

## Proposal at a Glance

Like SH and Theta, Team Star understands that VanPERS’ funding issue will not be solved through an optimized asset allocation alone. Star’s solution is unique, however, in how it employs aggressive leverage while sharing funding pressures between the governmental sponsor and the pension fund’s investment returns. In doing so, Star’s solution is liquidity-aware: the fund loads on greater risk while liquidity needs are low, safeguarding pension benefits.

Star’s strategy is explored below in three parts: (A) Liabilities and Risk Sharing, (B) Required return and multi-stage optimization (C) Risk Management and derivatives overlay.

### Liabilities and Risk Sharing

The current contribution model requires governments to fund only 60% of pensions accrued by active members in any given year, allowing funding gaps to be amortized over 20 years and funded by means of special contributions when the funding ratio becomes too low.

In contrast, Star’s proposal would require governments to fund the full amount of benefits earned yearly by active members. Under the new design, governments would be required to set aside 10% to 12% of their annual budget to fund the plan, for the next 10 years.

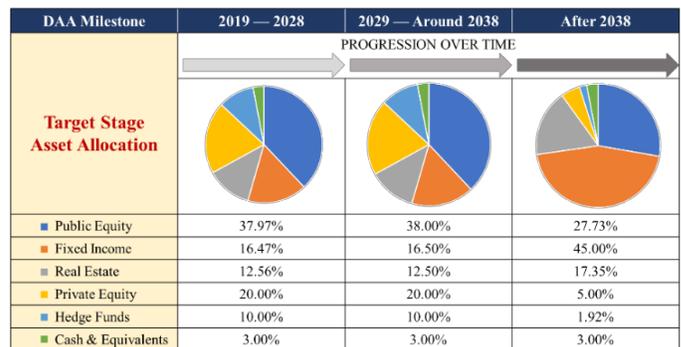
This risk- and funding-sharing design has two significant advantages: it disincentivizes the fund manager from pursuing greater risk to close the funding gap and makes bankruptcy-inducing special contributions from cities much less likely to occur.

### Required return and optimization

To withstand some degree of market fluctuations, STAR aims to fund the pension at a 105% assets-to-liability ratio by 2038. To meet this objective, the minimal required CAGR on assets is 8.13% until that year.

To attain these aggressive returns, the asset allocation is first optimized using the Black-Litterman model to

find the efficient frontier of the asset classes within VanPERS’s portfolio.



To improve the quality of their model, Star complements this quantitative prediction with information from *BlackRock’s Capital Market Assumptions 2018*. These considerations produce the target asset allocation in the chart below.

### Multi-stage asset allocation

Much like a life-cycle investment strategy, the chart shows how the portfolio reduces in volatility over time. Matching risk and liquidity requirements in this way allow the fund to expose itself to market risk while its liquidity needs are lowest, i.e. 2019-2028. The fund can therefore benefit from a rally without exposing pensioners to a shortfall in pay-outs if the market turns bearish.

**Solvency Recovery: 2019-2028.** Even with the asset classes optimized for return, achieving an 8.13% CAGR while avoiding special contributions requires a degree of leverage.

Because the return on investment will always outweigh the cost of debt, itself kept low by an implicit guarantee from the State of Vandalia, STAR maximizes leverage to the amount permitted by the fund regulation – 50%. Star therefore finances the portfolio with USD 14.5B worth of 10-year bonds at a 2.84% return. Existing assets and the proceeds of this financing are invested in risk-bearing asset classes such as public equities, private equity, hedge funds and real estate, together accounting for roughly 80% of all allocation.

Due to aggressive leverage and a risky allocation, the Expected Shortfall (90%) of this portfolio is a significant 10.84%. Therefore, to minimize potential losses associated with such a risk-heavy portfolio,

Star integrates several hedging strategies, discussed below.

**Full funding maintenance: 2029-2038.** The maintenance phase acts as a bridge between the risky allocation of 2019-2028 and the lower-risk perpetuity strategy post-2038. Cash is rolled over year-to-year to reduce the need to emit new bonds. However, if the market is favorable, VanPERS will consider emitting bonds during this period. Star has no explicit strategy to draw down their bond liabilities: it is safe to assume their bonds will be perpetually renewed.

**De-Risking Portfolio: 2038 onwards.** By 2038, the portfolio is expected to reach a 105% funding ratio and can sustain itself indefinitely by generating a reduced CAGR of 6.1%. The portfolio is therefore readjusted to respect bound ranges set by VanPERS while increasing allocation to low-risk asset classes (fixed income and cash), now representing 48% of the portfolio.

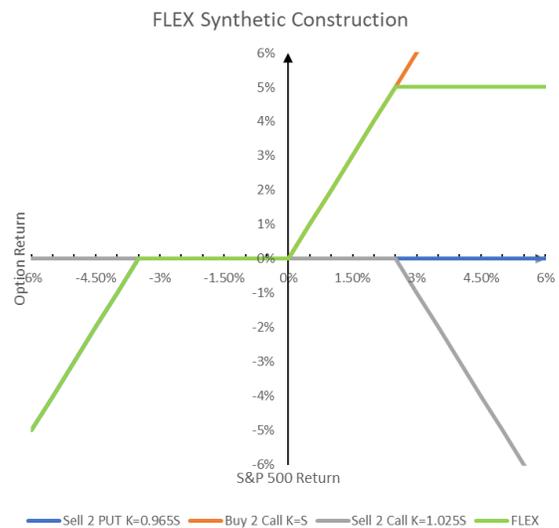
### Hedging Strategy

By design, the portfolio is hedged against interest risk: changes of up to 25% in long-term interest rates only require a reallocation of 5% of assets to meet the required CAGR again, according to Star's calculations.

The bulk of the downside risk, however, is mitigated by financial instruments. Star has designed two distinct hedging strategies (with a binary trigger between them based on recent market performance, explained shortly).

The first and main strategy is to purchase Enhance and Buffer Flexible Exchange options that charge 0.65% net premia while on average outperforming the S&P 500 by a factor of two. These combined options follow the "FLEX" payout schedule on the graph to the right, in green. The second hedging strategy is to clear the FLEX option and instead purchase put options. In both instances, 25% of the portfolio is used as the notional amount of the total assets.

To assess which option is most appropriate, VanPERS selects a market-timing strategy based on recent market volatility.



A very volatile market triggers the purchasing of put options, while a stable market results in opting for the cheaper FLEX option instead. This is useful in that recent volatility triggers a put that removes exposure to market downsides. This tends to be expensive, so Star suggests clearing that option when the volatility is low and downside is unlikely. As such, the price of the option and its usefulness are grounded in historical and expected market behaviour, keeping costs low, operations relatively straightforward, and downsides hedged against when it most matters.

All told, when back-tested from 2006 onwards, this FLEX+Put combo regime has a return of 11.24% and a volatility of 12.43%, with a 90% VaR of roughly -6% and an Expected Shortfall (90%) of -12.32%, a near-perfect symmetry of the VaR and Expected Shortfall of the portfolio itself – in essence a near-perfect hedge. The strategy is therefore expected to create significant value and hedging power for the fund going forward.

### Final Considerations

Star's portfolio is exposed to risk in ways that offset liquidity needs, while covering downsides through careful option planning. As such, the fund can gather strength during rallies while exposing pensioners to mild payout risks. In addition, Star will finance its liabilities without requiring additional contributions from cities or relying on any other politically-loaded levers.