Markets									
MSCI EAFE US\$	-43.38	31.78	7.75	-12.14	17.32	22.78	12.44	6.91	4.54
MSCI Emerging Markets	-53.18	79.02	19.20	-18.17	18.63	-2.27	15.15	11.52	11.22
Fixed Income									
Barclays Aggregate	5.24	5.93	6.54	7.84	4.21	-2.02	4.44	4.55	5.23
Citi Non-US	10.11	4.38	5.22	5.17	1.51	-4.56	2.27	4.10	4.47
Hedge Funds									
DJCS Hedge Fund Index	-19.07	18.57	10.95	-2.52	7.67	9.73	8.67	6.37	7.55
Cash Market									
90-Day T-Bill	2.06	0.21	0.13	0.10	0.11	0.07	0.12	1.68	2.33
Inflation									
CPI-U*	0.09	2.72	1.50	2.96	1.74	1.50	2.08	2.37	2.37

*CPI-U data are measured as year-over-year change through 12/31/2013.

Stock Market Returns by Calendar Year

2013 Performance in Perspective: History of the U.S. Stock Market (225 Years of Returns)



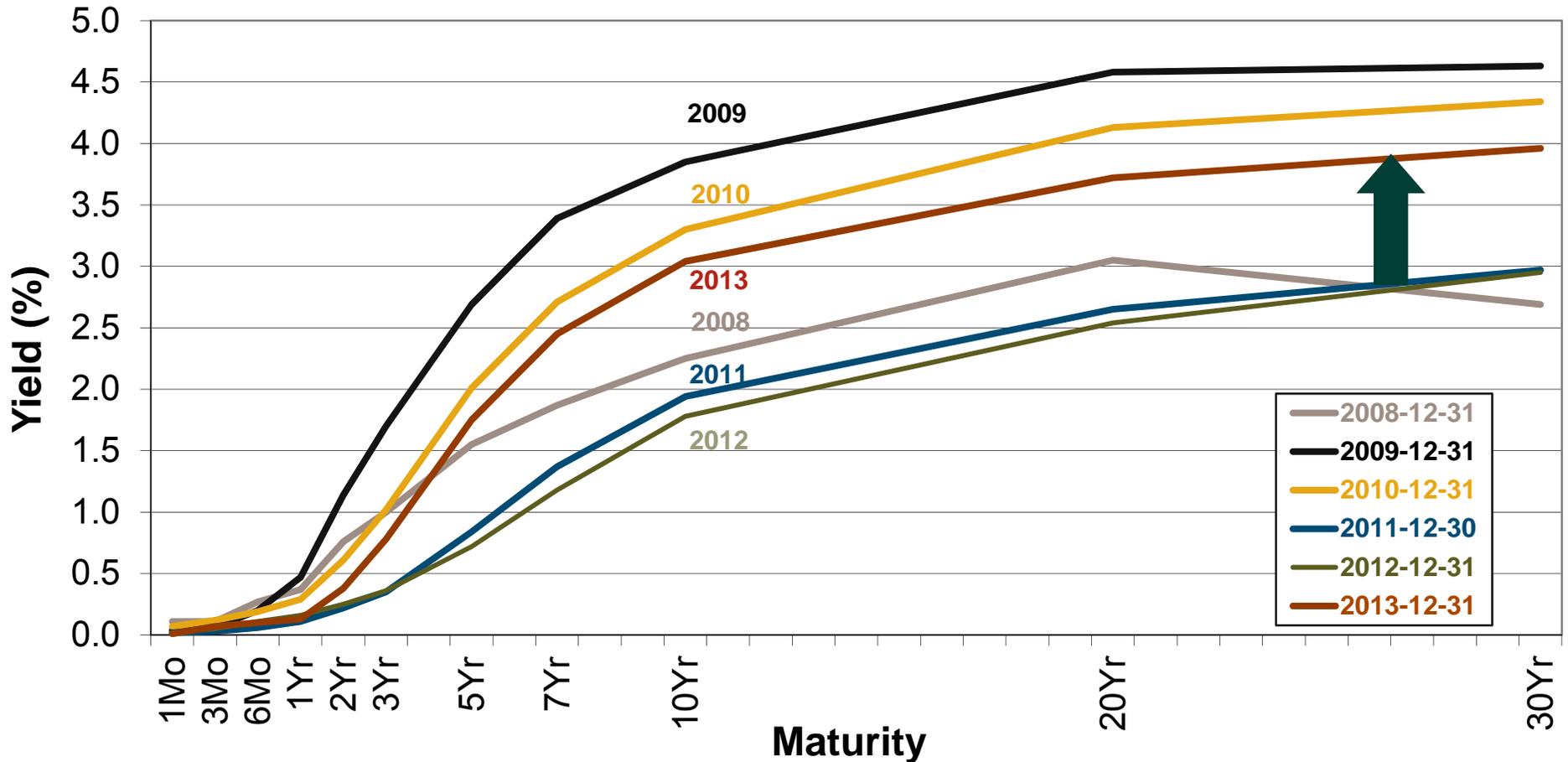
Treasury Rates Rose with Taper Talk

U.S. Treasury Yield Curves

U.S. Treasury Yield Curves

Constant Maturities: 1Mo/3Mo/6Mo/1Yr/2Yr/3Yr/5Yr/7Yr/10Yr/20Yr/30Yr

Source: Federal Reserve

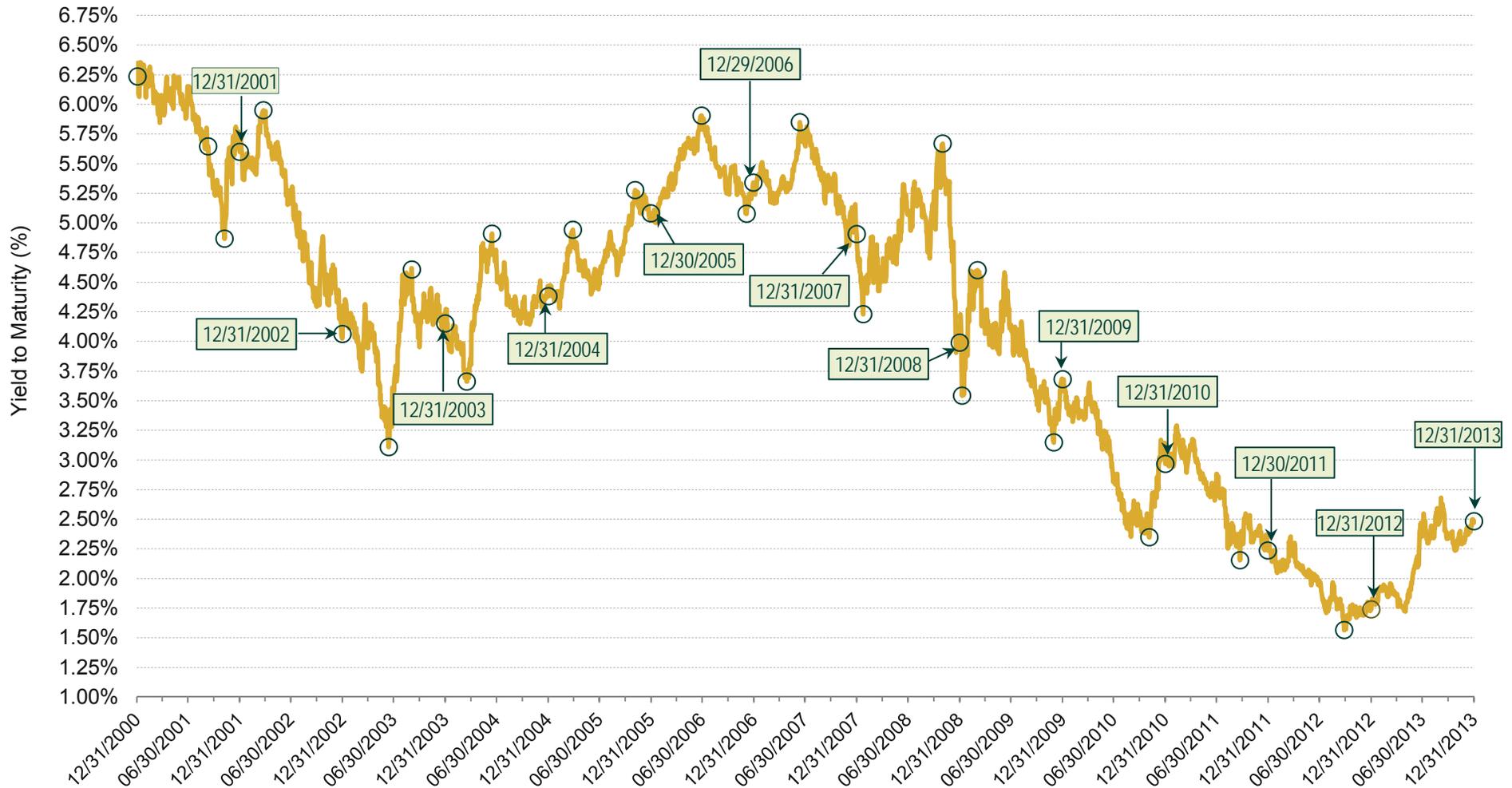


Source: Federal Reserve and Callan

Current Yield is Exceptionally Low, Expected to Rise

Uncharted Waters Going Forward; We Can Go Lower

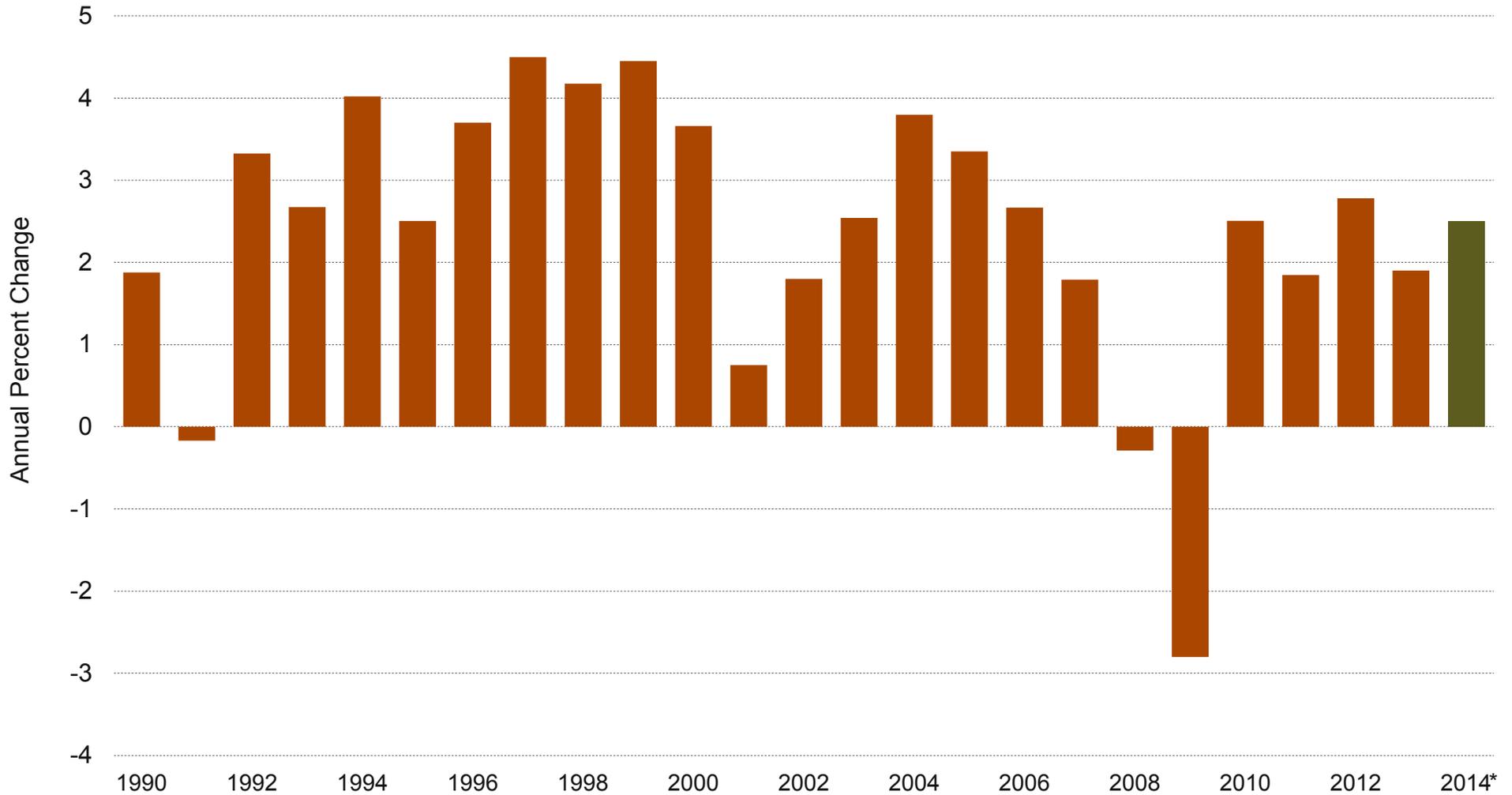
Barclays Aggregate Index – Daily Yield to Worst from 01/02/2001 to 12/31/2013



Source: Barclays and Callan

Below-Par Recovery for the U.S. Economy

Real GDP

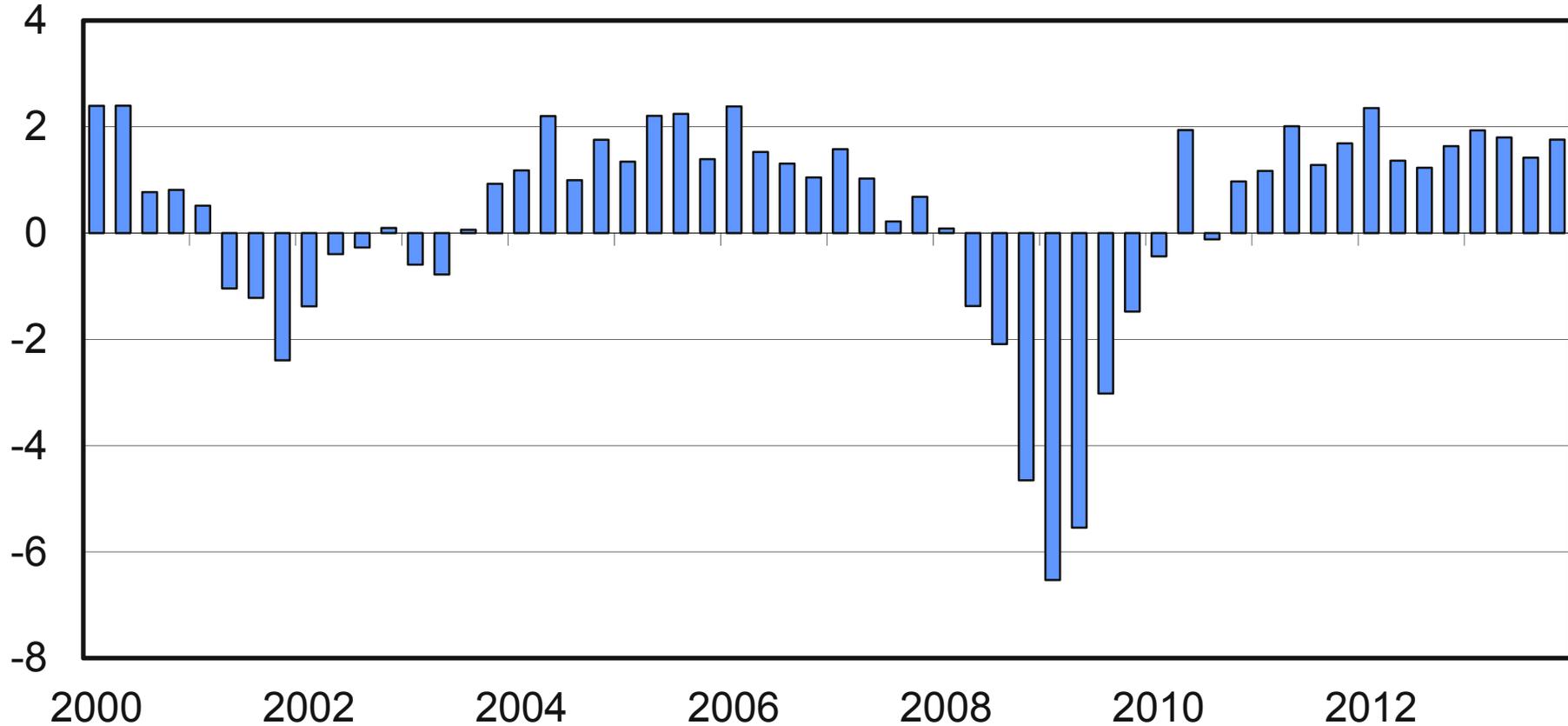


* 2014 estimate – Global Insight

Source: Global Insight

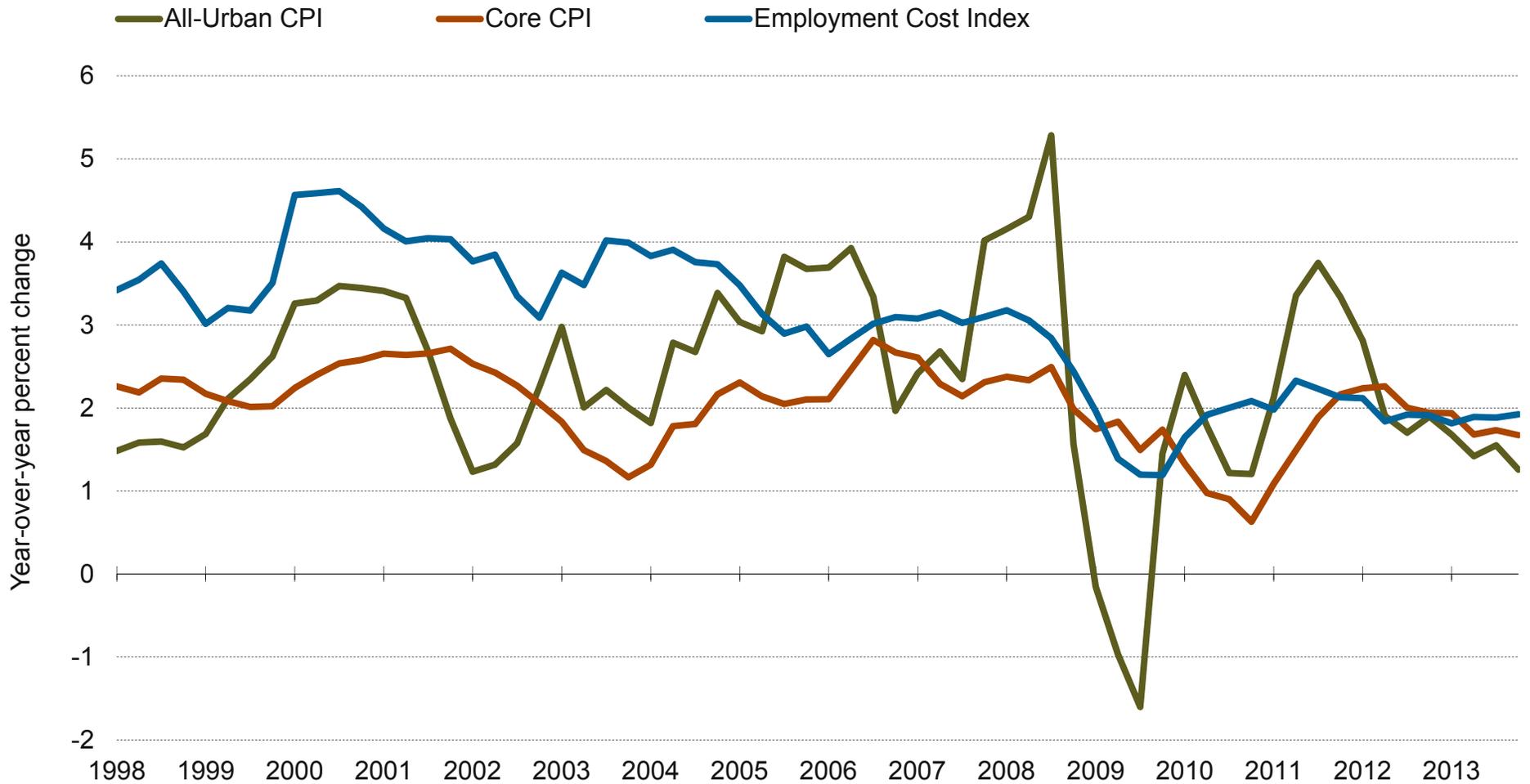
US Employment is Steadily Increasing and Will Regain Its January 2008 Peak in Mid-2014

(Payroll employment, percent change, annual rate)



Source: Global Insight

Consumer Price Inflation Eased Again in 2013



Source: Global Insight

What Will The Fed Do?

- The Fed remains concerned about growth, was surprised by the market moves in response to taper talk.
- Fed floated the idea of tapering asset purchases in May. The bond market responded immediately:
 - 10-year Treasury yields surged 120 bps by mid September
 - Real 10-year yields (from TIPS) swung from -64 bps to +64 bps
 - 30-year fixed mortgage rates rose from 3.35% to 4.5%
- Higher long-term interest rates are likely here to stay:
 - Expectations for short-term rates have been pushed higher. Long-term rates are a function of future short-term rates. Rate hike is tied to economic progress, and that progress is being made.
 - Tapering will reduce Fed-provided liquidity in the Treasury market, driving asset prices down and yields up.
 - Expectations for economic activity have improved.
 - Fed created scarcity in the TBA MBS market, driving down mortgage rates. Withdrawal from purchases will drive up mortgage rates.
- Fallout from the anticipation of a winding down of QE3 has already occurred. Once tapering actually begins, the impact should be minor on asset prices.
- Next move will be to address short term rates – 6.5% unemployment, 2015?
- The same economic growth that drives unemployment to 6.5% should push long-term rates up by 100-125 bps.

The Global Economy

- The U.S. economy and particularly its capital markets shone relative to the rest of the world in 2012 and 2013.
- Global (non-US) economic growth will gradually pick up in the year ahead, with developed countries leading the acceleration.
- The Eurozone's long recession has ended, but recovery will be slow.
- China's growth has stabilized, but their real estate markets pose substantial downside risks.
- Asia will lead global growth, while Latin America and Africa will do relatively well by historical standards.
- The emerging markets "story" is now under reassessment; does rapid economic growth necessarily translate into capital market outperformance?
- Emerging markets that depend on external finance are vulnerable to the withdrawal of extreme monetary accommodation by central banks.
- Geopolitics and policy mistakes are the main sources of risk.